Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 1

Exercise 1

We have one bank account that offers a continuous compound rate of 3% where we initially deposit 10 000 euros. How long time is it necessary until the amount of money in the account reaches 19 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **8.***** years.

2) In **0.***** years.

3) In **5.***** years.

4) In **9.***** years.

5) In **1.***** years.

Exercise 2

The population of a city is studied between years $t=1$ and $t=8$. In that period the population is given by the function $P(t) = 5 + 120\,t - 42\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between 69 and 95.

1) Along the intervals of years: $[2.58517, 3.]$ and $[4.70421, 6.1644]$.

2) Along the interval of years: $[5., 8.0469]$.

3) Along the intervals of years: $[1, 1.18826]$, $[3, 4]$ and $[5.81174, 6.31174]$.

4) Along the intervals of years: $[1., 2.50384]$ and $[6., 7.]$.

5) Along the interval of years: $[4.64429, 6.58944]$.

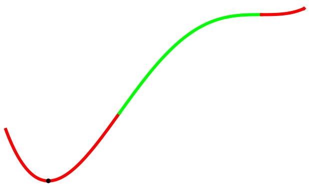
6) Along the intervals of years: $[1, 1]$, $[1.18826, 3]$, $[4, 5.81174]$ and $[6.31174, 8]$.

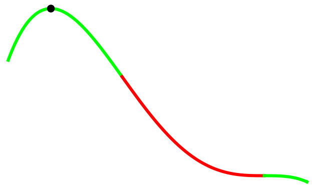
7) Along the interval of years: $[2., 4.20101]$.

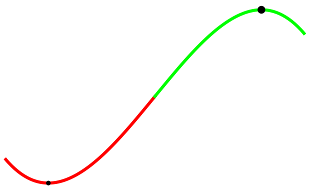
8) Along the intervals of years: $[1.39873, 2.6175]$ and $[4.62359, 7.75858]$.

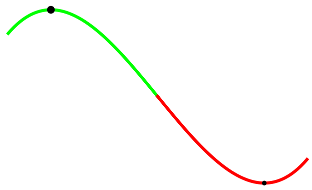
Exercise 3

Study the shape properties of the $f(x) = 1 - 48x + 48x^2 - 20x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1)


2)


3)


4)


Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 20\,e^{1+3t}$ millions of euros/year .

If the initial deposit in the investment fund was 20
millions of euros, compute the depositis available after 2 years.

1) $20 + \frac{20}{3e^2} - \frac{20e}{3}$ millions of euros = 2.7804 millions of euros

2) $20 - \frac{20e}{3} + \frac{20e^7}{3}$ millions of euros = 7312.7658 millions of euros

3) $20 - \frac{20e}{3} + \frac{20e^{10}}{3}$ millions of euros = 146844.9834 millions of euros

4) $20 - \frac{20e}{3} + \frac{20e^4}{3}$ millions of euros = 365.8658 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 2 \\ 1 & 3 \end{pmatrix} . X + \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} -1 & 3 \\ -3 & 3 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$5x_1 + x_2 + 5x_3 - 3x_4 == -1$$
$$-5x_1 + x_2 + 2x_3 - x_4 == -4$$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ -2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 33 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} 6 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 8 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 20 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -2 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix}$

5) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 32 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (-1 \;\; 2) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (-2 \;\; 3) \rangle$

1) $\begin{pmatrix} 7 & -12 \\ 4 & -7 \end{pmatrix}$ 2) $\begin{pmatrix} 7 & 4 \\ -12 & -7 \end{pmatrix}$ 3) $\begin{pmatrix} 7 & 12 \\ -4 & -7 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & -1 \\ 1 & -2 \end{pmatrix}$ 5) $\begin{pmatrix} 7 & -4 \\ 12 & -7 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 2

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=700-9Q. On the other hand, the production cost per ton is C=600-6Q. In addition, the transportation cost is 16 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 581 .

2) Profit = 588 .

3) Profit = 378 .

4) Profit = 338 .

5) Profit = 562 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -e^{x+1} & x \le -1 \\ e^{x+1} + 2\sin(x+1) - e^3 + 1 - 2\sin(3) & -1 < x < 2 \\ \sin(2-x) + \cos(2-x) & 2 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 2$.

5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

Exercise 3

Between the months $t = 3$ and $t = 9$, the true value of the shares of a company (in euros) are given by the function $C(t) = 613 + 324t - 45t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 6$ and $t = 8$.

1) It oscillates between 1234 and 1369.

2) It oscillates between 1349 and 1369.

3) It oscillates between 1349 and 1371.

4) It oscillates between 1342 and 1369.

5) It oscillates between 1343 and 1359.

Exercise 4

Compute the area enclosed by the function $f(x) = -12 + 10x + 4x^2 - 2x^3$ and the horizontal axis between the points $x = 1$ and $x = 4$.

1) $\frac{173}{6} = 28.8333$

2) $\frac{9}{2} = 4.5$

3) $\frac{179}{6} = 29.8333$

4) $\frac{85}{3} = 28.3333$

5) $\frac{155}{6} = 25.8333$

6) $\frac{82}{3} = 27.3333$

7) $\frac{91}{3} = 30.3333$

8) $\frac{167}{6} = 27.8333$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & 0 & -1 & 0 \\ -1 & 0 & -2 & 1 \\ 1 & 1 & a & 2 \\ 1 & 1 & 0 & -1 \end{pmatrix}$$ has determinant -4 ?

1) -2 2) 5 3) 1 4) -5 5) 4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$-x + m y - z == 1 + 2m$
$-x + m y == 1 + 2m$
$x - y + z == -3$

has only a solution. For that solution compute the value of variable y

1) $y = 2$.

2) $y = 0$.

3) $y = -8$.

4) $y = -4$.

5) $y = 1$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 20% repeat the course and 20% give
The students of course 2: 80% finish the degree and 20% repeat the course.

On the other hand, every year, the students, in a way or another,
promote their degree in such a way that for every 4 student in the degree
(for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 19.195 % in the first course and 80.805 % in the second course.

2) 24.075 % in the first course and 75.925 % in the second course.

3) 9.17 % in the first course and 90.83 % in the second course.

4) 4.879 % in the first course and 95.121 % in the second course.

5) 29.165 % in the first course and 70.835 % in the second course.

6) 46.9951 % in the first course and 53.0049 % in the second course.

7) 4.901 % in the first course and 95.099 % in the second course.

8) 29.4118 % in the first course and 70.5882 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 3

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 3% and in the bank B we are paid a continuous compound rate of 8% . We initially deposit 7000 euros in the bank A and 2000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **0.***** years.

2) In **9.***** years.

3) In **5.***** years.

4) In **7.***** years.

5) In **4.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	19
2	35
6	19

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 29 and 35 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

1) The funds are inside the limits for the inverval: $[0,5]$.

2) The funds are inside the limits for the inverval: $[2,5]$.

3) The funds are inside the limits for the intervals: $[0,1]$ y $[4,5]$.

4) The funds are inside the limits for the inverval: $[5,6]$.

5) The funds are inside the limits for the inverval: $[1,2]$.

6) The funds are inside the limits for the inverval: $[2,6]$.

7) The funds are inside the limits for the inverval: $[0,2]$.

8) The funds are inside the limits for the intervals: $[1,2]$ y $[4,5]$.

Exercise 3

Study the differentiability of the function f(x) =

$$\begin{cases} 2\sin(x+3) - \cos(x+3) - 4 & x \le -3 \\ 2\,e^{x+3} + \cos(x+3) - 8 & -3 < x < 0 \\ -3x + 2(x+1)\log(x+1) + 2\,e^{3} - 8 + \cos(3) & 0 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x= −3 .

4) The function is differentiable for all points except for x= 0 .

5) The function is differentiable for all points except for x= −3 and x= 0 .

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(4 - 6t)\right)\cos(5t)$ per-unit.

The initial deposit in the account is 2000 euros. Compute the deposit after 3π years.

1) 1959.6231 euros

2) 2029.6231 euros

3) 2059.6231 euros

4) 2009.6231 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -1 & -3 & 2 & 2 \\ -1 & -1 & 2 & 1 \\ a & 2 & 1 & -2 \\ 2 & 2 & -1 & -1 \end{pmatrix}$$ has determinant −6 ?

1) −4 2) −3 3) 5 4) −2 5) −1

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(4+m)x - 4y + 3z == 18 + m$
$-3x + 7y - 5z == -27$
$2x - 4y + 3z == 16$

has only a solution.

1) We have unique solution for m≠−4.

2) We have unique solution for m≠−1.

3) We have unique solution for m≥−6.

4) We have unique solution for m≥1.

5) We have unique solution for m≥−5.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3\ \ -8),\ (-1\ \ 3) \rangle$

1) $\begin{pmatrix} -3 & 1 \\ 3 & -2 \end{pmatrix}$ 2) $\begin{pmatrix} -3 & -2 \\ 0 & -2 \end{pmatrix}$ 3) $\begin{pmatrix} -2 & 3 \\ -2 & -1 \end{pmatrix}$ 4) $\begin{pmatrix} -2 & 0 \\ -1 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 4

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interes rate of 8% and in the bank B we are paid a continuous compound rate of 3%. We initially deposit 4000 euros in the bank A and 8000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **3.***** years.

2) In **9.***** years.

3) In **0.***** years.

4) In **4.***** years.

5) In **6.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
2	29
4	29
7	14

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 26 and 29. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=7$).

1) The funds are inside the limits for the inverval: $[0, 2]$.

2) The funds are inside the limits for the inverval: $[0, 5]$.

3) The funds are inside the limits for the inverval: $[1, 2]$.

4) The funds are inside the limits for the inverval: $[2, 5]$.

5) The funds are inside the limits for the inverval: $[5, 7]$.

6) The funds are inside the limits for the intervals: $[0, 1]$ y $[4, 5]$.

7) The funds are inside the limits for the inverval: $[2, 7]$.

8) The funds are inside the limits for the intervals: $[2, 2]$ y $[4, 5]$.

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} -3\cos(x+3) & x \leq -3 \\ -\frac{1}{3}(x+3)^2 & -3 < x < 0 \\ -2(\sin(x) + \cos(x)) & 0 \leq x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -3$.

4) The function is differentiable for all points except for $x = 0$.

5) The function is differentiable for all points except for $x = -3$ and $x = 0$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(-1+4t)\right)\cos(4t)$ per-unit.

The initial deposit in the account is 20 000 euros. Compute the deposit after 2π years.

1) 20 000 euros

2) 20 040 euros

3) 20 080 euros

4) 20041.2343 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} a & 1 & 0 & -2 \\ -2 & 1 & -1 & -4 \\ 0 & 1 & -1 & -3 \\ 1 & 0 & 1 & 1 \end{pmatrix}$ has determinant -2 ?

1) 3 2) 0 3) 1 4) 5 5) −4

Exercise 6

Determine the values of the parameter , m , for which the linear system

$-2x + y + (1+m)z == -8 - 2m$
$-2x + y - z == -4$
$-5x + 2y - 2z == -10$

has only a solution.

1) We have unique solution for $m \neq -5$.

2) We have unique solution for $m \geq -1$.

3) We have unique solution for $m \geq -3$.

4) We have unique solution for $m \leq 1$.

5) We have unique solution for $m \neq 0$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course, 10% repeat the course and 10% give
The students of course 2: 80% finish the degree and 20% repeat the course.

On the other hand, every year, the amount of students that starts the degree is equivalent to 40% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 23.244 % in the first course and 76.756 % in the second course.

2) 20.066 % in the first course and 79.934 % in the second course.

3) 13.661 % in the first course and 86.339 % in the second course.

4) 11.23 % in the first course and 88.77 % in the second course.

5) 20.258 % in the first course and 79.742 % in the second course.

6) 6.842 % in the first course and 93.158 % in the second course.

7) 9.722 % in the first course and 90.278 % in the second course.

8) 47.8907 % in the first course and 52.1093 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 5

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=8000-9Q. On the other hand, the production cost per ton is C=3000-7Q. In addition, the transportation cost is 4872 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 2048 .

2) Profit = 2811 .

3) Profit = 2580 .

4) Profit = 1818 .

5) Profit = 1348 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 2e^x + \sin(x) & x \le 0 \\ 2 - x & 0 < x < 1 \\ 2\log(x) + 1 & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for x= 0 .

4) The function is continuous for all the points except for x= 1 .

5) The function is continuous for all the points except for x= 0 and x= 1 .

Exercise 3

Between the months t= 3 and t= 10 , the true value of the shares of a company (in euros) are given by the function $C(t) = 297 + 192t - 36t^2 + 2t^3$.

Determine the interval where the value oscillates between the months t= 7 and t= 10 .

1) It oscillates between 553 and 617.

2) It oscillates between 557 and 607.

3) It oscillates between 546 and 618.

4) It oscillates between 560 and 625.

5) It oscillates between 559 and 617.

Exercise 4

Compute the area enclosed by the function $f(x) = -6 + x + 4x^2 + x^3$ and the horizontal axis between the points $x = -4$ and $x = 3$.

1) $\frac{385}{12} = 32.0833$

2) $\frac{779}{12} = 64.9167$

3) $\frac{767}{12} = 63.9167$

4) $\frac{773}{12} = 64.4167$

5) $\frac{479}{12} = 39.9167$

6) $\frac{155}{4} = 38.75$

7) $\frac{749}{12} = 62.4167$

8) $\frac{785}{12} = 65.4167$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & 1 & 2 & 2 \\ 0 & 1 & 1 & -1 \\ 1 & 1 & 0 & a \\ 1 & 1 & 3 & -1 \end{pmatrix}$ has determinant 9 ?

1) -4 2) -2 3) 4 4) -1 5) 5

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-1 + m)\, x + y + z == -1 + 2m$
$-x + 2y + z == 0$
$-x + 3y + 2z == 1$

has only a solution. For that solution compute the value of variable y

1) $y = -4$.

2) $y = 9$.

3) $y = 1$.

4) $y = 3$.

5) $y = -7$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 30% repeat the course and 10% give
The students of course 2: 60% finish the degree, 20% repeat the course and 20% give up the stuc

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 5 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 14.957 % in the first course and 85.043 % in the second course.

2) 20.031 % in the first course and 79.969 % in the second course.

3) 30.127 % in the first course and 69.873 % in the second course.

4) 16.626 % in the first course and 83.374 % in the second course.

5) 24.626 % in the first course and 75.374 % in the second course.

6) 23.979 % in the first course and 76.021 % in the second course.

7) 3.132 % in the first course and 96.868 % in the second course.

8) 40. % in the first course and 60. % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 6

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interes rate of 10% and in the bank B we are paid a periodic compound interes rate of 6% in 10 periods (compounding frequency). We initially deposit 1000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **3.***** years.

3) In **7.***** years.

4) In **0.***** years.

5) In **1.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	2
2	8
6	92

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 8 and 20. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=6$).

1) The funds are inside the limits for the inverval: $[0, 2]$.

2) The funds are inside the limits for the inverval: $[-2, 6]$.

3) The funds are inside the limits for the inverval: $[-2, 0]$.

4) The funds are inside the limits for the inverval: $[2, 3]$.

5) The funds are inside the limits for the inverval: $[-2, -1]$.

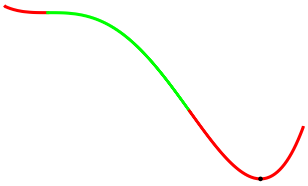
6) The funds are inside the limits for the inverval: $[-2, 2]$.

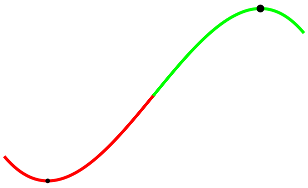
7) The funds are inside the limits for the intervals: $[-2, -1]$ y $[3, 6]$.

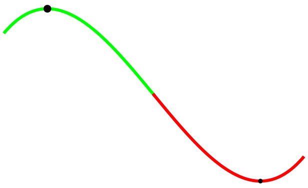
8) The funds are inside the limits for the inverval: $[2, 6]$.

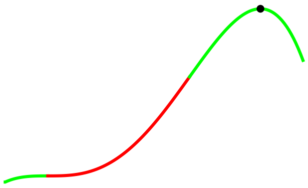
Exercise 3

Study the shape properties of the $f(x) = 1 + 6x^2 + 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 2t + 3t^2 + t^3 + 2t^4$ millions of euros/year.

If the initial deposit in the investment fund was 30 millions of euros, compute the depositis available after 2 years.

1) $\frac{653}{20}$ millions of euros = 32.65 millions of euros

2) $\frac{3669}{20}$ millions of euros = 183.45 millions of euros

3) $\frac{294}{5}$ millions of euros = 58.8 millions of euros

4) $\frac{2918}{5}$ millions of euros = 583.6 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X + \begin{pmatrix} 3 & -1 \\ 1 & 0 \end{pmatrix}\right) \cdot \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 3 \\ -1 & 1 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$x_1 - x_2 + 3\,x_3 - x_4 == 2$
$-x_1 + 2\,x_2 + 5\,x_3 + 4\,x_4 == 1$
$-4\,x_1 + 5\,x_2 - 4\,x_3 + 7\,x_4 == -5$

taking as parameters, if it is necessary, the
 last variables and solving for the first ones (that is to say,
 apply Gauss elimination technique selecting columns from left to right)
 . Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 10 \end{pmatrix}, \begin{pmatrix} 7 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ 3 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -8 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -2 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ 5 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -5 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -4 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ 9 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -9 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 0 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -4 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ -1 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -9 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3\ \ -2), (2\ \ -1) \rangle$

1) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ 2) $\begin{pmatrix} -2 & 1 \\ 3 & -3 \end{pmatrix}$ 3) $\begin{pmatrix} -2 & 2 \\ -3 & -2 \end{pmatrix}$ 4) $\begin{pmatrix} -2 & -2 \\ 3 & 2 \end{pmatrix}$ 5) $\begin{pmatrix} 0 & 2 \\ 1 & -2 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 7

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=9000-17Q$. On the other hand, the production cost per ton is $C=4000-12Q$. In addition, the transportation cost is 4720 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 3920 .

2) Profit = 5505 .

3) Profit = 6315 .

4) Profit = 4421 .

5) Profit = 6450 .

Exercise 2

From an initial deposit 15000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t)=$ $15\,000\left(\frac{-2+7t-3t^2}{5-9t-3t^2}\right)^{-6+6t}$. Determine the future tendency for the deposits that we will have after a large number of years.

1) 0

2) $\frac{15\,000}{e^4}$

3) $-\infty$

4) $\frac{15\,000}{e^{32}}$

5) ∞

6) $\frac{15\,000}{e^{16\,001/500}}$

7) $15\,000$

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-1+\mathrm{Cos}[x^2]}{x^4}$

1) ∞

2) $-\infty$

3) 0

4) $-\frac{1}{2}$

5) -1

6) -2

7) 1

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = 1 + 2t^2 + 2t^3 + 2t^4$ euros.

Compute the average value of the shares along the first 6 months of the year (between t=0 and t=6).

1) $\frac{77}{180}$ euros = 0.4278 euros

2) $\frac{529}{20}$ euros = 26.45 euros

3) $\frac{211}{45}$ euros = 4.6889 euros

4) $\frac{3257}{5}$ euros = 651.4 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 3 & 1 \\ 2 & 1 \end{pmatrix} . X . \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}^{-1} = \begin{pmatrix} 0 & 1 \\ 0 & 1 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-x_1 + 5 x_2 + 4 x_3 + x_4 - 2 x_5 == -1$
$4 x_1 + 3 x_2 + 3 x_3 - x_4 + 3 x_5 == 0$
$5 x_1 - 2 x_2 - x_3 - 2 x_4 + 5 x_5 == 1$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} 0 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -21 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -7 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} -3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -6 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -18 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -17 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} 3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -2 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -20 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 1 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -6 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 4 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -9 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -5 \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ 6 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -9 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 10 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 1 & 9 \\ -1 & -5 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2 \ \ -1)$.

2) The matrix is diagonalizable and $\lambda = 4$ is an eigenvalue with eigenvector $(0 \ \ -2)$.

3) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-3 \ \ 2)$.

4) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(3 \ \ -1)$.

5) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(3 \ \ -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 8

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=15000−13Q. On the other hand, the production cost per ton is C=1000−11Q. In addition, the transportation cost is 13872 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 3347 .

2) Profit = 3304 .

3) Profit = 2048 .

4) Profit = 2321 .

5) Profit = 845 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 2\,e^{x-2} & x \le 2 \\ 2 & 2 < x < 5 \\ 2 - 3\log(x-4) & 5 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for x= 2 .

4) The function is continuous for all the points except for x= 5 .

5) The function is continuous for all the points except for x= 2 and x= 5 .

Exercise 3

Study the differentiability of the function f(x) =

$$\begin{cases} e^{x-3} - 2\sin(3)\sin(x) - 2\cos(3)\cos(x) + 5 & x \le 3 \\ \frac{1}{6}\left(x^2 + 39\right) & 3 < x < 6 \\ 5x - 3(x-5)\log(x-5) - \frac{35}{2} & 6 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x= 3 .

4) The function is differentiable for all points except for x= 6 .

5) The function is differentiable for all points except for x= 3 and x= 6 .

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}\,(5 + 3\,t)\right)(\cos(2\pi t) + 1)$ per-unit.

The initial deposit in the account is 8000 euros. Compute the deposit after 2 years.

1) 9418.087 euros

2) 9408.087 euros

3) 9388.087 euros

4) 9428.087 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -1 & 2 & 1 & -1 \\ -1 & 1 & 0 & 1 \\ 0 & 1 & 0 & -1 \\ 1 & 2 & 1 & a \end{pmatrix}$ has determinant -4 ?

1) -1 2) -4 3) 2 4) -5 5) -3

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-2 + m)\,x + y + 2\,z == -4 + 2\,m$
$-2\,x + y + z == -3$
$-x + y + 2\,z == -2$

has only a solution.

1) We have unique solution for $m \neq 2$.

2) We have unique solution for $m \leq 4$.

3) We have unique solution for $m \geq -1$.

4) We have unique solution for $m \neq 2$.

5) We have unique solution for $m \neq 1$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course and 20% give up the studies.
The students of course 2: 70% finish the degree, 20% repeat the course and 10% give up the stuc

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 9 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 24.3136 % in the first course and 75.6864 % in the second course.

2) 36.981 % in the first course and 63.019 % in the second course.

3) 42.456 % in the first course and 57.544 % in the second course.

4) 13.253 % in the first course and 86.747 % in the second course.

5) 7.576 % in the first course and 92.424 % in the second course.

6) 0 % in the first course and 100. % in the second course.

7) 34.434 % in the first course and 65.566 % in the second course.

8) 15.506 % in the first course and 84.494 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 9

Exercise 1

Certain parcel of land is revalued from an initial value of 317 000 euros until a final value of 441 000 euros along 7 years. Determine the rate of periodic compound interes in 11 periods for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) The interest rate is **0.***** %.

2) The interest rate is **4.***** %.

3) The interest rate is **8.***** %.

4) The interest rate is **6.***** %.

5) The interest rate is **9.***** %.

Exercise 2

The population of a city is studied between years t=1 and t=7. In that period the population is given by the function $P(t) = 5 + 288\,t - 60\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between −347 and 445.

1) Along the interval of years: [1.19032, 3.].

2) Along the intervals of years: [3.38135, 5.34953] and [6.63406, 7.22027].

3) Along the interval of years: [3.13869, 4.].

4) Along the interval of years: [3.60132, 7.5822].

5) Along the intervals of years: [1, 1], [3.26795, 5] and [6.73205, 7].

6) Along the intervals of years: [1, 3.26795] and [5, 6.73205].

7) Along the interval of years: [1.44068, 7.].

8) Along the intervals of years: [2., 3.73273] and [4., 7.].

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} 2\,e^{x+2} + 3\cos(x+2) - 2 & x \le -2 \\ \frac{17}{3} - \frac{1}{3}(x-2)\,x & -2 < x < 1 \\ x + x\,(-\log(x)) + 5 & 1 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x = −2.

4) The function is differentiable for all points except for x = 1.

5) The function is differentiable for all points except for x = −2 and x = 1.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(5 + 9t)\right)(\cos(2\pi t) + 1)$ per-unit.

The initial deposit in the account is 11 000 euros. Compute the deposit after 3 years.

1) 19191.3508 euros

2) 19201.3508 euros

3) 19211.3508 euros

4) 19161.3508 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -2 & -1 & 1 & a \\ -2 & 0 & 5 & -1 \\ 1 & 0 & -2 & 0 \\ 1 & 1 & -1 & -2 \end{pmatrix}$ has determinant 3 ?

1) 1   2) 0   3) −1   4) 4   5) 3

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(7 + m)\,x - 2y + 4z == 12$
$x + z == 2$
$3x - y + 2z == 6$

has only a solution.

1) We have unique solution for $m \geq 0$.

2) We have unique solution for $m \neq -2$.

3) We have unique solution for $m \geq -5$.

4) We have unique solution for $m \neq -2$.

5) We have unique solution for $m \leq 1$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 100% pass to the following course.
The students of course 2: 60% finish the degree and 40% give up the studies.

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 5 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) -80.9017 % in the first course and 180.902 % in the second course.

2) 16.6667 % in the first course and 83.3333 % in the second course.

3) 30.9017 % in the first course and 69.0983 % in the second course.

4) 28.045 % in the first course and 71.955 % in the second course.

5) 4.735 % in the first course and 95.265 % in the second course.

6) 33.069 % in the first course and 66.931 % in the second course.

7) 23.018 % in the first course and 76.982 % in the second course.

8) 24.942 % in the first course and 75.058 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 10

Exercise 1

We have one bank account that offers a continuous compound rate of 1% where we initially deposit 12 000 euros. How long time is it necessary until the amount of money in the account reaches 21 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **1.***** years.

2) In **5.***** years.

3) In **7.***** years.

4) In **9.***** years.

5) In **0.***** years.

Exercise 2

The population of a city is studied between years $t=1$ and $t=10$. In that period the population is given by the function $P(t) = 1 + 324\,t - 72\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between 33 and 401.

1) Along the intervals of years: $[1.,5.]$ and $[9.,10.6126]$.

2) Along the interval of years: $[8.71633,10.]$.

3) Along the interval of years: $[8.,9.]$.

4) Along the intervals of years: $[3.17925,5.]$ and $[6.67102,9.65068]$.

5) Along the intervals of years: $[3.35681,6.60083]$ and $[8.,9.03109]$.

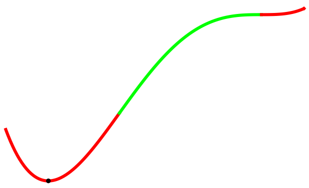
6) Along the intervals of years: $[2.,3.]$ and $[8.56641,9.64423]$.

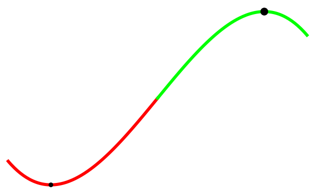
7) Along the intervals of years: $[1,2.10102]$, $[4,8]$ and $[9.89898,10]$.

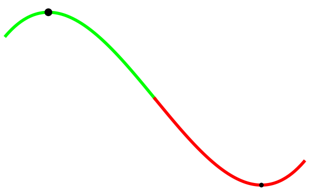
8) Along the intervals of years: $[1,1]$, $[2.10102,4]$, $[8,9.89898]$ and $[10,10]$.

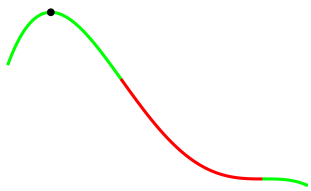
Exercise 3

Study the shape properties of the $f(x) = 1 - 48x + 48x^2 - 20x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 20\,e^{-2+2t}$ millions of euros/year.

If the initial deposit in the investment fund was 30 millions of euros, compute the depositis available after 1 year.

1) $30 - \frac{10}{e^2} + 10\,e^2$ millions of euros = 102.5372 millions of euros

2) $40 - \frac{10}{e^2}$ millions of euros = 38.6466 millions of euros

3) $30 + \frac{10}{e^4} - \frac{10}{e^2}$ millions of euros = 28.8298 millions of euros

4) $30 - \frac{10}{e^2} + 10\,e^4$ millions of euros = 574.6281 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} . X . \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & -4 \\ 1 & -2 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$3\,x_3 + 2\,x_4 == 3$
$-6\,x_1 + 8\,x_3 + 6\,x_4 == -2$
$-3\,x_1 + x_3 + x_4 == -4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix}$

2) $\begin{pmatrix} ? \\ ? \\ 11 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 9 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 0 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ -6 \end{pmatrix}$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ -17 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -9 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ -2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 10 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle\, (-5 \;\; 1)\, \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle\, (19 \;\; -4)\, \rangle$

1) $\begin{pmatrix} -39 & -10 \\ 152 & 39 \end{pmatrix}$ 2) $\begin{pmatrix} -39 & 152 \\ -10 & 39 \end{pmatrix}$ 3) $\begin{pmatrix} -3 & -1 \\ 0 & 2 \end{pmatrix}$ 4) $\begin{pmatrix} -39 & 8 \\ -190 & 39 \end{pmatrix}$ 5) $\begin{pmatrix} -39 & -190 \\ 8 & 39 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 11

Exercise 1

We have one bank account that offers a periodic compound interes rate of 6% in 10 periods (compounding frequency) where we initially deposit 12 000 euros. How long time is it necessary until the amount of money in the account reaches 19 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **2.***** years.

2) In **5.***** years.

3) In **0.***** years.

4) In **7.***** years.

5) In **9.***** years.

Exercise 2

The population of a city is studied between years t=1 and t=10. In that period the population is given by the function $P(t) = 5 + 336\,t - 66\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between 509 and 535.

1) Along the interval of years: [1., 6.] .

2) Along the interval of years: [2.64098, 10.7808] .

3) Along the intervals of years: [2.68826, 3.18826], [5, 6] and [7.81174, 8.31174] .

4) Along the interval of years: [2., 9.] .

5) Along the intervals of years: [1.79871, 3.] and [7., 8.31319] .

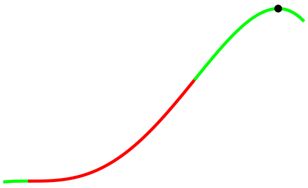
6) Along the intervals of years: [1, 2.68826], [3.18826, 5], [6, 7.81174] and [8.31174, 10] .

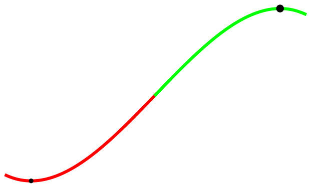
7) Along the intervals of years: [2., 4.57178] and [7., 8.] .

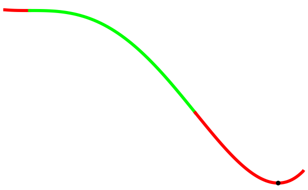
8) Along the interval of years: [7., 9.35615] .

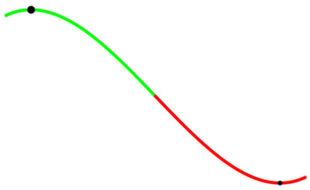
Exercise 3

Study the shape properties of the $f(x) = 2 - 12x - 6x^2 + 4x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1)


2)


3)


4)


Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 20\,e^{2t}$ millions of euros/year.

If the initial deposit in the investment fund was 70
millions of euros, compute the depositis available after 3 years.

1) $60 + \frac{10}{e^2}$ millions of euros = 61.3534 millions of euros

2) $60 + 10\,e^2$ millions of euros = 133.8906 millions of euros

3) $60 + 10\,e^6$ millions of euros = 4094.2879 millions of euros

4) $60 + 10\,e^4$ millions of euros = 605.9815 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X - \begin{pmatrix} -1 & 1 \\ -2 & 1 \end{pmatrix}\right) \cdot \begin{pmatrix} 0 & -1 \\ 1 & 2 \end{pmatrix}^{-1} = \begin{pmatrix} 2 & 0 \\ 6 & 2 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-3\,x_1 + 3\,x_2 - x_3 - 3\,x_4 == 2$
$-3\,x_1 - x_2 + x_3 + 2\,x_4 == 3$

taking as parameters, if it is necessary, the
first variables and solving for the last ones (that is to say,
apply Gauss elimination technique selecting columns from right to left)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ -8 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 6 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -2 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 10 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -1 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} 2 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix}, \begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 7 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ 3 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 14 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -6 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -6 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 3 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 17 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -4 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle\, (-2 \;\; -1)\,\rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle\, (-3 \;\; -2)\,\rangle$

1) $\begin{pmatrix} -4 & -2 \\ 6 & 3 \end{pmatrix}$ 2) $\begin{pmatrix} -4 & -6 \\ 2 & 3 \end{pmatrix}$ 3) $\begin{pmatrix} -2 & -3 \\ 2 & -3 \end{pmatrix}$ 4) $\begin{pmatrix} -4 & 6 \\ -2 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -4 & 2 \\ -6 & 3 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 12

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 3% in 5 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a continuous compound rate of 8%. The initial deposit is 12000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

1) We will have ****7.***** euros.

2) We will have ****4.***** euros.

3) We will have ****1.***** euros.

4) We will have ****0.***** euros.

5) We will have ****5.***** euros.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 2e^{x-2} & x \le 2 \\ 2 & 2 < x < 4 \\ 1 - 2\log(x-3) & 4 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 2$.

4) The function is continuous for all the points except for $x = 4$.

5) The function is continuous for all the points except for $x = 2$ and $x = 4$.

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} \cos(2-x) + 4 & x \le 2 \\ \frac{1}{4}(x-4)\,x + 9 & 2 < x < 4 \\ e^{x-4} - 3\cos(4-x) + 11 & 4 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 2$.

4) The function is differentiable for all points except for $x = 4$.

5) The function is differentiable for all points except for $x = 2$ and $x = 4$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$$I(t) = \frac{1}{100}\left(3 + t + 3t^2 + 2t^3\right) \text{ per-unit.}$$

The initial deposit in the account is 15 000 euros. Compute the deposit after 2 years.

1) 19148.7373 euros

2) 19078.7373 euros

3) 19118.7373 euros

4) 19068.7373 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 0 & a & 0 & 1 \\ -1 & -1 & -1 & -1 \\ -1 & -1 & -1 & -2 \\ 2 & 1 & 1 & 1 \end{pmatrix} \text{ has determinant } -1\,?$$

1) 1 2) -1 3) 2 4) -2 5) -5

Exercise 6

Determine the values of the parameter, m, for which the linear system

$$m x - m y + m z == 4 m$$
$$-2 x + 5 y - 4 z == -16$$
$$2 x - 3 y + 3 z == 11$$

has only a solution.

1) We have unique solution for $m \neq -1$.

2) We have unique solution for $m \neq -2$.

3) We have unique solution for $m \geq -2$.

4) We have unique solution for $m \leq 2$.

5) We have unique solution for $m \neq 0$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 1 & 0 & -1 \\ -1 & 2 & -1 \\ 0 & 0 & 2 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(-1\ -1\ 1)$.

2) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(2\ 3\ 0)$.

3) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-1\ -1\ 1)$.

4) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(0\ -2\ 3)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(1\ 1\ 0)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 13

Exercise 1

We have one bank account that offers a periodic compound interes rate of 2% in 2 periods (compounding frequency) where we initially deposit 10 000 euros. How long time is it necessary until the amount of money in the account reaches 15 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **2.***** years.

3) In **3.***** years.

4) In **0.***** years.

5) In **9.***** years.

Exercise 2

The population of a city is studied between years t=1 and t=8. In that period the population is given by the function $P(t) = 2 + 144t - 48t^2 + 4t^3$. Determine the intervals of years when the population is between 22 and 66.

1) Along the intervals of years: [4, 5] and [6.8541, 7.4641].

2) Along the intervals of years: [2., 3.41496] and [4., 6.].

3) Along the intervals of years: [1.48301, 4.32324] and [5., 6.].

4) Along the interval of years: [3., 4.0677].

5) Along the interval of years: [2.77039, 5.].

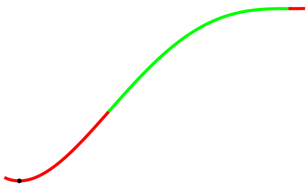
6) Along the intervals of years: [1, 4], [5, 6.8541] and [7.4641, 8].

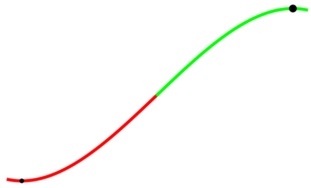
7) Along the interval of years: [1., 6.18229].

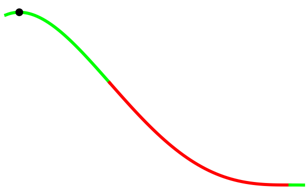
8) Along the interval of years: [4.65492, 5.].

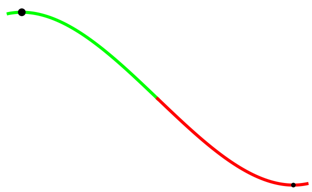
Exercise 3

Study the shape properties of the $f(x) = 5 + 96x - 24x^2 - 8x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 10\,e^{1+t}$ millions of euros/year.

If the initial deposit in the investment fund was 70 millions of euros, compute the depositis available after 2 years.

1) $80 - 10\,e$ millions of euros = 52.8172 millions of euros

2) $70 - 10\,e + 10\,e^3$ millions of euros = 243.6726 millions of euros

3) $70 - 10\,e + 10\,e^4$ millions of euros = 588.7987 millions of euros

4) $70 - 10\,e + 10\,e^2$ millions of euros = 116.7077 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}^{-1} . X + \begin{pmatrix} 1 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ -2 & 0 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-5 x_2 - 3 x_3 + 2 x_4 == -5$
$6 x_2 + 10 x_3 - 8 x_4 == -2$
$4 x_2 + 4 x_3 - 3 x_4 == 2$

taking as parameters, if it is necessary, the
first variables and solving for the last ones (that is to say,
apply Gauss elimination technique selecting columns from right to left)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ 11 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 0 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 4 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -8 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -3 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -5 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -8 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -3 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -9 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ 12 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -8 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (-7 \ \ 4) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (-9 \ \ 5) \rangle$

1) $\begin{pmatrix} 71 & -56 \\ 90 & -71 \end{pmatrix}$ 2) $\begin{pmatrix} 71 & -40 \\ 126 & -71 \end{pmatrix}$ 3) $\begin{pmatrix} -3 & 0 \\ 0 & -1 \end{pmatrix}$ 4) $\begin{pmatrix} 71 & 126 \\ -40 & -71 \end{pmatrix}$ 5) $\begin{pmatrix} 71 & 90 \\ -56 & -71 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 14

Exercise 1

We have a bank account that initially offers a continuous compound rate of 9%, and after 1 year the conditions are modified and then we obtain a periodic compound interes rate of 6% in 10 periods (compounding frequency). The initial deposit is 15 000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

1) We will have ****0.***** euros.

2) We will have ****4.***** euros.

3) We will have ****5.***** euros.

4) We will have ****8.***** euros.

5) We will have ****2.***** euros.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} \sin(x+1) & x \leq -1 \\ -\frac{2x}{3} - \frac{2}{3} & -1 < x < 2 \\ -2\sin(2-x) - 2\cos(2-x) & 2 \leq x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 2$.

5) The function is continuous for all the points except for $x = -1$ and $x = 2$.

Exercise 3

Between the months $t = 2$ and $t = 6$, the true value of the shares of a company (in euros) are given by the function $C(t) = 132 + 108t - 27t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 3$ and $t = 4$.

1) It oscillates between 260 and 267.

2) It oscillates between 251 and 258.

3) It oscillates between 240 and 267.

4) It oscillates between 253 and 276.

5) It oscillates between 240 and 267.

Exercise 4

Compute the area enclosed by the function $f(x) = -6 - 11x - 6x^2 - x^3$ and the horizontal axis between the points $x = -4$ and $x = 2$.

1) 59

2) 61

3) $\frac{121}{2} = 60.5$

4) 62

5) $\frac{125}{2} = 62.5$

6) $\frac{123}{2} = 61.5$

7) 54

8) 63

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 0 & 0 & 1 & 2 \\ 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & -1 & a \end{pmatrix}$$ has determinant 5 ?

1) 3 2) −3 3) 1 4) −1 5) −2

Exercise 6

Determine the values of the parameter , m , for which the linear system

$$(1+m)\,x + y - z == 4 + m$$
$$x + 2y - z == 6$$
$$-x - y + z == -4$$

has only a solution. For that solution compute the value of variable z

1) $z = 0$.

2) $z = -1$.

3) $z = 2$.

4) $z = 5$.

5) $z = 4$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 20% repeat the course and 10% give
The students of course 2: 60% finish the degree, 30% repeat the course and 10% give up the stuc

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 9 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 19.037 % in the first course and 80.963 % in the second course.

2) 20.874 % in the first course and 79.126 % in the second course.

3) 3.423 % in the first course and 96.577 % in the second course.

4) 18.375 % in the first course and 81.625 % in the second course.

5) 10.731 % in the first course and 89.269 % in the second course.

6) 25. % in the first course and 75. % in the second course.

7) 10.53 % in the first course and 89.47 % in the second course.

8) 1.5625 % in the first course and 98.4375 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 15

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 10% in 2 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a periodic compound interes rate of 9% in 3 periods (compounding frequency). The initial deposit is 10 000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

1) We will have ****0.***** euros.

2) We will have ****6.***** euros.

3) We will have ****9.***** euros.

4) We will have ****3.***** euros.

5) We will have ****8.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty}\left(\frac{4+9x+9x^2}{6+5x+9x^2}\right)^{4-7x+8x^2}$

1) 1

2) $-\infty$

3) $\frac{1}{e}$

4) ∞

5) $\frac{1}{e^4}$

6) $\frac{1}{e^3}$

7) 0

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-1+\text{Cos}[x^2]}{x^3}$

1) 1

2) ∞

3) $-\infty$

4) 0

5) $\frac{1}{3}$

6) $-\frac{1}{3}$

7) -1

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (7+6t)(\sin(2\pi t)+2)$ euros.

Compute the average value of the shares along the first 3 months of the year (between t=0 and t=3).

1) $\frac{1}{3}\left(96-\frac{9}{\pi}\right)$ euros = 31.0451 euros

2) $\frac{1}{3}\left(-8+\frac{3}{\pi}\right)$ euros = -2.3484 euros

3) $\frac{1}{3}\left(52-\frac{6}{\pi}\right)$ euros = 16.6967 euros

4) $\frac{1}{3}\left(20-\frac{3}{\pi}\right)$ euros = 6.3484 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X-\begin{pmatrix}1 & -1\\ 0 & 1\end{pmatrix}\right).\begin{pmatrix}1 & -1\\ -1 & 2\end{pmatrix}=\begin{pmatrix}-2 & 4\\ -1 & 1\end{pmatrix}$$

1) $\begin{pmatrix}-2 & *\\ * & *\end{pmatrix}$ 2) $\begin{pmatrix}-1 & *\\ * & *\end{pmatrix}$ 3) $\begin{pmatrix}1 & *\\ * & *\end{pmatrix}$ 4) $\begin{pmatrix}* & -2\\ * & *\end{pmatrix}$ 5) $\begin{pmatrix}* & -1\\ * & *\end{pmatrix}$

Exercise 6

Find the solution of the linear system

$2 x_1 + 3 x_2 + 3 x_3 + 3 x_4 + x_5 == -1$
$-x_1 - x_2 + 3 x_3 + x_4 + x_5 == -5$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ -10 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 9 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -9 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 10 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -9 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -7 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -11 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 12 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -5 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -3 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -11 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 5 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -5 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 14 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 9 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 6 & 8 \\ -4 & -6 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(3\ \ 1)$.

2) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(2\ \ -1)$.

3) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(-1\ \ 1)$.

4) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(2\ \ -1)$.

5) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(0\ \ 2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 16

Exercise 1

We have a bank account that initially offers a compound interes rate of 6%, and after 2 years the conditions are modified and then we obtain a periodic compound interes rate of 7% in 8 periods (compounding frequency). The initial deposit is 9000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

1) We will have ****2.***** euros.

2) We will have ****9.***** euros.

3) We will have ****1.***** euros.

4) We will have ****8.***** euros.

5) We will have ****4.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty} \dfrac{5+2x+6x^2+6x^3}{-7-6x+3x^2}$

1) $-\frac{1}{2}$

2) $-\frac{3}{7}$

3) 0

4) ∞

5) 1

6) $-\infty$

7) -2

Exercise 3

Compute the limit: $\lim_{x\to 0}\dfrac{-1+e^{x^2}-x^2}{x^4}$

1) ∞

2) $-\infty$

3) -1

4) 0

5) 1

6) $-\dfrac{1}{3}$

7) $\dfrac{1}{2}$

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = \sin(-2 + 7t)$ euros.

Compute the average value of the shares along the first π months of the year (between $t=0$ and $t=\pi$).

1) $-60 + \dfrac{2\,\mathrm{Cos}[2]}{7\pi}$ euros $=$ -60.0378 euros

2) $\dfrac{2\,\mathrm{Cos}[2]}{7\pi}$ euros $=$ -0.0378 euros

3) $-70 + \dfrac{2\,\mathrm{Cos}[2]}{7\pi}$ euros $=$ -70.0378 euros

4) $-20 + \dfrac{2\,\mathrm{Cos}[2]}{7\pi}$ euros $=$ -20.0378 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 0 \\ 3 & 1 \end{pmatrix}.X + \begin{pmatrix} 0 & -1 \\ 1 & 3 \end{pmatrix} = \begin{pmatrix} -1 & -1 \\ -2 & 4 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$-x_1 - 2x_2 + x_3 + 4x_4 - 5x_5 == 3$$
$$2x_1 + 3x_2 + 4x_3 + 3x_4 + 5x_5 == -5$$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -14 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 13 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 4 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ -3 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 7 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 8 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} 8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -10 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 6 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 11 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -5 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ 7 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 8 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 4 & -4 \\ 2 & -2 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(2\ \ 1)$.

2) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(-2\ \ 1)$.

3) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(2\ \ 1)$.

4) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(3\ \ 0)$.

5) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-2\ \ 1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle (1,1,-1) \rangle$ and $\lambda=3$ with eigenvectors $\langle (1,0,1) \rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle (1,1,-1),(0,1,1) \rangle$ and $\lambda=3$ with eigenvectors $\langle (1,0,1) \rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle (2,1) \rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 17

Exercise 1

Certain parcel of land is revalued from an initial value of 327 000 euros until a final value of 444 000 euros along 8 years. Determine the rate of periodic compound interes in 11 periods for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) The interest rate is **6.***** %.

2) The interest rate is **2.***** %.

3) The interest rate is **5.***** %.

4) The interest rate is **1.***** %.

5) The interest rate is **3.***** %.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} e^{x} + \sin(x) & x \leq 0 \\ -2\, e^{x} + \sin(x) + 3 & 0 < x < 3 \\ 2\, e^{x-3} - 3 \sin(3-x) & 3 \leq x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 3$.

5) The function is continuous for all the points except for $x = 0$ and $x = 3$.

Exercise 3

Between the months $t = 1$ and $t = 7$, the true value of the shares of a company (in euros) are given by the function $C(t) = 153 + 210\, t - 36\, t^2 + 2\, t^3$.

Determine the interval where the value oscillates between the months $t = 1$ and $t = 6$.

1) It oscillates between 327 and 545.

2) It oscillates between 329 and 553.

3) It oscillates between 545 and 553.

4) It oscillates between 333 and 558.

5) It oscillates between 325 and 546.

Exercise 4

Compute the area enclosed by the function $f(x) = 6x - x^2 - x^3$ and the horizontal axis between the points $x = -2$ and $x = 1$.

1) $\frac{211}{12} = 17.5833$

2) $\frac{175}{12} = 14.5833$

3) $\frac{205}{12} = 17.0833$

4) $\frac{33}{4} = 8.25$

5) $\frac{181}{12} = 15.0833$

6) $\frac{199}{12} = 16.5833$

7) $\frac{193}{12} = 16.0833$

8) $\frac{157}{12} = 13.0833$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & -1 & -1 & a \\ 1 & 0 & 3 & 0 \\ 1 & -1 & 3 & -2 \\ 0 & 0 & -1 & 0 \end{pmatrix}$$ has determinant -3 ?

1) 2 2) 3 3) 1 4) −2 5) 4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$$(3+m)x - y + z == -m$$
$$-2x + 2y - z == -3$$
$$2x - y + z == 1$$

has only a solution. For that solution compute the value of variable z

1) $z = 1$.

2) $z = -1$.

3) $z = 8$.

4) $z = 6$.

5) $z = 7$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 30% repeat the course and 10% give
The students of course 2: 80% finish the degree and 20% give up the studies.

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 9 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 13.576 % in the first course and 86.424 % in the second course.

2) 11.597 % in the first course and 88.403 % in the second course.

3) 47.1638 % in the first course and 52.8362 % in the second course.

4) 4.316 % in the first course and 95.684 % in the second course.

5) 25.47 % in the first course and 74.53 % in the second course.

6) 40.6593 % in the first course and 59.3407 % in the second course.

7) 30.518 % in the first course and 69.482 % in the second course.

8) 15.319 % in the first course and 84.681 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 18

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=6000-17Q$. On the other hand, the production cost per ton is $C=1000-8Q$. In addition, the transportation cost is 4820 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 1000 .

2) Profit = 303 .

3) Profit = 900 .

4) Profit = 897 .

5) Profit = 708 .

Exercise 2

From an initial deposit 20000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) = 20\,000\left(\frac{-1+t-t^2}{-8-3t-t^2}\right)^{5+6t}$. Determine the future tendency for the deposits that we will have after a large number of years.

1) $20\,000$

2) $-\infty$

3) $\frac{20\,000}{e^{12\,001/500}}$

4) $\frac{20\,000}{e^{24}}$

5) ∞

6) 0

7) $\frac{20\,000}{e^{5}}$

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-x^2+\text{Sin}[x^2]}{x^3}$

1) -2

2) 0

3) $\frac{1}{2}$

4) $-\infty$

5) 1

6) $-\frac{1}{3}$

7) ∞

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = 20\,e^{-3+3t}$ euros.

Compute the average value of the shares along the first 6 months of the year (between t=0 and t=6).

1) $\frac{1}{6}\left(-\frac{20}{3\,e^3}+\frac{20\,e^{15}}{3}\right)$ euros $=3.6322\times 10^6$ euros

2) $\frac{1}{6}\left(\frac{20}{3}-\frac{20}{3\,e^3}\right)$ euros $=1.0558$ euros

3) $\frac{1}{6}\left(\frac{20}{3\,e^6}-\frac{20}{3\,e^3}\right)$ euros $=-0.0526$ euros

4) $\frac{1}{6}\left(-\frac{20}{3\,e^3}+\frac{20\,e^3}{3}\right)$ euros $=22.2619$ euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 5 & -12 \\ -2 & 5 \end{pmatrix}.X.\begin{pmatrix} -2 & -3 \\ 3 & 4 \end{pmatrix} = \begin{pmatrix} 70 & 99 \\ -29 & -41 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$5 x_1 - x_2 - x_3 + 11 x_4 + 4 x_5 == -2$
$10 x_1 + x_2 + 3 x_3 + 3 x_4 + x_5 == -6$
$-5 x_1 - 2 x_2 - 4 x_3 + 8 x_4 + 3 x_5 == 4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 98 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 12 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 35 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} 10 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -9 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 60 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -35 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 36 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -37 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 13 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -14 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 9 \\ ? \\ ? \\ ? \end{pmatrix}$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 3 & 9 \\ -1 & -3 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-1 \ \ 0)$.

2) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(3 \ \ -1)$.

3) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2 \ \ -1)$.

4) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(-1 \ \ 2)$.

5) The matrix is diagonalizable and $\lambda = 4$ is an eigenvalue with eigenvector $(0 \ \ -2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 19

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	7
2	15
3	13

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account.

1) The maximum for the depositis in the account was 0.

2) The maximum for the depositis in the account was -4.

3) The maximum for the depositis in the account was 15.

4) The maximum for the depositis in the account was 2.

5) The maximum for the depositis in the account was -17.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 51\,000\,e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 1000\,\mathrm{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 85000. (the solution can be found for t between 21 and 26).

1) $t = **.0****$

2) $t = **.2****$

3) $t = **.4****$

4) $t = **.6****$

5) $t = **.8****$

Exercise 3

Between the months $t=0$ and $t=7$, the true value of the shares of a company (in euros) are given by the function $C(t) = 23 + 24t - 15t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t=5$ and $t=6$.

1) It oscillates between 7 and 142.

2) It oscillates between 8 and 51.

3) It oscillates between 7 and 34.

4) It oscillates between 18 and 59.

5) It oscillates between 20 and 60.

Exercise 4

Compute the area enclosed by the function $f(x) = 4 - 2x - 2x^2$ and the horizontal axis between the points $x=-4$ and $x=5$.

1) 99

2) 120

3) $\frac{247}{3} = 82.3333$

4) $\frac{239}{2} = 119.5$

5) $\frac{237}{2} = 118.5$

6) $\frac{193}{3} = 64.3333$

7) 119

8) 117

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -2 & 1 & 1 & 4 \\ a & 1 & 2 & -2 \\ -2 & 1 & 1 & 5 \\ 1 & 0 & 1 & 3 \end{pmatrix}$$ has determinant -4?

1) -5 2) -1 3) 0 4) -2 5) 2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$m x - 3 y - z == -4 - 2 m$
$x + y == -1$
$(2 - m) x + 6 y + 2 z == 4 + 2 m$

has only a solution. For that solution compute the value of variable z

1) $z = 8$.

2) $z = -8$.

3) $z = 2$.

4) $z = 1$.

5) $z = 3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 30% repeat the course and 10% give
The students of course 2: 60% finish the degree and 40% repeat the course.

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 9 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 18.96 % in the first course and 81.04 % in the second course.

2) 5.36 % in the first course and 94.64 % in the second course.

3) 30.5406 % in the first course and 69.4594 % in the second course.

4) 7.177 % in the first course and 92.823 % in the second course.

5) 14.157 % in the first course and 85.843 % in the second course.

6) 23.926 % in the first course and 76.074 % in the second course.

7) 1.81818 % in the first course and 98.1818 % in the second course.

8) 9.258 % in the first course and 90.742 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 20

Exercise 1

We have one bank account that offers a periodic compound interes rate of 3% in 8 periods (compounding frequency) where we initially deposit 12 000 euros. How long time is it necessary until the amount of money in the account reaches 21 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **4.***** years.

3) In **8.***** years.

4) In **0.***** years.

5) In **7.***** years.

Exercise 2

The deposits in certain account between the months $t=1$ and $t=10$ is given by the function $C(t) = 9 + 216\,t - 66\,t^2 + 4\,t^3$. Determine the months for which the deposit is between -61 and 73 euros.

1) Along the interval of months: [4.77839, 6.22786] .

2) Along the interval of months: [2.79527, 4.19825] .

3) Along the intervals of months: [1, 4] and [5, 10] .

4) Along the interval of months: [4, 5] .

5) Along the interval of months: [1.6527, 3.06067] .

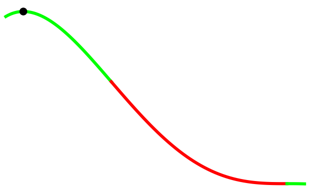
6) Along the interval of months: [4.03795, 10.5497] .

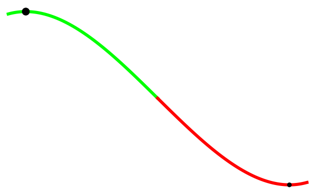
7) Along the intervals of months: [3.16335, 6.04034] and [8., 9.33606] .

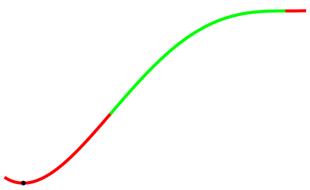
8) Along the intervals of months: [4.11646, 7.20344] and [9., 10.5543] .

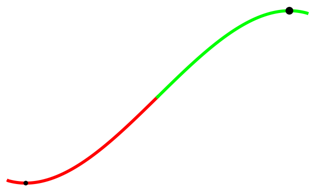
Exercise 3

Study the shape properties of the $f(x) = 4 - 12x + 3x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 20\, e^{3t}$ millions of euros/year.

If the initial deposit in the investment fund was 20 millions of euros, compute the depositis available after 3 years.

1) $\frac{40}{3} + \frac{20\, e^{9}}{3}$ millions of euros = 54033.8929 millions of euros

2) $\frac{40}{3} + \frac{20\, e^{6}}{3}$ millions of euros = 2702.8586 millions of euros

3) $\frac{40}{3} + \frac{20\, e^{3}}{3}$ millions of euros = 147.2369 millions of euros

4) $\frac{40}{3} + \frac{20}{3\, e^{3}}$ millions of euros = 13.6652 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X + \begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}\right) \cdot \begin{pmatrix} -1 & -1 \\ 2 & 1 \end{pmatrix} = \begin{pmatrix} -2 & -1 \\ 1 & -1 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-x_1 - 2x_2 + 7x_3 - 5x_4 == 0$
$2x_1 + 4x_2 - 4x_3 + 3x_4 == 1$
$-10x_3 + 7x_4 == -1$

taking as parameters, if it is necessary, the
 first variables and solving for the last ones (that is to say,
 apply Gauss elimination technique selecting columns from right to left)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix} + \langle \begin{pmatrix} ? \\ ? \\ ? \\ 6 \end{pmatrix} \rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ 3 \end{pmatrix} + \langle \begin{pmatrix} ? \\ -10 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -6 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix} \rangle$

3) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} + \langle \begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -14 \\ ? \end{pmatrix} \rangle$

4) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \end{pmatrix} + \langle \begin{pmatrix} ? \\ ? \\ ? \\ -13 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -13 \\ ? \end{pmatrix} \rangle$

5) $\begin{pmatrix} ? \\ ? \\ 8 \\ ? \end{pmatrix} + \langle \begin{pmatrix} ? \\ ? \\ -5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -18 \end{pmatrix} \rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (5\ 2), (2\ 1) \rangle$

1) $\begin{pmatrix} -3 & -3 \\ 2 & 2 \end{pmatrix}$ 2) $\begin{pmatrix} -3 & -2 \\ 3 & 0 \end{pmatrix}$ 3) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & 1 \\ 0 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & -3 \\ -1 & -1 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 21

Exercise 1

Certain parcel of land is revalued from an initial value of 386 000 euros until a final value of 496 000 euros along 6 years. Determine the rate of compound interes for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) The interest rate is **4.***** %.

2) The interest rate is **3.***** %.

3) The interest rate is **7.***** %.

4) The interest rate is **2.***** %.

5) The interest rate is **0.***** %.

Exercise 2

The population of certain type of rodents is analyzed in a region between years t=1 and t=10. Along that period the population is given by the function $P(t) = 4 + 288t - 66t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 158 and 356.

1) Along the intervals of years: [1.23579, 3.75544] and [6., 10.].

2) Along the interval of years: [5., 7.].

3) Along the interval of years: [4.42752, 8.].

4) Along the interval of years: [3.43985, 9.49324].

5) Along the intervals of years: [3.55972, 4.39333] and [5., 9.2673].

6) Along the intervals of years: [1, 2.11932], [4, 7] and [8.88068, 10].

7) Along the intervals of years: [1.32605, 5.] and [8., 9.].

8) Along the intervals of years: [1, 1], [2.11932, 4], [7, 8.88068] and [10, 10].

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} \sin(x+2) + 3\cos(x+2) - 2 & x \le -2 \\ x + x(-\sin(1)) - \sin(x+2) + x\cos(1) - \cos(x+2) + 4 - 2\sin(1) + 2\cos(1) & -2 < x < -1 \\ 2x - (x+2)\log(x+2) + 5 - 2\sin(1) & -1 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x = −2.

4) The function is differentiable for all points except for x = −1.

5) The function is differentiable for all points except for x = −2 and x = −1.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(1+2t)\right)\log(t)$ per-unit.

In the year t=1 we deposint in the account 7000 euros. Compute the deposit in the account after (with respect to t=1) 5 years.

1) 11853.2944 euros

2) 11933.2944 euros

3) 11863.2944 euros

4) 11883.2944 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & 0 & -2 & 2 \\ 0 & 1 & -1 & -2 \\ 1 & -1 & a & 1 \\ 0 & -1 & -2 & 3 \end{pmatrix}$ has determinant -3 ?

1) 0 2) 4 3) 5 4) −4 5) −5

Exercise 6

Determine the values of the parameter , m , for which the linear system

$m x - y == -2 + m$
$(2 - m) x + 4 y - z == 9 - m$
$-x - 2 y + z == -4$

has only a solution.

1) We have unique solution for $m \neq 2$.

2) We have unique solution for $m \neq 0$.

3) We have unique solution for $m \geq -3$.

4) We have unique solution for $m \geq -3$.

5) We have unique solution for $m \neq -1$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (4\ \ 1) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (3\ \ 1) \rangle$

1) $\begin{pmatrix} -4 & 12 \\ -1 & 3 \end{pmatrix}$ 2) $\begin{pmatrix} -4 & -1 \\ 12 & 3 \end{pmatrix}$ 3) $\begin{pmatrix} -4 & -3 \\ 4 & 3 \end{pmatrix}$ 4) $\begin{pmatrix} -4 & 4 \\ -3 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & 0 \\ -3 & -2 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 22

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interes rate of 10% and in the bank B we are paid a continuous compound rate of 6% . We initially deposit 3000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **3.***** years.

2) In **6.***** years.

3) In **0.***** years.

4) In **2.***** years.

5) In **5.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
1	37
3	61
5	61

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 37 and 52 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=1$ to $t=5$).

1) The funds are inside the limits for the intervals: $[0,1]$ y $[6,7]$.

2) The funds are inside the limits for the inverval: $[0,7]$.

3) The funds are inside the limits for the inverval: $[2,5]$.

4) The funds are inside the limits for the inverval: $[2,7]$.

5) The funds are inside the limits for the inverval: $[1,2]$.

6) The funds are inside the limits for the inverval: $[5,7]$.

7) The funds are inside the limits for the intervals: $[1,2]$ y $[5,6]$.

8) The funds are inside the limits for the inverval: $[0,2]$.

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} -3\cos(x+3) - 1 & x \le -3 \\ -\frac{1}{4}\, x\, (x+6) - \frac{25}{4} & -3 < x < -1 \\ -x - 6 & -1 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -3$.

4) The function is differentiable for all points except for $x = -1$.

5) The function is differentiable for all points except for $x = -3$ and $x = -1$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \frac{1}{10}\cos(7 + t)$ per-unit.

The initial deposit in the account is 17000 euros. Compute the deposit after 5π years.

1) 14966.7782 euros

2) 14886.7782 euros

3) 14896.7782 euros

4) 14906.7782 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -1 & 0 & 2 & 0 \\ 2 & 1 & -3 & 2 \\ 0 & -2 & 1 & a \\ -1 & 0 & 1 & 2 \end{pmatrix}$ has determinant -8?

1) -4 2) 1 3) -2 4) -1 5) -3

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-3 + m)\, x - 3y + z == -4 + 2m$
$3x + 2y - z == 4$
$5x + 3y - z == 8$

has only a solution.

1) We have unique solution for $m \ge -6$.

2) We have unique solution for $m \ge -5$.

3) We have unique solution for $m \ge -1$.

4) We have unique solution for $m \ne -1$.

5) We have unique solution for $m \ne -3$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -11 & -6 & -12 \\ 6 & 4 & 6 \\ 6 & 3 & 7 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(-1\ 0\ -2)$.

2) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-2\ 2\ 1)$.

3) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(2\ -1\ -1)$.

4) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(3\ 2\ 3)$.

5) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(0\ 2\ -3)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1),(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 23

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interes rate of 1% in 6 periods (compounding frequency) and in the bank B we are paid a compound interes rate of 10% . We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **0.***** years.

2) In **8.***** years.

3) In **5.***** years.

4) In **1.***** years.

5) In **9.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	10
2	18
4	10

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between −8 and 16 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from t = 0 to t = 4).

1) The funds are inside the limits for the inverval: [0, 3] .

2) The funds are inside the limits for the inverval: [−1, 4] .

3) The funds are inside the limits for the intervals: [0, 1] y [3, 4] .

4) The funds are inside the limits for the inverval: [−2, 4] .

5) The funds are inside the limits for the inverval: [4, 4] .

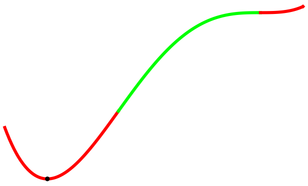
6) The funds are inside the limits for the inverval: [1, 4] .

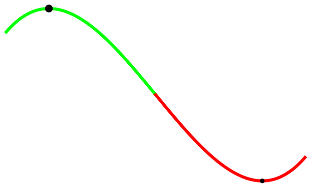
7) The funds are inside the limits for the inverval: [0, 4] .

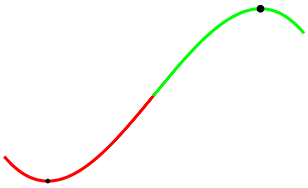
8) The funds are inside the limits for the inverval: [3, 4] .

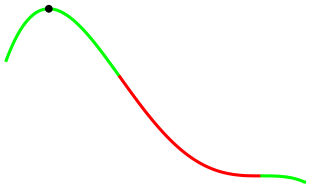
Exercise 3

Study the shape properties of the $f(x) = 5 + 24x + 30x^2 + 16x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 2 + 3t + t^2 + t^3 + t^4$ millions of euros/year.

If the initial deposit in the investment fund was 20 millions of euros, compute the depositis available after 1 year.

1) $\frac{1457}{60}$ millions of euros = 24.2833 millions of euros

2) $\frac{646}{15}$ millions of euros = 43.0667 millions of euros

3) $\frac{2347}{20}$ millions of euros = 117.35 millions of euros

4) $\frac{5132}{15}$ millions of euros = 342.1333 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 0 & -1 \\ 1 & 2 \end{pmatrix} . X + \begin{pmatrix} 1 & -1 \\ 2 & -1 \end{pmatrix} = \begin{pmatrix} 0 & -1 \\ 4 & -2 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$x_1 + x_2 + 3\,x_3 - x_4 == -2$
$2\,x_1 + 3\,x_2 - x_3 + 5\,x_4 == 0$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 4 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -10 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -7 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 4 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -9 \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ 8 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -9 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -6 \\ ? \end{pmatrix}, \begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -10 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 3 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -11 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -9 \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ -3 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -4 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -8 \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle\, (-1\ \ 2),\ (-1\ \ 1)\,\rangle$

1) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ 2) $\begin{pmatrix} -2 & 1 \\ 1 & -2 \end{pmatrix}$ 3) $\begin{pmatrix} -1 & -3 \\ 0 & 2 \end{pmatrix}$ 4) $\begin{pmatrix} -1 & 1 \\ -2 & 1 \end{pmatrix}$ 5) $\begin{pmatrix} 0 & -1 \\ -1 & 2 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 24

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	-2
1	12
2	22

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account.

1) The maximum for the depositis in the account was -7.

2) The maximum for the depositis in the account was 30.

3) The maximum for the depositis in the account was -5.

4) The maximum for the depositis in the account was -9.

5) The maximum for the depositis in the account was 4.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 53\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 3000 + 2000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 106000. (the solution can be found for t between 68 and 73).

1) $t = **.1****$

2) $t = **.3****$

3) $t = **.5****$

4) $t = **.7****$

5) $t = **.9****$

Exercise 3

Between the months $t = 1$ and $t = 7$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 62 + 120\,t - 27\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 6$ and $t = 7$.

1) It oscillates between 242 and 265.

2) It oscillates between 248 and 266.

3) It oscillates between 244 and 263.

4) It oscillates between 157 and 265.

5) It oscillates between 237 and 238.

Exercise 4

Compute the area enclosed by the function $f(x) = 9 - x^2$
and the horizontal axis between the points $x = -5$ and $x = 0$.

1) $\frac{217}{6} = 36.1667$

2) $\frac{113}{3} = 37.6667$

3) $\frac{223}{6} = 37.1667$

4) $\frac{110}{3} = 36.6667$

5) $\frac{10}{3} = 3.3333$

6) $\frac{98}{3} = 32.6667$

7) $\frac{104}{3} = 34.6667$

8) $\frac{107}{3} = 35.6667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -1 & 1 & 1 & -2 \\ -2 & 0 & -1 & 1 \\ a & 2 & -1 & 1 \\ 2 & 1 & 2 & -2 \end{pmatrix}$$ has determinant -3 ?

1) -4 2) 4 3) 1 4) 2 5) -3

Exercise 6

Determine the values of the parameter , m , for which the linear system

$-x + (3 + m)\, y - z == -8 - 2\, m$
$-x + 2\, y == -6$
$x - 2\, y + z == 6$

has only a solution. For that solution compute the value of variable z

1) $z = 3$.

2) $z = 6$.

3) $z = 4$.

4) $z = 0$.

5) $z = -6$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course and 30% repeat the course.
The students of course 2: 60% finish the degree, 10% repeat the course and 30% give up the stuc

On the other hand, every year, the students, in a way or another,
promote their degree in such a way that for every 9 student in the degree
(for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 12.822 % in the first course and 87.178 % in the second course.

2) 27.22 % in the first course and 72.78 % in the second course.

3) 6.475 % in the first course and 93.525 % in the second course.

4) 40.42 % in the first course and 59.58 % in the second course.

5) 23.263 % in the first course and 76.737 % in the second course.

6) 20.107 % in the first course and 79.893 % in the second course.

7) 0.975 % in the first course and 99.025 % in the second course.

8) 1.494 % in the first course and 98.506 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 25

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=11000−10Q. On the other hand, the production cost per ton is C=7000−7Q. In addition, the transportation cost is 3712 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 9542 .

2) Profit = 4439 .

3) Profit = 6912 .

4) Profit = 10 179 .

5) Profit = 10 940 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -2\sin(x+1) & x \leq -1 \\ \frac{x}{2} + \frac{1}{2} & -1 < x < 1 \\ -3\sin(1-x) & 1 \leq x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 1$.

5) The function is continuous for all the points except for $x = -1$ and $x = 1$.

Exercise 3

Between the months $t = 3$ and $t = 9$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 378 + 210\,t - 36\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 7$ and $t = 8$.

1) It oscillates between 738 and 810.

2) It oscillates between 777 and 769.

3) It oscillates between 770 and 778.

4) It oscillates between 765 and 779.

5) It oscillates between 764 and 772.

Exercise 4

Compute the area enclosed by the function $f(x) = 6 + 7x - x^3$ and the horizontal axis between the points $x = -5$ and $x = 1$.

1) 84

2) $\frac{223}{2} = 111.5$

3) $\frac{219}{2} = 109.5$

4) 108

5) $\frac{225}{2} = 112.5$

6) $\frac{171}{2} = 85.5$

7) 112

8) 111

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 2 & 0 & -1 & 0 \\ -1 & 3 & -1 & 1 \\ a & 1 & 2 & 1 \\ 2 & 1 & 0 & 0 \end{pmatrix} \text{ has determinant } -16\,?$$

1) 4   2) -1 3) 5   4) -5 5) 2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$-2x - 3y + (1 + m)z == 4$
$x + 2y - z == -3$
$-2x - 3y + 2z == 4$

has only a solution. For that solution compute the value of variable y

1) $y = -4$.

2) $y = 6$.

3) $y = -1$.

4) $y = -2$.

5) $y = 3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course and 40% repeat the course.
The students of course 2: 60% finish the degree and 40% give up the studies.

On the other hand, every year, the amount of students that starts the degree is equivalent to 60% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 4.763 % in the first course and 95.237 % in the second course.

2) 8.105 % in the first course and 91.895 % in the second course.

3) 58.1139 % in the first course and 41.8861 % in the second course.

4) 18.924 % in the first course and 81.076 % in the second course.

5) 29.185 % in the first course and 70.815 % in the second course.

6) 18.771 % in the first course and 81.229 % in the second course.

7) 10.894 % in the first course and 89.106 % in the second course.

8) 17.338 % in the first course and 82.662 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 26

Exercise 1

We have one bank account that offers a periodic compound interes rate of 1% in 3 periods (compounding frequency) where we initially deposit 10 000 euros. How long time is it necessary until the amount of money in the account reaches 12 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **2.***** years.

2) In **3.***** years.

3) In **0.***** years.

4) In **6.***** years.

5) In **8.***** years.

Exercise 2

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=8$. Along that period the population is given by the function $P(t)=120t-42t^2+4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 64 and 90.

1) Along the intervals of years: $[1, 1]$, $[1.18826, 3]$, $[4, 5.81174]$ and $[6.31174, 8]$.

2) Along the intervals of years: $[2.03337, 6.]$ and $[7.04619, 8.]$.

3) Along the intervals of years: $[3., 6.]$ and $[7., 8.57709]$.

4) Along the intervals of years: $[1, 1.18826]$, $[3, 4]$ and $[5.81174, 6.31174]$.

5) Along the interval of years: $[3., 8.]$.

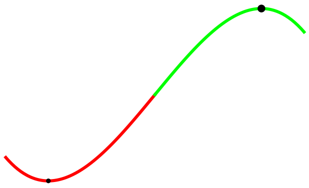
6) Along the interval of years: $[4., 7.56879]$.

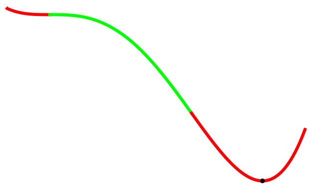
7) Along the intervals of years: $[1.3287, 2.75012]$ and $[5.71563, 8.25307]$.

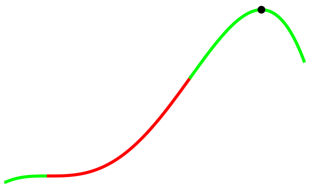
8) Along the intervals of years: $[1.2301, 2.30411]$ and $[6., 7.]$.

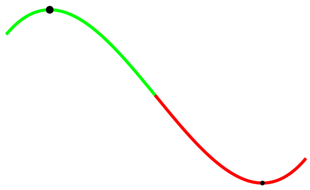
Exercise 3

Study the shape properties of the $f(x) = 2 + 48x + 48x^2 + 20x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 10\, e^{2+t}$ millions of euros/year.

If the initial deposit in the investment fund was 80
millions of euros, compute the depositis available after 2 years.

1) $80 - 10\, e^2 + 10\, e^5$ millions of euros = 1490.241 millions of euros

2) $80 - 10\, e^2 + 10\, e^3$ millions of euros = 206.9648 millions of euros

3) $80 + 10\, e - 10\, e^2$ millions of euros = 33.2923 millions of euros

4) $80 - 10\, e^2 + 10\, e^4$ millions of euros = 552.0909 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix} . X . \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix} = \begin{pmatrix} -8 & -3 \\ -21 & -8 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-3\,x_1 - 3\,x_2 + 3\,x_3 + 4\,x_4 == 2$
$-7\,x_1 + 5\,x_3 + 7\,x_4 == 1$
$-4\,x_1 + 3\,x_2 + 2\,x_3 + 3\,x_4 == -1$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 21 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 9 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -14 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ -10 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -4 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 9 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -13 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} -6 \\ ? \\ ? \\ ? \end{pmatrix}$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (-4 \;\; -9) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (5 \;\; 11) \rangle$

1) $\begin{pmatrix} 89 & -40 \\ 198 & -89 \end{pmatrix}$ 2) $\begin{pmatrix} 89 & 72 \\ -110 & -89 \end{pmatrix}$ 3) $\begin{pmatrix} 89 & 198 \\ -40 & -89 \end{pmatrix}$ 4) $\begin{pmatrix} 89 & -110 \\ 72 & -89 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & 1 \\ 2 & 0 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 27

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	0
2	104
4	192

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 8 .

2) The maximum for the depositis in the account was 392 .

3) The maximum for the depositis in the account was 0 .

4) The maximum for the depositis in the account was 14 .

5) The maximum for the depositis in the account was 294 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 63\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 3000 \,\text{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 102000. (the solution can be found for t between 38 and 43).

1) t = **.0****

2) t = **.2****

3) t = **.4****

4) t = **.6****

5) t = **.8****

Exercise 3

Between the months $t = 3$ and $t = 9$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 605 + 324\,t - 45\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 6$ and $t = 9$.

1) It oscillates between 1324 and 1365.

2) It oscillates between 1226 and 1361.

3) It oscillates between 1330 and 1353.

4) It oscillates between 1334 and 1361.

5) It oscillates between 1335 and 1365.

Exercise 4

Compute the area enclosed by the function $f(x) = 4 - 6\,x + 2\,x^2$
and the horizontal axis between the points $x = -3$ and $x = 1$.

1) $\frac{185}{3} = 61.6667$

2) $\frac{367}{6} = 61.1667$

3) $\frac{191}{3} = 63.6667$

4) $\frac{176}{3} = 58.6667$

5) $\frac{361}{6} = 60.1667$

6) $\frac{188}{3} = 62.6667$

7) $\frac{197}{3} = 65.6667$

8) $\frac{182}{3} = 60.6667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 2 & 1 & 3 & -1 \\ a & 1 & 1 & 2 \\ -2 & 0 & -2 & 3 \\ 2 & 0 & 1 & -1 \end{pmatrix}$ has determinant -5?

1) -3 2) 3 3) -5 4) 1 5) -2

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(1+2m)x + y + 3z == -1 - 2m$
$2x + y + 2z == -2$
$mx + z == -m$

has only a solution. For that solution compute the value of variable x

1) $x = 4$.

2) $x = -1$.

3) $x = 0$.

4) $x = 3$.

5) $x = 8$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course, 10% repeat the course and 10% give
The students of course 2: 60% finish the degree and 40% repeat the course.

On the other hand, every year, the amount of students that starts the degree is equivalent to 70% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 0.028 % in the first course and 99.972 % in the second course.

2) 13.218 % in the first course and 86.782 % in the second course.

3) 9.506 % in the first course and 90.494 % in the second course.

4) 54.9193 % in the first course and 45.0807 % in the second course.

5) 21.7 % in the first course and 78.3 % in the second course.

6) 22.874 % in the first course and 77.126 % in the second course.

7) 9.054 % in the first course and 90.946 % in the second course.

8) 23.297 % in the first course and 76.703 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 28

Exercise 1

We have one bank account that offers a continuous compound rate of 1% where we initially deposit 10 000 euros. How long time is it necessary until the amount of money in the account reaches 18 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **8.***** years.

3) In **0.***** years.

4) In **6.***** years.

5) In **1.***** years.

Exercise 2

The population of a city is studied between years t=1 and t=8. In that period the population is given by the function $P(t) = 1 + 144t - 48t^2 + 4t^3$. Determine the intervals of years when the population is between 65 and 109.

1) Along the intervals of years: [1., 5.30312] and [6.25244, 8.42058] .

2) Along the interval of years: [3.13435, 4.59861] .

3) Along the intervals of years: [1.67109, 6.] and [7., 8.] .

4) Along the intervals of years: [1, 1], [1.1459, 3], [4, 7.4641] and [7.8541, 8] .

5) Along the intervals of years: [1., 4.] and [6., 7.38088] .

6) Along the intervals of years: [1.53125, 2.] and [3., 4.] .

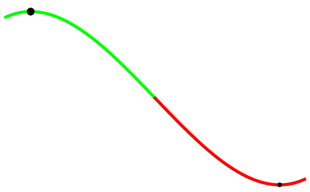
7) Along the interval of years: [1.0811, 2.] .

8) Along the intervals of years: [1, 1.1459], [3, 4] and [7.4641, 7.8541] .

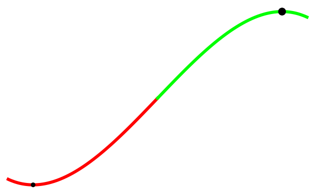
Exercise 3

Study the shape properties of the $f(x) = 4 - 6x + 2x^3$
to decide which amongst the following ones is the representation of the function.

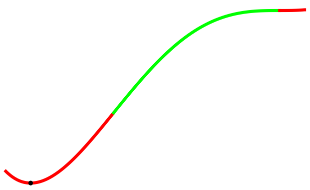
1)



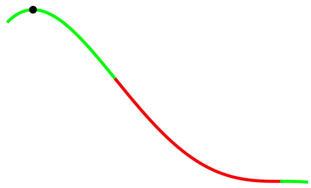
2)



3)



4)



● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 10\,e^{-2+t}$ millions of euros/year .

If the initial deposit in the investment fund was 30
millions of euros, compute the depositis available after 2 years.

1) $40 - \frac{10}{e^2}$ millions of euros = 38.6466 millions of euros

2) $30 - \frac{10}{e^2} + \frac{10}{e}$ millions of euros = 32.3254 millions of euros

3) $30 - \frac{10}{e^2} + 10\,e$ millions of euros = 55.8295 millions of euros

4) $30 + \frac{10}{e^3} - \frac{10}{e^2}$ millions of euros = 29.1445 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 0 \\ -3 & 1 \end{pmatrix} . X + \begin{pmatrix} 1 & -1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 5 & -3 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-x_2 - x_3 + x_4 == 2$
$4 x_1 + x_2 - 2 x_3 + x_4 == -1$
$-8 x_1 + x_2 + 7 x_3 - 5 x_4 == -4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 6 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -2 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -4 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 8 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 6 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -9 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 8 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} -2 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 4 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (4 \ \ -3) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (3 \ \ -2) \rangle$

1) $\begin{pmatrix} 17 & -12 \\ 24 & -17 \end{pmatrix}$ 2) $\begin{pmatrix} 17 & 24 \\ -12 & -17 \end{pmatrix}$ 3) $\begin{pmatrix} -2 & -3 \\ 3 & 0 \end{pmatrix}$ 4) $\begin{pmatrix} 17 & 12 \\ -24 & -17 \end{pmatrix}$ 5) $\begin{pmatrix} 17 & -24 \\ 12 & -17 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 29

Exercise 1

We have a bank account that initially offers a continuous compound rate of 2% , and after 2 years the conditions are modified and then we obtain a continuous compound rate of 1% . The initial deposit is 9000 euros. Compute the amount of money in the account after 8 years from the moment of the first deposit.

1) We will have ****4.***** euros.

2) We will have ****2.***** euros.

3) We will have ****1.***** euros.

4) We will have ****7.***** euros.

5) We will have ****6.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to\infty}\left(\frac{6+4x-2x^2-3x^3}{-9+7x+6x^2-3x^3}\right)^{-3+2x}$

1) $e^{16/3}$

2) ∞

3) $-\infty$

4) 0

5) 1

6) $\frac{1}{e^4}$

7) $\frac{1}{e^5}$

Exercise 3

Compute the limit: $\lim_{x\to 1}\frac{\frac{25}{6}-8x+6x^2-\frac{8x^3}{3}+\frac{x^4}{2}+\text{Log}[x^2]}{-1+5x-10x^2+10x^3-5x^4+x^5}$

1) $\frac{2}{5}$

2) ∞

3) 0

4) $-\infty$

5) -2

6) -1

7) 1

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (6 + 4t)\,e^{-1+2t}$ euros .

Compute the average value of the shares along the first
5 months of the year (between t=0 and t=5).

1) $\frac{1}{5}\left(-\frac{2}{e} + 6e^{3}\right)$ euros = 23.9555 euros

2) $-\frac{2}{5e}$ euros = −0.1472 euros

3) $\frac{1}{5}\left(-\frac{2}{e} + 4e\right)$ euros = 2.0275 euros

4) $\frac{1}{5}\left(-\frac{2}{e} + 12e^{9}\right)$ euros = 19447.2543 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 2 & 3 \\ -1 & -1 \end{pmatrix}^{-1} . \left(X + \begin{pmatrix} 1 & -2 \\ -3 & 7 \end{pmatrix}\right) = \begin{pmatrix} 5 & -17 \\ -3 & 11 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$3 x_1 - 2 x_2 - 2 x_3 - 3 x_4 == 5$
$-x_1 + x_2 - 5 x_3 - x_4 - 5 x_5 == 9$
$-4 x_1 + 3 x_2 - 3 x_3 + 2 x_4 - 5 x_5 == 4$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix} + \left\langle \begin{pmatrix} 12 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 5 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 15 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 6 \end{pmatrix} + \left\langle \begin{pmatrix} 10 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 4 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 14 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 7 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 9 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -7 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 5 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 1 \end{pmatrix} + \left\langle \begin{pmatrix} 15 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 6 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 13 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -1 & -2 \\ 3 & 4 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(\,-1\ \ 1\,)$.

2) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(\,0\ \ -2\,)$.

3) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(\,-2\ \ 3\,)$.

4) The matrix is diagonalizable and $\lambda = 5$ is an eigenvalue with eigenvector $(\,-1\ \ 2\,)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(\,1\ \ -1\,)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 30

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=8000-16Q$. On the other hand, the production cost per ton is $C=2000+Q$. In addition, the transportation cost is 5830 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 314 .

2) Profit = 245 .

3) Profit = 454 .

4) Profit = 425 .

5) Profit = 546 .

Exercise 2

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{4 + x + 9x^2 + 6x^3 + 2x^4}{2 + 8x + 8x^2 + 3x^3 + 2x^4}$. Determine the expected cost per unit when a large amount of units is produced.

1) 20 000

2) 0

3) $-\infty$

4) ∞

5) 1

6) $\frac{26}{25}$

7) -1

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-1+e^{x^2}-x^2}{x^3}$

1) $-\frac{2}{3}$

2) 0

3) $-\infty$

4) -1

5) -2

6) 1

7) ∞

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (9+6t)(\sin(2\pi t)+1)$ euros .

Compute the average value of the shares along the first 9 months of the year (between t=0 and t=9).

1) $\frac{1}{9}\left(324-\frac{27}{\pi}\right)$ euros $=$ 35.0451 euros

2) $\frac{1}{9}\left(12-\frac{3}{\pi}\right)$ euros $=$ 1.2272 euros

3) $\frac{1}{9}\left(30-\frac{6}{\pi}\right)$ euros $=$ 3.1211 euros

4) $\frac{1}{9}\left(-6+\frac{3}{\pi}\right)$ euros $=$ -0.5606 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X-\begin{pmatrix}-1 & -3\\ 2 & 5\end{pmatrix}\right).\begin{pmatrix}1 & 1\\ 0 & 1\end{pmatrix}^{-1}=\begin{pmatrix}0 & 4\\ -2 & -3\end{pmatrix}$$

1) $\begin{pmatrix}-1 & *\\ * & *\end{pmatrix}$ 2) $\begin{pmatrix}0 & *\\ * & *\end{pmatrix}$ 3) $\begin{pmatrix}2 & *\\ * & *\end{pmatrix}$ 4) $\begin{pmatrix}* & -2\\ * & *\end{pmatrix}$ 5) $\begin{pmatrix}* & -1\\ * & *\end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$-10\,x_1 + 7\,x_2 + 3\,x_3 - 7\,x_4 - 3\,x_5 == 6$$
$$-4\,x_1 + 3\,x_2 + 5\,x_3 - 3\,x_4 - x_5 == 2$$
$$-3\,x_1 + 2\,x_2 - x_3 - 2\,x_4 - x_5 == 2$$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 8 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 2 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ 2 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -3 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 3 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -13 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -5 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -9 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -7 \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -4 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 3 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 3 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2 \ \ -1)$.

2) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(0 \ \ 1)$.

3) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(0 \ \ 0)$.

4) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(1 \ \ -1)$.

5) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(-2 \ \ 1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle (1,1,-1) \rangle$ and $\lambda=3$ with eigenvectors $\langle (1,0,1) \rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle (1,1,-1),(0,1,1) \rangle$ and $\lambda=3$ with eigenvectors $\langle (1,0,1) \rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle (2,1) \rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 31

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=20000−14Q. On the other hand, the production cost per ton is C=10000+10Q. In addition, the transportation cost is 8224 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 12 328 .

2) Profit = 32 165 .

3) Profit = 14 560 .

4) Profit = 32 856 .

5) Profit = 44 638 .

Exercise 2

The population of certain country (in millions of habitants) is given by the function $P(t) = 39\left(\frac{4-6t-3t^2+4t^3}{-9-8t+4t^2+4t^3}\right)^{-1+4t}$. Determine the future tendency for this population.

1) $-\infty$

2) 0

3) $\frac{39}{e^5}$

4) ∞

5) $\frac{39}{e^7}$

6) 39

7) $\frac{39}{e^4}$

Exercise 3

Compute the limit: $\lim_{x\to 1}\frac{\frac{11}{3}-6x+3x^2-\frac{2x^3}{3}+\text{Log}\left[x^2\right]}{1-4x+6x^2-4x^3+x^4}$

1) ∞

2) -1

3) $-\frac{2}{3}$

4) 1

5) $-\frac{1}{2}$

6) 0

7) $-\infty$

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t)=(6+3t)\,e^{-1+3t}$ euros .

Compute the average value of the shares along the first 6 months of the year (between t=0 and t=6).

1) $\frac{1}{6}\left(\frac{2}{3e^4}-\frac{5}{3e}\right)$ euros = -0.1002 euros

2) $\frac{1}{6}\left(-\frac{5}{3e}+\frac{23e^{17}}{3}\right)$ euros = 3.0865×10^7 euros

3) $\frac{1}{6}\left(-\frac{5}{3e}+\frac{11e^5}{3}\right)$ euros = 90.5947 euros

4) $\frac{1}{6}\left(-\frac{5}{3e}+\frac{8e^2}{3}\right)$ euros = 3.1818 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X-\begin{pmatrix}0 & 1\\ -1 & -3\end{pmatrix}\right).\begin{pmatrix}2 & 3\\ 3 & 5\end{pmatrix}=\begin{pmatrix}0 & 0\\ 14 & 23\end{pmatrix}$$

1) $\begin{pmatrix}-1 & *\\ * & *\end{pmatrix}$ 2) $\begin{pmatrix}1 & *\\ * & *\end{pmatrix}$ 3) $\begin{pmatrix}* & -1\\ * & *\end{pmatrix}$ 4) $\begin{pmatrix}* & 1\\ * & *\end{pmatrix}$ 5) $\begin{pmatrix}* & 2\\ * & *\end{pmatrix}$

Exercise 6

Find the solution of the linear system

$8 x_1 - 8 x_2 - 4 x_3 - 2 x_4 == 8$
$-3 x_1 + 3 x_2 + 4 x_3 + 2 x_4 + x_5 == 0$
$x_1 - x_2 + 2 x_3 + x_4 + x_5 == 4$

taking as parameters, if it is necessary, the
first variables and solving for the last ones (that is to say,
apply Gauss elimination technique selecting columns from right to left)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 8 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 5 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -4 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 7 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -2 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -4 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -3 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -1 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -3 \\ ? \\ ? \end{pmatrix}$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ -6 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -8 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -4 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -3 & 4 \\ -1 & 1 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 4$ is an eigenvalue with eigenvector $(1 \ \ -1)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(2 \ \ -2)$.

3) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2 \ \ 0)$.

4) The matrix is diagonalizable and $\lambda = -4$ is an eigenvalue with eigenvector $(3 \ \ 1)$.

5) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-2 \ \ -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 32

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 2% and in the bank B we are paid a periodic compound interes rate of 5% in 11 periods (compounding frequency). We initially deposit 15 000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **2.***** years.

2) In **3.***** years.

3) In **0.***** years.

4) In **7.***** years.

5) In **9.***** years.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -2\sin(x+1) & x \leq -1 \\ 0 & -1 < x < 0 \\ 2\log(x+1) - 2 & 0 \leq x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 0$.

5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

Exercise 3

Between the months $t = 0$ and $t = 6$, the true value of the shares of a company (in euros) are given by the function $C(t) = 132 - 15t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 2$ and $t = 3$.

1) It oscillates between 42 and 79.

2) It oscillates between 7 and 132.

3) It oscillates between 7 and 132.

4) It oscillates between 51 and 88.

5) It oscillates between 53 and 87.

Exercise 4

Compute the area enclosed by the function $f(x) = -12x - 2x^2 + 2x^3$ and the horizontal axis between the points $x = -3$ and $x = 2$.

1) $\frac{101}{6} = 16.8333$

2) $\frac{9}{2} = 4.5$

3) $\frac{283}{6} = 47.1667$

4) $\frac{149}{3} = 49.6667$

5) $\frac{301}{6} = 50.1667$

6) $\frac{307}{6} = 51.1667$

7) $\frac{155}{6} = 25.8333$

8) $\frac{146}{3} = 48.6667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -2 & a & 1 & 0 \\ 1 & -1 & 0 & 1 \\ -2 & -1 & 0 & -1 \\ -1 & -2 & 1 & -1 \end{pmatrix}$$ has determinant 7?

1) 5 2) 0 3) −2 4) −4 5) 4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(1 + m)x - y + z == -2 - m$
$x + y - z == 0$
$-x + z == 0$

has only a solution. For that solution compute the value of variable y

1) $y = -1$.

2) $y = -7$.

3) $y = 0$.

4) $y = 4$.

5) $y = 3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course, 10% repeat the course and 10% give
The students of course 2: 80% finish the degree and 20% give up the studies.

On the other hand, every year, the amount of students that starts the degree is equivalent to 30% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 47.6834 % in the first course and 52.3166 % in the second course.

2) 2.881 % in the first course and 97.119 % in the second course.

3) 33.3333 % in the first course and 66.6667 % in the second course.

4) 7.521 % in the first course and 92.479 % in the second course.

5) 36.045 % in the first course and 63.955 % in the second course.

6) 12.029 % in the first course and 87.971 % in the second course.

7) 27.978 % in the first course and 72.022 % in the second course.

8) 10.945 % in the first course and 89.055 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 33

Exercise 1

We have a bank account that initially offers a continuous compound rate of 6% , and after 3 years the conditions are modified and then we obtain a compound interes rate of 6% . The initial deposit is 9000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

1) We will have ****3.***** euros.

2) We will have ****7.***** euros.

3) We will have ****0.***** euros.

4) We will have ****2.***** euros.

5) We will have ****1.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to\infty}\left(\frac{-2+3x+8x^2}{-8+5x+8x^2}\right)^{-2+7x}$

1) $-\infty$

2) $\frac{1}{e^5}$

3) $\frac{1}{e^{7/4}}$

4) $\frac{1}{e^3}$

5) 1

6) 0

7) ∞

Exercise 3

Compute the limit: $\lim_{x\to 1}\frac{\frac{11}{3}-6x+3x^2-\frac{2x^3}{3}+\mathrm{Log}\left[x^2\right]}{1-4x+6x^2-4x^3+x^4}$

1) $-\infty$

2) ∞

3) 1

4) 0

5) -1

6) $-\frac{1}{2}$

7) -2

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (1 + 7t)\,e^{1+t}$ euros .

Compute the average value of the shares along the first 5 months of the year (between t=0 and t=5).

1) $\frac{1}{5}(-13 + 6e)$ euros = 0.6619 euros

2) $\frac{1}{5}\left(6e + 8e^{3}\right)$ euros = 35.3988 euros

3) $\frac{1}{5}\left(6e + e^{2}\right)$ euros = 4.7397 euros

4) $\frac{1}{5}\left(6e + 29e^{6}\right)$ euros = 2343.1489 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X - \begin{pmatrix} 2 & -3 \\ -1 & 2 \end{pmatrix}\right) . \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} = \begin{pmatrix} -4 & 3 \\ 3 & -1 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & * \\ -1 & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-3x_1 + 2x_2 - 2x_3 + 5x_4 - 3x_5 == 5$
$-2x_1 + x_2 - 4x_3 + 4x_4 == -5$
$5x_1 - 3x_2 + 6x_3 - 9x_4 + 3x_5 == 0$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -3 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -10 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 1 \end{pmatrix} + \left\langle \begin{pmatrix} -4 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 6 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 4 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix} + \left\langle \begin{pmatrix} -6 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix} + \left\langle \begin{pmatrix} -6 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 24 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 42 & 30 \\ -56 & -40 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-1 \;\; 1)$.

2) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(5 \;\; -7)$.

3) The matrix is diagonalizable and $\lambda = 5$ is an eigenvalue with eigenvector $(0 \;\; -2)$.

4) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(5 \;\; -7)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(3 \;\; -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle (1,1,-1) \rangle$ and $\lambda=3$ with eigenvectors $\langle (1,0,1) \rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle (1,1,-1),(0,1,1) \rangle$ and $\lambda=3$ with eigenvectors $\langle (1,0,1) \rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle (2,1) \rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 34

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	25
2	40
3	53

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 9 .

2) The maximum for the depositis in the account was 11 .

3) The maximum for the depositis in the account was 89 .

4) The maximum for the depositis in the account was 18 .

5) The maximum for the depositis in the account was 73 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -2e^x - 3\sin(x) & x \le 0 \\ 3\sin(x) - 2 & 0 < x < 1 \\ 3\log(x) + 1 & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 1$.

5) The function is continuous for all the points except for $x = 0$ and $x = 1$.

Exercise 3

Between the months $t = 4$ and $t = 9$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 683 + 324\,t - 45\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 4$ and $t = 9$.

1) It oscillates between 1412 and 1439.

2) It oscillates between 1388 and 1443.

3) It oscillates between 1382 and 1446.

4) It oscillates between 1387 and 1439.

5) It oscillates between 1381 and 1446.

Exercise 4

Compute the area enclosed by the function $f(x) = -2x - 3x^2 - x^3$ and the horizontal axis between the points $x = -4$ and $x = 1$.

1) $\frac{83}{4} = 20.75$

2) $\frac{55}{4} = 13.75$

3) $\frac{85}{4} = 21.25$

4) $\frac{87}{4} = 21.75$

5) $\frac{91}{4} = 22.75$

6) $\frac{75}{4} = 18.75$

7) $\frac{93}{4} = 23.25$

8) $\frac{89}{4} = 22.25$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & a & 2 & 1 \\ 2 & -1 & 0 & 1 \\ 1 & 2 & 0 & 0 \\ -2 & 2 & 1 & -2 \end{pmatrix}$$ has determinant -6?

1) 2 2) -5 3) 4 4) 0 5) -4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$m x + (1 - m) y - 2 z == -5 + 2 m$
$2 x - y - 2 z == -1$
$-x + y + z == 0$

has only a solution. For that solution compute the value of variable x

1) $x = 4$.

2) $x = 1$.

3) $x = -9$.

4) $x = 2$.

5) $x = -1$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 30% repeat the course and 10% give
The students of course 2: 70% finish the degree, 20% repeat the course and 10% give up the stuc

On the other hand, every year, the amount of students that
starts the degree is equivalent to 20% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 14.416 % in the first course and 85.584 % in the second course.

2) 13.95 % in the first course and 86.05 % in the second course.

3) 0.247 % in the first course and 99.753 % in the second course.

4) 10.399 % in the first course and 89.601 % in the second course.

5) 40. % in the first course and 60. % in the second course.

6) 3.432 % in the first course and 96.568 % in the second course.

7) 7.026 % in the first course and 92.974 % in the second course.

8) 1.221 % in the first course and 98.779 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 35

Exercise 1

We have two bank accounts, the first in the
bank A and the second in the bank B. In the bank A we obtain a
periodic compound interes rate of 9% in 3 periods (compounding frequency)
and in the bank B we are paid a
periodic compound interes rate of 4% in 12 periods (compounding frequency)
. We initially deposit 2000 euros in the bank A and 6000
in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **6.***** years.

2) In **2.***** years.

3) In **4.***** years.

4) In **3.***** years.

5) In **0.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus.
We have the following information for several years (in millions of euros):

year	funds
0	18
3	27
6	18

Employ an interpolation polynomial to build a function that
yields the funds for each year t. We know that due to the legislation
the funds of such an institution have to be kept between 23 and 26
. Compute (by means of the polynomial obtained before by interpolation) the
periods along which the funds are between the indicated limits inside the
interval of time where we have information (that is to say, from $t=0$ to $t=6$).

1) The funds are inside the limits for the inverval: $[0,5]$.

2) The funds are inside the limits for the inverval: $[2,5]$.

3) The funds are inside the limits for the inverval: $[1,2]$.

4) The funds are inside the limits for the intervals: $[0,1]$ y $[4,5]$.

5) The funds are inside the limits for the inverval: $[5,6]$.

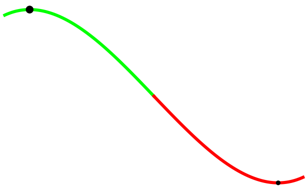
6) The funds are inside the limits for the inverval: $[0,2]$.

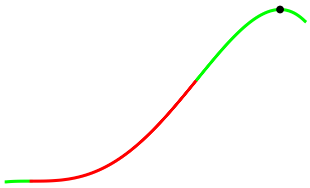
7) The funds are inside the limits for the inverval: $[2,6]$.

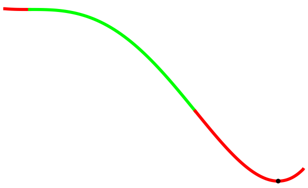
8) The funds are inside the limits for the intervals: $[1,2]$ y $[4,5]$.

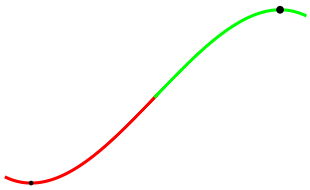
Exercise 3

Study the shape properties of the $f(x) = 3 - 6x^2 + 2x^3$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 1 + t^3 + t^4$ millions of euros/year.

If the initial deposit in the investment fund was 30
millions of euros, compute the depositis available after 3 years.

1) $\frac{2037}{20}$ millions of euros = 101.85 millions of euros

2) $\frac{212}{5}$ millions of euros = 42.4 millions of euros

3) $\frac{1514}{5}$ millions of euros = 302.8 millions of euros

4) $\frac{629}{20}$ millions of euros = 31.45 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} . X + \begin{pmatrix} 2 & -1 \\ -7 & 4 \end{pmatrix} = \begin{pmatrix} 1 & -3 \\ -7 & 3 \end{pmatrix}$$

1) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$x_1 + x_2 - 2x_3 - x_4 == -2$
$-2x_1 - x_2 - 3x_3 - x_4 == -5$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 4 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 6 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} 4 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 2 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -9 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -5 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -2 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 10 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 10 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix}, \begin{pmatrix} -8 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 2 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} 9 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 6 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 6 \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3 \;\; -11) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (-1 \;\; 4) \rangle$

1) $\begin{pmatrix} -12 & 44 \\ -3 & 11 \end{pmatrix}$ 2) $\begin{pmatrix} -12 & -33 \\ 4 & 11 \end{pmatrix}$ 3) $\begin{pmatrix} -12 & -3 \\ 44 & 11 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & -1 \\ 0 & -3 \end{pmatrix}$ 5) $\begin{pmatrix} -12 & 4 \\ -33 & 11 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 36

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=700-17Q. On the other hand, the production cost per ton is C=200+14Q. In addition, the transportation cost is 438 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 50 .

2) Profit = 27 .

3) Profit = 31 .

4) Profit = 18 .

5) Profit = 11 .

Exercise 2

The population of certain country (in millions of habitants) is given by the function $P(t) = 32\left(\frac{7-6t+2t^2}{-2-6t+2t^2}\right)^{-9+6t+8t^2}$. Determine the future tendency for this population.

1) $-\infty$

2) 32

3) $32\,e^{17999/500}$

4) 0

5) ∞

6) $32\,e^{36}$

7) $\frac{32}{e^4}$

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-1+e^{x^2}-x^2}{x^3}$

1) -1

2) ∞

3) -2

4) $-\infty$

5) 1

6) $\frac{1}{2}$

7) 0

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = \sin(-3 + 4t)$ euros .

Compute the average value of the shares along the first 3π months of the year (between $t=0$ and $t=3\pi$).

1) -50 euros

2) 0 euros

3) 20 euros

4) -40 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} . X - \begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 1 & 0 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$2x_1 - x_2 + 4x_3 + 2x_4 + 3x_5 == -5$
$5x_1 + 2x_2 + 5x_3 - x_4 - x_5 == -4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} 5 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 10 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -9 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 3 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -9 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 21 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ -5 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 17 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 19 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -14 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 20 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -2 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -11 \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -4 & 4 \\ -1 & 0 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(0 \ 0)$.

2) The matrix is diagonalizable and $\lambda = 4$ is an eigenvalue with eigenvector $(1 \ 0)$.

3) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-3 \ 0)$.

4) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(2 \ 1)$.

5) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(0 \ 2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 37

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 5% in 2 periods (compounding frequency), and after 2 years the conditions are modified and then we obtain a periodic compound interes rate of 3% in 6 periods (compounding frequency). The initial deposit is 10000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

1) We will have ****4.***** euros.

2) We will have ****3.***** euros.

3) We will have ****5.***** euros.

4) We will have ****8.***** euros.

5) We will have ****6.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to\infty}\left(\frac{-7-9x-x^2}{-6-2x-x^2}\right)^{6+9x}$

1) $\frac{1}{e^3}$

2) 0

3) $\frac{1}{e^5}$

4) $-\infty$

5) ∞

6) 1

7) e^{63}

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-x^2+\mathrm{Sin}[x^2]}{x^3}$

1) ∞

2) -2

3) 0

4) -1

5) 1

6) $-\frac{1}{2}$

7) $-\infty$

Exercise 4

The true value of certain shares oscillates along the year.
 The following function yields the value of the shares for each month t:

$V(t) = 10\, e^{-3+2t}$ euros .

Compute the average value of the shares along the first
 5 months of the year (between t=0 and t=5).

1) $\frac{1}{5}\left(-\frac{5}{e^3}+5\,e^7\right)$ euros = 1096.5834 euros

2) $\frac{1}{5}\left(\frac{5}{e^5}-\frac{5}{e^3}\right)$ euros = -0.043 euros

3) $\frac{1}{5}\left(-\frac{5}{e^3}+5\,e\right)$ euros = 2.6685 euros

4) $\frac{1}{5}\left(-\frac{5}{e^3}+\frac{5}{e}\right)$ euros = 0.3181 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 3 & -2 \\ -1 & 1 \end{pmatrix}.X+\begin{pmatrix} -1 & 1 \\ 0 & -1 \end{pmatrix}=\begin{pmatrix} 0 & 6 \\ 0 & -3 \end{pmatrix}$$

1) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$3\,x_1 + x_2 + 4\,x_3 - 2\,x_4 + 3\,x_5 == 1$$
$$2\,x_1 + x_2 - 2\,x_3 + 3\,x_4 - x_5 == 4$$

taking as parameters, if it is necessary, the
last variables and solving for the first ones (that is to say,
apply Gauss elimination technique selecting columns from left to right)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} -10 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 6 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} -2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 16 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -12 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 12 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ 0 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 14 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -13 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 9 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ 8 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 2 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ 1 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 12 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 12 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -4 & 2 \\ -3 & 1 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(1\ \ 1)$.

2) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-2\ \ 0)$.

3) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(1\ \ 1)$.

4) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-1\ \ 3)$.

5) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-1\ \ -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors $((1,1,-1),(0,1,1)$ and $(1,0,1))$ for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

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Exam-training for serial number: 38

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 10% and in the bank B we are paid a compound interes rate of 6% . We initially deposit 1000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **0.***** years.

2) In **5.***** years.

3) In **7.***** years.

4) In **4.***** years.

5) In **8.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	1
2	-11
5	-74

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between -11 and -2 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from t= 0 to t= 5).

1) The funds are inside the limits for the intervals: [-2 , -1] y [1 , 5] .

2) The funds are inside the limits for the inverval: [1 , 2] .

3) The funds are inside the limits for the inverval: [-2 , -1] .

4) The funds are inside the limits for the inverval: [-1 , 5] .

5) The funds are inside the limits for the inverval: [0 , 2] .

6) The funds are inside the limits for the inverval: [-1 , 0] .

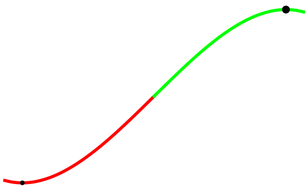
7) The funds are inside the limits for the inverval: [2 , 5] .

8) The funds are inside the limits for the inverval: [-1 , 2] .

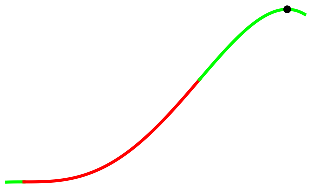
Exercise 3

Study the shape properties of the $f(x) = 4 - 24x - 18x^2 + 3x^4$
to decide which amongst the following ones is the representation of the function.

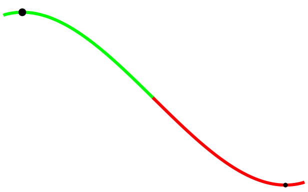
1)



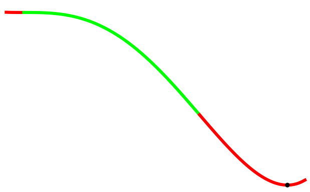
2)



3)



4)



Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 2 + 2t + 3t^4$ millions of euros/year.

If the initial deposit in the investment fund was 90
millions of euros, compute the depositis available after 2 years.

1) $\frac{586}{5}$ millions of euros = 117.2 millions of euros

2) $\frac{1254}{5}$ millions of euros = 250.8 millions of euros

3) $\frac{3642}{5}$ millions of euros = 728.4 millions of euros

4) $\frac{468}{5}$ millions of euros = 93.6 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & -3 \\ 0 & 1 \end{pmatrix} . X + \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} -2 & 5 \\ 1 & 0 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-x_1 + x_2 + 2 x_4 == 2$
$2 x_1 - 3 x_2 - 2 x_3 - x_4 == 1$
$6 x_1 - 10 x_2 - 8 x_3 == 8$

taking as parameters, if it is necessary, the
 last variables and solving for the first ones (that is to say,
 apply Gauss elimination technique selecting columns from left to right)
 . Express the solution by means of linear combinations.

1) $\begin{pmatrix} 7 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 7 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -5 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} -7 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -2 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 5 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 10 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 5 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -9 \end{pmatrix}, \begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -5 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 6 \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (1 \;\; -2), \; (-1 \;\; 3) \rangle$

1) $\begin{pmatrix} -1 & -1 \\ 1 & 2 \end{pmatrix}$ 2) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ 3) $\begin{pmatrix} -1 & -1 \\ 0 & 0 \end{pmatrix}$ 4) $\begin{pmatrix} -1 & 1 \\ 2 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -1 & 3 \\ 2 & -2 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 39

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	−4
1	10
3	26

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 28 .

2) The maximum for the depositis in the account was 26 .

3) The maximum for the depositis in the account was 7 .

4) The maximum for the depositis in the account was −5 .

5) The maximum for the depositis in the account was 4 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 53\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 2000 + 1000 \,\mathrm{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 92000. (the solution can be found for t between 49 and 54).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Between the months $t = 1$ and $t = 7$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 4 + 12t - 9t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 1$ and $t = 2$.

1) It oscillates between 8 and 333.

2) It oscillates between 13 and 5.

3) It oscillates between 8 and 9.

4) It oscillates between −1 and 3.

5) It oscillates between 6 and 6.

Exercise 4

Compute the area enclosed by the function $f(x) = 2x + x^2$
and the horizontal axis between the points $x = -4$ and $x = 4$.

1) $\frac{128}{3} = 42.6667$

2) $\frac{136}{3} = 45.3333$

3) $\frac{145}{3} = 48.3333$

4) $\frac{281}{6} = 46.8333$

5) $\frac{287}{6} = 47.8333$

6) $\frac{142}{3} = 47.3333$

7) $\frac{88}{3} = 29.3333$

8) 32

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} a & 1 & -1 & 2 \\ -2 & -2 & 1 & 1 \\ 1 & 1 & 0 & -1 \\ 0 & -1 & 0 & 2 \end{pmatrix}$ has determinant 5?

1) −1 2) −2 3) 5 4) 4 5) 2

Exercise 6

Determine the values of the parameter , m , for which the linear system

$x + (2 + m)\ y + m\ z == -4 - 2\ m$
$x + y - z == -2$
$-3\ x - 2\ y + 3\ z == 5$

has only a solution. For that solution compute the value of variable z

1) $z = -6$.

2) $z = 8$.

3) $z = 1$.

4) $z = -1$.

5) $z = -9$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 100% pass to the following course.
The students of course 2: 80% finish the degree, 10% repeat the course and 10% give up the stuc

On the other hand, every year, the amount of students that starts the degree is equivalent to 90% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 41.875 % in the first course and 58.125 % in the second course.

2) 31.15 % in the first course and 68.85 % in the second course.

3) 34.168 % in the first course and 65.832 % in the second course.

4) 9.178 % in the first course and 90.822 % in the second course.

5) 44.4444 % in the first course and 55.5556 % in the second course.

6) 27.177 % in the first course and 72.823 % in the second course.

7) 58.8403 % in the first course and 41.1597 % in the second course.

8) 16.45 % in the first course and 83.55 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 40

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 8% and in the bank B we are paid a continuous compound rate of 3%. We initially deposit 1000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **6.***** years.

2) In **2.***** years.

3) In **0.***** years.

4) In **7.***** years.

5) In **4.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	26
2	14
5	41

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 17 and 26. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

1) The funds are inside the limits for the intervals: $[0,1]$ y $[4,5]$.

2) The funds are inside the limits for the inverval: $[0,0]$.

3) The funds are inside the limits for the inverval: $[0,1]$.

4) The funds are inside the limits for the inverval: $[0,3]$.

5) The funds are inside the limits for the inverval: $[3,5]$.

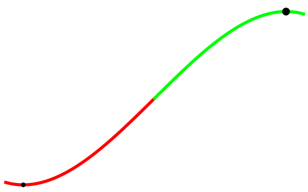
6) The funds are inside the limits for the inverval: $[-1,3]$.

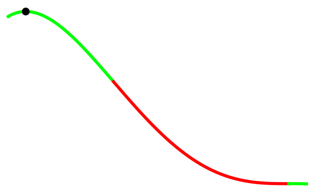
7) The funds are inside the limits for the intervals: $[0,1]$ y $[3,4]$.

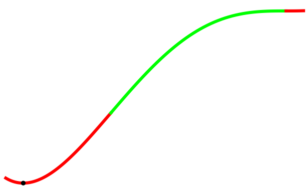
8) The funds are inside the limits for the inverval: $[0,5]$.

Exercise 3

Study the shape properties of the $f(x) = 3 + 24x - 18x^2 + 3x^4$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 2 + t + 3t^3$ millions of euros/year.

If the initial deposit in the investment fund was 80 millions of euros, compute the depositis available after 1 year.

1) 98 millions of euros

2) 288 millions of euros

3) $\frac{333}{4}$ millions of euros = 83.25 millions of euros

4) $\frac{605}{4}$ millions of euros = 151.25 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}^{-1} \cdot \left(X + \begin{pmatrix} 0 & 1 \\ -1 & 2 \end{pmatrix} \right) = \begin{pmatrix} -1 & 1 \\ -2 & 1 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$x_1 + 3 x_2 + x_4 == -1$
$-2 x_1 - 7 x_2 - 6 x_4 == 1$
$-x_1 - 2 x_2 + 3 x_4 == 2$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -3 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -6 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -5 \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ 8 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 2 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} -9 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -10 \end{pmatrix}, \begin{pmatrix} -7 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -9 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 0 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 11 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (1 \;\; 2), (-1 \;\; -1) \rangle$

1) $\begin{pmatrix} -3 & -2 \\ 1 & -2 \end{pmatrix}$ 2) $\begin{pmatrix} -3 & -3 \\ -2 & -3 \end{pmatrix}$ 3) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & 2 \\ -1 & 2 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & -3 \\ 1 & 0 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 41

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interes rate of 3% in 11 periods (compounding frequency) and in the bank B we are paid a compound interes rate of 6%. We initially deposit 5000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **6.***** years.

2) In **7.***** years.

3) In **8.***** years.

4) In **9.***** years.

5) In **0.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
2	10
4	-14
6	-62

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between -14 and 1. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=6$).

1) The funds are inside the limits for the inverval: $[-1, 0]$.

2) The funds are inside the limits for the inverval: $[-2, -1]$.

3) The funds are inside the limits for the inverval: $[4, 6]$.

4) The funds are inside the limits for the inverval: $[3, 4]$.

5) The funds are inside the limits for the inverval: $[-1, 6]$.

6) The funds are inside the limits for the intervals: $[-2, -1]$ y $[3, 6]$.

7) The funds are inside the limits for the inverval: $[0, 4]$.

8) The funds are inside the limits for the inverval: $[-1, 4]$.

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} 2\,e^{x+3} + 3\cos(x+3) - 3 & x \le -3 \\ 2\,(x+4) & -3 < x < -1 \\ 2\sin(x+1) - \cos(x+1) + 7 & -1 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -3$.

4) The function is differentiable for all points except for $x = -1$.

5) The function is differentiable for all points except for $x = -3$ and $x = -1$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}\,(4 + 4\,t)\right)\log(3\,t)$ per-unit.

In the year t=1 we deposint in the account 5000 euros. Compute the deposit in the account after (with respect to t=1) 5 years.

1) 43305.4314 euros

2) 43355.4314 euros

3) 43285.4314 euros

4) 43345.4314 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 2 & 0 & -2 & 1 \\ 1 & -1 & -2 & 3 \\ a & 1 & -2 & -2 \\ 2 & 1 & 1 & -2 \end{pmatrix}$ has determinant -3 ?

1) -1 2) 5 3) 2 4) -5 5) 3

Exercise 6

Determine the values of the parameter , m , for which the linear system

$-3\,x - 3\,y + z == 1$
$(1 + m)\,x - y + z == 1$
$-2\,x - 2\,y + z == 1$

has only a solution.

1) We have unique solution for $m \neq 1$.

2) We have unique solution for $m \geq -5$.

3) We have unique solution for $m \leq 1$.

4) We have unique solution for $m \neq -5$.

5) We have unique solution for $m \geq -1$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 70% finish the degree and 30% repeat the course.

On the other hand, every year, the students, in a way or another,
promote their degree in such a way that for every student in the degree
(for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 12.984 % in the first course and 87.016 % in the second course.

2) 24.058 % in the first course and 75.942 % in the second course.

3) 2.708 % in the first course and 97.292 % in the second course.

4) 65.4724 % in the first course and 34.5276 % in the second course.

5) 2.189 % in the first course and 97.811 % in the second course.

6) 1.126 % in the first course and 98.874 % in the second course.

7) 22.878 % in the first course and 77.122 % in the second course.

8) 7.268 % in the first course and 92.732 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 42

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 3% in 8 periods (compounding frequency), and after 1 year the conditions are modified and then we obtain a periodic compound interes rate of 10% in 3 periods (compounding frequency). The initial deposit is 14 000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

1) We will have ****4.***** euros.

2) We will have ****5.***** euros.

3) We will have ****6.***** euros.

4) We will have ****9.***** euros.

5) We will have ****8.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty} \dfrac{-9-3x-9x^2}{8+4x-6x^2-5x^3}$

1) 0

2) -2

3) -3

4) $-\infty$

5) ∞

6) $-\dfrac{3}{5}$

7) 1

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} \cos(x+1) - 3 & x \le -1 \\ -2\left(x + e^{x+1} - e^3 (x+1) + 1\right) & -1 < x < 2 \\ -2 e^{x-2} - 3\cos(2-x) + 4 e^3 - 1 & 2 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x=-1$.

4) The function is differentiable for all points except for $x=2$.

5) The function is differentiable for all points except for $x=-1$ and $x=2$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{240}(2-3t)\right)e^{2+t}$ per-unit.

The initial deposit in the account is 15000 euros. Compute the deposit after 1 year.

1) 15202.9731 euros

2) 15227.5407 euros

3) 15212.9731 euros

4) 15262.9731 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -1 & 1 & 0 & -2 \\ 1 & 0 & 1 & 2 \\ 1 & -1 & 1 & -1 \\ 0 & 1 & 0 & a \end{pmatrix}$$ has determinant 5 ?

1) −4 2) −5 3) 5 4) −1 5) −2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-2+m)\,x + 2\,y + 2\,z == 2 - 2\,m$
$-x + y + z == 1$
$-x + z == 1$

has only a solution.

1) We have unique solution for $m \neq 0$.

2) We have unique solution for $m \neq -3$.

3) We have unique solution for $m \leq 2$.

4) We have unique solution for $m \neq 3$.

5) We have unique solution for $m \leq 3$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (-3\;\; 4) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (5\;\; -7) \rangle$

1) $\begin{pmatrix} -3 & 0 \\ 0 & -2 \end{pmatrix}$ 2) $\begin{pmatrix} -41 & 70 \\ -24 & 41 \end{pmatrix}$ 3) $\begin{pmatrix} -41 & -30 \\ 56 & 41 \end{pmatrix}$ 4) $\begin{pmatrix} -41 & 56 \\ -30 & 41 \end{pmatrix}$ 5) $\begin{pmatrix} -41 & -24 \\ 70 & 41 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 43

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	205
2	133
4	77

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the minimum funds available in the investment account.

1) The minimum for the depositis in the account was 6.

2) The minimum for the depositis in the account was 5.

3) The minimum for the depositis in the account was 10.

4) The minimum for the depositis in the account was 23.

5) The minimum for the depositis in the account was 7.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 93\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 5000 + 3000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 133000. (the solution can be found for t between 13 and 18).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x-1} - 3\sin(1)\sin(x) - 3\cos(1)\cos(x) + 2 & x \leq 1 \\ x & 1 < x < 2 \\ e^{x-2} + 2\cos(2-x) - 1 & 2 \leq x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 1$.

4) The function is differentiable for all points except for $x = 2$.

5) The function is differentiable for all points except for $x = 1$ and $x = 2$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(-4 - 6t)\right)\cos(t)$ per-unit.

The initial deposit in the account is 13000 euros. Compute the deposit after 3π years.

1) 14687.4591 euros

2) 14657.4591 euros

3) 14727.4591 euros

4) 14577.4591 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & 1 & -1 & 1 \\ 2 & -1 & 1 & 0 \\ a & 2 & 1 & 1 \\ 2 & 1 & 0 & 1 \end{pmatrix}$ has determinant -3 ?

1) 1 2) 4 3) −5 4) 3 5) 5

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-3 + m)x + 2y - z == -10 + 2m$
$-x + y == -3$
$x - 2y + z == 6$

has only a solution.

1) We have unique solution for $m \neq 4$.

2) We have unique solution for $m \leq -1$.

3) We have unique solution for $m \geq 0$.

4) We have unique solution for $m \leq 5$.

5) We have unique solution for $m \neq 3$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle\, (-1 \;\; 1)\, \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle\, (-3 \;\; 2)\, \rangle$

1) $\begin{pmatrix} -3 & -3 \\ 3 & 0 \end{pmatrix}$ 2) $\begin{pmatrix} 2 & 6 \\ -1 & -3 \end{pmatrix}$ 3) $\begin{pmatrix} 2 & 3 \\ -2 & -3 \end{pmatrix}$ 4) $\begin{pmatrix} 2 & -2 \\ 3 & -3 \end{pmatrix}$ 5) $\begin{pmatrix} 2 & -1 \\ 6 & -3 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 44

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 2% in 7 periods (compounding frequency), and after 4 years the conditions are modified and then we obtain a compound interes rate of 1%. The initial deposit is 15000 euros. Compute the amount of money in the account after 10 years from the moment of the first deposit.

1) We will have ****5.***** euros.

2) We will have ****6.***** euros.

3) We will have ****3.***** euros.

4) We will have ****7.***** euros.

5) We will have ****9.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty}\left(\frac{-9-3x-9x^2}{9-4x-9x^2}\right)^{-1-8x+5x^2}$

1) ∞

2) $\frac{1}{e^5}$

3) $-\infty$

4) $\frac{1}{e}$

5) 0

6) 1

7) $\frac{1}{e^4}$

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} -e^{x+1} - \cos(x+1) - 5 & x \le -1 \\ -\frac{1}{2}x(x+4) - \frac{17}{2} & -1 < x < 0 \\ -2e^x + 3\cos(x) - \frac{19}{2} & 0 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x=-1$.

4) The function is differentiable for all points except for $x=0$.

5) The function is differentiable for all points except for $x=-1$ and $x=0$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$$I(t) = \frac{1}{100}\left(t + t^2 + 2\,t^3\right) \text{ per-unit.}$$

The initial deposit in the account is 1000 euros. Compute the deposit after 3 years.

1) 1716.0069 euros

2) 1706.0069 euros

3) 1696.0069 euros

4) 1786.0069 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 0 & 1 & a & 2 \\ 0 & 1 & 2 & 1 \\ 0 & -1 & -2 & -2 \\ 1 & -1 & -2 & -1 \end{pmatrix} \text{ has determinant } 3\,?$$

1) 4 2) −2 3) 2 4) −1 5) −4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$$\begin{aligned} m\,x - y &== -1 - m \\ x + y - z &== -2 \\ -x + z &== 3 \end{aligned}$$

has only a solution.

1) We have unique solution for $m \geq -2$.

2) We have unique solution for $m \leq 3$.

3) We have unique solution for $m \neq 1$.

4) We have unique solution for $m \neq 0$.

5) We have unique solution for $m \neq -3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course and 40% give up the studies.
The students of course 2: 70% finish the degree and 30% repeat the course.

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 2 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 21.046 % in the first course and 78.954 % in the second course.

2) 41.0546 % in the first course and 58.9454 % in the second course.

3) 11.372 % in the first course and 88.628 % in the second course.

4) 14.792 % in the first course and 85.208 % in the second course.

5) 19.435 % in the first course and 80.565 % in the second course.

6) 24.654 % in the first course and 75.346 % in the second course.

7) 23.564 % in the first course and 76.436 % in the second course.

8) 25. % in the first course and 75. % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 45

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	22
3	38
4	40

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account.

1) The maximum for the depositis in the account was 40.

2) The maximum for the depositis in the account was 15.

3) The maximum for the depositis in the account was 4.

4) The maximum for the depositis in the account was 32.

5) The maximum for the depositis in the account was 20.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 53\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 3000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 101000. (the solution can be found for t between 28 and 33).

1) t = **.0****

2) t = **.2****

3) t = **.4****

4) t = **.6****

5) t = **.8****

Exercise 3

Between the months $t=1$ and $t=8$

, the true value of the shares of a company (in euros) are given by the function $C(t)=$ $206+252\,t-39\,t^2+2\,t^3$.

Determine the interval where the value oscillates between the months $t=4$ and $t=7$.

1) It oscillates between 719 and 752.

2) It oscillates between 718 and 746.

3) It oscillates between 421 and 750.

4) It oscillates between 745 and 746.

5) It oscillates between 728 and 750.

Exercise 4

Compute the area enclosed by the function $f(x)=6\,x-2\,x^2$

and the horizontal axis between the points $x=-5$ and $x=3$.

1) $\frac{517}{3}=172.3333$

2) $\frac{508}{3}=169.3333$

3) $\frac{502}{3}=167.3333$

4) $\frac{1031}{6}=171.8333$

5) $\frac{448}{3}=149.3333$

6) $\frac{523}{3}=174.3333$

7) $\frac{511}{3}=170.3333$

8) $\frac{1025}{6}=170.8333$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & 1 & 0 & 0 \\ 2 & -3 & 1 & 1 \\ a & 2 & -1 & 1 \\ 1 & -2 & 3 & 2 \end{pmatrix}$ has determinant 24 ?

1) -4 2) -3 3) 4 4) 3 5) 2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$x + 4y + 3z == 9$
$(1 + m)x + my + mz == -2 + m$
$x + 3y + 2z == 6$

has only a solution. For that solution compute the value of variable z

1) $z = -1$.

2) $z = -9$.

3) $z = 1$.

4) $z = -5$.

5) $z = 2$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course and 30% give up the studies.
The students of course 2: 70% finish the degree and 30% give up the studies.

On the other hand, every year, the amount of students that starts the degree is equivalent to 90% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 17.212 % in the first course and 82.788 % in the second course.

2) 3.798 % in the first course and 96.202 % in the second course.

3) 66.0592 % in the first course and 33.9408 % in the second course.

4) 5.968 % in the first course and 94.032 % in the second course.

5) 33.002 % in the first course and 66.998 % in the second course.

6) 1.926 % in the first course and 98.074 % in the second course.

7) 27.981 % in the first course and 72.019 % in the second course.

8) 13.966 % in the first course and 86.034 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 46

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
2	122
3	172
5	260

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account.

1) The maximum for the depositis in the account was 332.

2) The maximum for the depositis in the account was 0.

3) The maximum for the depositis in the account was 460.

4) The maximum for the depositis in the account was 20.

5) The maximum for the depositis in the account was 15.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 65\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 5000 + 2000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 120000. (the solution can be found for t between 27 and 32).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Between the months $t = 4$ and $t = 10$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 245 + 144\,t - 30\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 4$ and $t = 7$.

1) It oscillates between 466 and 470.

2) It oscillates between 461 and 685.

3) It oscillates between 461 and 469.

4) It oscillates between 464 and 461.

5) It oscillates between 458 and 466.

Exercise 4

Compute the area enclosed by the function $f(x) = -6 - 3\,x + 3\,x^2$
and the horizontal axis between the points $x = -1$ and $x = 3$.

1) $\frac{45}{2} = 22.5$

2) 22

3) 8

4) $\frac{43}{2} = 21.5$

5) 23

6) 21

7) $\frac{41}{2} = 20.5$

8) 19

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -3 & 0 & 1 & 0 \\ 2 & a & 2 & 1 \\ 4 & -1 & -2 & 1 \\ 1 & -1 & 0 & 0 \end{pmatrix}$$ has determinant 8 ?

1) -1 2) 2 3) 5 4) -2 5) -3

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(2+m)\ x+y+2z==4+2m$
$2x+y+z==3$
$2x+z==5$

has only a solution. For that solution compute the value of variable z

1) $z=1$.

2) $z=-5$.

3) $z=-8$.

4) $z=5$.

5) $z=2$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 100% pass to the following course.
The students of course 2: 60% finish the degree, 10% repeat the course and 30% give up the stuc

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 3 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 5.336 % in the first course and 94.664 % in the second course.

2) 34.6196 % in the first course and 65.3804 % in the second course.

3) 18.9189 % in the first course and 81.0811 % in the second course.

4) 7.9 % in the first course and 92.1 % in the second course.

5) 13.452 % in the first course and 86.548 % in the second course.

6) 24.814 % in the first course and 75.186 % in the second course.

7) 26.891 % in the first course and 73.109 % in the second course.

8) 18.718 % in the first course and 81.282 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 47

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interes rate of 4% in 7 periods (compounding frequency) and in the bank B we are paid a continuous compound rate of 8% . We initially deposit 9000 euros in the bank A and 5000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **6.***** years.

2) In **4.***** years.

3) In **9.***** years.

4) In **0.***** years.

5) In **2.***** years.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} \sin(2-x) - e^{x-2} & x \le 2 \\ -3\sin(2-x) - 1 & 2 < x < 4 \\ -2\sin(4-x) & 4 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x=2$.

4) The function is continuous for all the points except for $x=4$.

5) The function is continuous for all the points except for $x=2$ and $x=4$.

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} 2\sin(2-x) + 3\cos(2-x) - 1 & x \le 2 \\ \frac{2}{3}\left((x-7)\,x + 13\right) & 2 < x < 5 \\ 2\,(x-4)\log(x-4) + 6 & 5 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x=2$.

4) The function is differentiable for all points except for $x=5$.

5) The function is differentiable for all points except for $x=2$ and $x=5$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(5 + 7t)\right)(\cos(2\pi t) + 1)$ per-unit.

The initial deposit in the account is 5000 euros. Compute the deposit after 4 years.

1) 10711.3811 euros

2) 10691.3811 euros

3) 10701.3811 euros

4) 10721.3811 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 2 & 1 & 0 & 2 \\ -1 & -2 & 1 & 0 \\ -1 & 1 & 0 & 1 \\ a & 1 & -2 & -2 \end{pmatrix}$ has determinant -10 ?

1) 3 2) -1 3) 2 4) -3 5) -2

Exercise 6

Determine the values of the parameter , m , for which the linear system

$m x + (-2 + m) y - 2 z == 4 - 4 m$
$2 x + 5 y + 2 z == -14$
$-x - 3 y - z == 8$

has only a solution.

1) We have unique solution for $m \geq -5$.

2) We have unique solution for $m \leq 0$.

3) We have unique solution for $m \neq -5$.

4) We have unique solution for $m \neq -2$.

5) We have unique solution for $m \neq 1$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 2 & 3 & -3 \\ 1 & 0 & -1 \\ 3 & 3 & -4 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(1\ 1\ 2)$.

2) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(0\ 2\ -3)$.

3) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(1\ 0\ 1)$.

4) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(1\ 0\ 1)$.

5) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(1\ 1\ -3)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 48

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	20
2	26
3	28

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 10 .

2) The maximum for the depositis in the account was 3 .

3) The maximum for the depositis in the account was 2 .

4) The maximum for the depositis in the account was 15 .

5) The maximum for the depositis in the account was 28 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 52\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 5000 + 3000\,\mathrm{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 95000. (the solution can be found for t between 25 and 30).

1) t = **.0****

2) t = **.2****

3) t = **.4****

4) t = **.6****

5) t = **.8****

Exercise 3

Between the months $t=1$ and $t=6$
, the true value of the shares of a company (in euros) are given by the function $C(t)=121+108\,t-27\,t^2+2\,t^3$.

Determine the interval where the value oscillates between the months $t=1$ and $t=3$.

1) It oscillates between 200 and 261.

2) It oscillates between 229 and 256.

3) It oscillates between 196 and 265.

4) It oscillates between 205 and 253.

5) It oscillates between 204 and 256.

Exercise 4

Compute the area enclosed by the function $f(x)=6\,x+3\,x^2$
and the horizontal axis between the points $x=-5$ and $x=4$.

1) 170

2) 162

3) $\frac{343}{2} = 171.5$

4) 54

5) 173

6) 62

7) $\frac{345}{2} = 172.5$

8) 172

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -1 & 0 \\ a & -1 & 2 & 1 \end{pmatrix}$$ has determinant -6?

1) -1 2) 0 3) 5 4) 1 5) -4

Exercise 6

Determine the values of the parameter , m , for which the linear system

$m x - 2 y + z == -4 + m$
$-x - y + z == -4$
$-x - 2 y + z == -5$

has only a solution. For that solution compute the value of variable x

1) $x = -3$.

2) $x = 1$.

3) $x = 0$.

4) $x = -6$.

5) $x = 8$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 80% finish the degree and 20% give up the studies.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 90% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 20.106 % in the first course and 79.894 % in the second course.

2) 21.107 % in the first course and 78.893 % in the second course.

3) 9.092 % in the first course and 90.908 % in the second course.

4) 18.855 % in the first course and 81.145 % in the second course.

5) 54.7013 % in the first course and 45.2987 % in the second course.

6) 32.291 % in the first course and 67.709 % in the second course.

7) 36.126 % in the first course and 63.874 % in the second course.

8) 11.669 % in the first course and 88.331 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 49

Exercise 1

We have a bank account that initially offers a continuous compound rate of 9% , and after 4 years the conditions are modified and then we obtain a continuous compound rate of 4% . The initial deposit is 13 000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

1) We will have ****3.***** euros.

2) We will have ****7.***** euros.

3) We will have ****8.***** euros.

4) We will have ****9.***** euros.

5) We will have ****5.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to\infty} \frac{8+7x-3x^2}{-5-2x+8x^2}$

1) $-\frac{3}{7}$

2) $-\frac{1}{3}$

3) 1

4) $-\infty$

5) 0

6) ∞

7) $-\frac{3}{8}$

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} 4\cos^2\left(\frac{x+1}{2}\right) & x \le -1 \\ \frac{3}{2}x(x+2) + \frac{11}{2} & -1 < x < 0 \\ 2(x+1)\log(x+1) + \frac{11}{2} & 0 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x=-1$.

4) The function is differentiable for all points except for $x=0$.

5) The function is differentiable for all points except for $x=-1$ and $x=0$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{-3-3t}{1166844}\right) e^{3t}$ per-unit.

The initial deposit in the account is 6000 euros. Compute the deposit after 3 years.

1) 5907.0552 euros

2) 5939.1542 euros

3) 5849.1542 euros

4) 5929.1542 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -1 & a & 0 & 1 \\ 1 & 1 & 0 & 1 \\ 2 & 2 & 1 & 3 \\ 0 & 2 & 1 & 0 \end{pmatrix}$ has determinant 0 ?

1) 1 2) -1 3) -5 4) -4 5) 4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$m x + y == -1 + m$
$-m x - y - z == 2 - m$
$m x + 2 y + z == -3 + m$

has only a solution.

1) We have unique solution for $m \leq 3$.

2) We have unique solution for $m \leq -3$.

3) We have unique solution for $m \neq -2$.

4) We have unique solution for $m \geq -1$.

5) We have unique solution for $m \neq 2$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 10% repeat the course and 30% give
The students of course 2: 100% finish the degree.

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 9 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 2.198 % in the first course and 97.802 % in the second course.

2) 34.2823 % in the first course and 65.7177 % in the second course.

3) 16.761 % in the first course and 83.239 % in the second course.

4) 16.445 % in the first course and 83.555 % in the second course.

5) 26.0274 % in the first course and 73.9726 % in the second course.

6) 25.47 % in the first course and 74.53 % in the second course.

7) 30.474 % in the first course and 69.526 % in the second course.

8) 11.251 % in the first course and 88.749 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 50

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=9000-14Q$. On the other hand, the production cost per ton is $C=1000-6Q$. In addition, the transportation cost is 7568 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 5080 .

2) Profit = 5832 .

3) Profit = 4228 .

4) Profit = 8577 .

5) Profit = 5124 .

Exercise 2

The population of certain country (in millions of habitants) is given by the function $P(t)= 39\left(\frac{-2-5t+5t^2+9t^3}{-7+5t-9t^2+9t^3}\right)^{-5+9t}$. Determine the future tendency for this population.

1) $39\,e^{14}$

2) 39

3) ∞

4) $\frac{39}{e^3}$

5) $\frac{39}{e^4}$

6) 0

7) $-\infty$

Exercise 3

Compute the limit: $\lim_{x\to 1} \frac{3 - 4x + x^2 + \text{Log}[x^2]}{-1 + 3x - 3x^2 + x^3}$

1) $\frac{2}{3}$

2) -1

3) 0

4) $-\infty$

5) ∞

6) $-\frac{1}{3}$

7) 1

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (6 + 6t)\, e^{2+3t}$ euros.

Compute the average value of the shares along the first 6 months of the year (between t=0 and t=6).

1) $\frac{1}{6}\left(-\frac{2}{3e} - \frac{4e^2}{3}\right)$ euros $=$ -1.6829 euros

2) $\frac{1}{6}\left(-\frac{4e^2}{3} + \frac{40e^{20}}{3}\right)$ euros $=$ 1.0781×10^9 euros

3) $\frac{1}{6}\left(-\frac{4e^2}{3} + \frac{16e^8}{3}\right)$ euros $=$ 2648.0984 euros

4) $\frac{1}{6}\left(-\frac{4e^2}{3} + \frac{10e^5}{3}\right)$ euros $=$ 80.8097 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X + \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}\right) . \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} 4 & 1 \\ 2 & 1 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$8 x_1 - 5 x_2 - 5 x_3 - 3 x_4 + 8 x_5 == 10$
$5 x_1 - 3 x_3 - x_4 + 3 x_5 == 4$
$-2 x_1 - 5 x_2 + x_3 - x_4 + 2 x_5 == 2$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -7 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 9 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ 6 \\ ? \end{pmatrix}$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -5 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 8 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 1 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ 5 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -6 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -17 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 3 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 3 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -19 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -3 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 12 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 1 & 1 \\ -4 & -3 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-1 \ \ 2)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(2 \ \ -2)$.

3) The matrix is diagonalizable and $\lambda = -4$ is an eigenvalue with eigenvector $(-1 \ \ 1)$.

4) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(-1 \ \ 2)$.

5) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-2 \ \ 2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 51

Exercise 1

Certain parcel of land is revalued from an initial value of 372 000 euros until a final value of 487 000 euros along 9 years. Determine the rate of continuous compound interes for that revaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) The interest rate is **0.***** %.

2) The interest rate is **3.***** %.

3) The interest rate is **9.***** %.

4) The interest rate is **1.***** %.

5) The interest rate is **2.***** %.

Exercise 2

The population of a city is studied between years t=1 and t=7. In that period the population is given by the function $P(t) = 3 + 120\,t - 42\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between 67 and 93.

1) Along the intervals of years: $[1, 1]$, $[1.18826, 3]$, $[4, 5.81174]$ and $[6.31174, 7]$.

2) Along the interval of years: $[3.11523, 4.]$.

3) Along the intervals of years: $[2., 4.]$ and $[6.45104, 7.50497]$.

4) Along the interval of years: $[4.17932, 5.]$.

5) Along the intervals of years: $[1, 1.18826]$, $[3, 4]$ and $[5.81174, 6.31174]$.

6) Along the intervals of years: $[1., 4.]$ and $[6.78864, 7.]$.

7) Along the interval of years: $[2., 5.]$.

8) Along the interval of years: $[2.41596, 7.]$.

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2\,(\sin(x+2)+2) & x \le -2 \\ -4\,x + 2\sin(x+2) - \cos(x+2) - 11 & -2 < x < 1 \\ 3\cos(1-x) - 15 + 2\sin(3) - \cos(3) & 1 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -2$.

4) The function is differentiable for all points except for $x = 1$.

5) The function is differentiable for all points except for $x = -2$ and $x = 1$.

Exercise 4

Certain bank account offers a variable continuous compound
interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(4 + 2t)\right) \log(t)$ per-unit.

In the year $t=1$ we depposint in the account 13 000
euros. Compute the deposit in the account after (with respect to $t=1$) 5 years.

1) 26210.2429 euros

2) 26200.2429 euros

3) 26240.2429 euros

4) 26180.2429 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 0 & 1 & 0 & 1 \\ -1 & -2 & 2 & 1 \\ 1 & 0 & -1 & 1 \\ -2 & 1 & -1 & a \end{pmatrix}$ has determinant 10 ?

1) 1 2) −3 3) −5 4) 2 5) 3

Exercise 6

Determine the values of the parameter, m, for which the linear system

$-4x + y - 2z == 3$
$(-4 - m)x + y - z == 4 + m$
$x + z == 0$

has only a solution.

1) We have unique solution for $m \neq -2$.

2) We have unique solution for $m \neq -4$.

3) We have unique solution for $m \leq 1$.

4) We have unique solution for $m \leq -3$.

5) We have unique solution for $m \geq -5$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3 \ \ -8) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (-4 \ \ 11) \rangle$

1) $\begin{pmatrix} -33 & -24 \\ 44 & 32 \end{pmatrix}$ 2) $\begin{pmatrix} -2 & -2 \\ 3 & 3 \end{pmatrix}$ 3) $\begin{pmatrix} -33 & 44 \\ -24 & 32 \end{pmatrix}$ 4) $\begin{pmatrix} -33 & -12 \\ 88 & 32 \end{pmatrix}$ 5) $\begin{pmatrix} -33 & 88 \\ -12 & 32 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 52

Exercise 1

We have a bank account that initially offers a compound interes rate of 3% , and after 3 years the conditions are modified and then we obtain a continuous compound rate of 7% . The initial deposit is 9000 euros. Compute the amount of money in the account after 5 years from the moment of the first deposit.

1) We will have ****0.***** euros.

2) We will have ****3.***** euros.

3) We will have ****5.***** euros.

4) We will have ****2.***** euros.

5) We will have ****8.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty} -1-8x-2x^2-6x^3$

1) 2

2) 0

3) $-\infty$

4) 1

5) -1

6) -9

7) ∞

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-1+\mathrm{Cos}\left[x^2\right]}{x^4}$

1) $-\infty$

2) ∞

3) $-\frac{1}{2}$

4) 1

5) 0

6) $\frac{1}{3}$

7) $-\frac{1}{3}$

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = 1 + 3t^2 + t^3$ euros .

Compute the average value of the shares along the first 5 months of the year (between t=0 and t=5).

1) $\frac{201}{20}$ euros = 10.05 euros

2) $\frac{14}{5}$ euros = 2.8 euros

3) $\frac{229}{4}$ euros = 57.25 euros

4) $\frac{9}{20}$ euros = 0.45 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X - \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}\right) \cdot \begin{pmatrix} 1 & 1 \\ -2 & -1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$$

1) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-2 x_1 + x_2 + 4 x_3 + x_4 - 3 x_5 == -4$
$x_1 - x_2 - 2 x_3 - x_4 + x_5 == 5$
$3 x_1 - x_2 - 6 x_3 - x_4 + 5 x_5 == 3$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 0 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} -2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -4 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} -2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 4 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} -2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}$

5) $\begin{pmatrix} ? \\ ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 4 & -10 \\ 3 & -7 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(2\ 0)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(2\ 1)$.

3) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(2\ 1)$.

4) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2\ -2)$.

5) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-2\ -2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 53

Exercise 1

We have one bank account that offers a compound interes rate of 5% where we initially deposit 9000 euros. How long time is it necessary until the amount of money in the account reaches 15 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **1.***** years.

2) In **4.***** years.

3) In **9.***** years.

4) In **7.***** years.

5) In **0.***** years.

Exercise 2

The population of certain type of rodents is analyzed in a region between years $t=1$ and $t=7$. Along that period the population is given by the function $P(t) = 9 + 180t - 48t^2 + 4t^3$ (thousands of rodents). Determine the intervals of years during which the number of rodents is between 209 and 225.

1) Along the intervals of years: $[1.30026, 3.]$ and $[5., 6.10425]$.

2) Along the interval of years: $[3.22094, 5.]$.

3) Along the interval of years: $[5., 6.]$.

4) Along the intervals of years: $[1, 2]$, $[3, 3]$, $[5, 5]$ and $[6, 7]$.

5) Along the interval of years: $[2, 6]$.

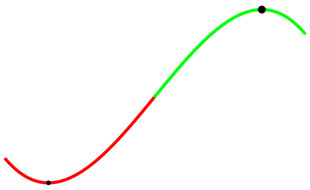
6) Along the intervals of years: $[1.58384, 4.77862]$ and $[5., 7.]$.

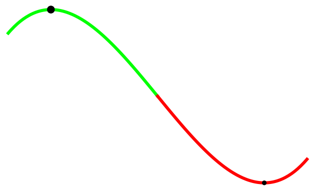
7) Along the interval of years: $[1.79137, 4.]$.

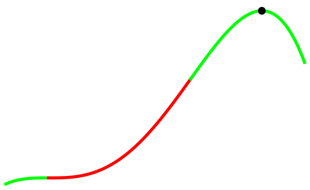
8) Along the intervals of years: $[3.17156, 4.53728]$ and $[5., 6.]$.

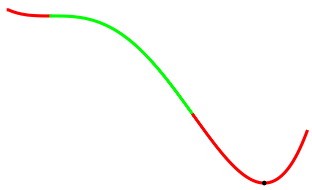
Exercise 3

Study the shape properties of the $f(x) = 2 - 24x + 30x^2 - 16x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points -2, -1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 20\, e^{3t}$ millions of euros/year.

If the initial deposit in the investment fund was 90 millions of euros, compute the depositis available after 1 year.

1) $\frac{250}{3} + \frac{20}{3\, e^3}$ millions of euros = 83.6652 millions of euros

2) $\frac{250}{3} + \frac{20\, e^9}{3}$ millions of euros = 54103.8929 millions of euros

3) $\frac{250}{3} + \frac{20\, e^6}{3}$ millions of euros = 2772.8586 millions of euros

4) $\frac{250}{3} + \frac{20\, e^3}{3}$ millions of euros = 217.2369 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X + \begin{pmatrix} 5 & 3 \\ 3 & 2 \end{pmatrix}\right) \cdot \begin{pmatrix} 3 & -1 \\ -2 & 1 \end{pmatrix} = \begin{pmatrix} 6 & -1 \\ 5 & -1 \end{pmatrix}$$

1) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-x_1 + 5\,x_3 - 3\,x_4 == -10$
$-5\,x_1 + 3\,x_3 - 2\,x_4 == -5$
$4\,x_1 + 2\,x_3 - x_4 == -5$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -22 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 0 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 5 \end{pmatrix}, \begin{pmatrix} ? \\ -6 \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -14 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 3 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ 7 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 8 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -4 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 9 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 0 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -15 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (1 \;\; -3) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (2 \;\; -5) \rangle$

1) $\begin{pmatrix} 11 & -6 \\ 20 & -11 \end{pmatrix}$ 2) $\begin{pmatrix} 11 & 4 \\ -30 & -11 \end{pmatrix}$ 3) $\begin{pmatrix} 11 & -30 \\ 4 & -11 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & 0 \\ 2 & 0 \end{pmatrix}$ 5) $\begin{pmatrix} 11 & 20 \\ -6 & -11 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 54

Exercise 1

We have a bank account that initially offers a continuous compound rate of 4%
, and after 3 years the conditions are modified and then we obtain a
periodic compound interes rate of 1% in 8 periods (compounding frequency)
. The initial deposit is 9000 euros. Compute the amount of money in the account after
3 years from the moment of the first deposit.

1) We will have ****7.***** euros.

2) We will have ****0.***** euros.

3) We will have ****1.***** euros.

4) We will have ****3.***** euros.

5) We will have ****6.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty} -7 - 8x - 3x^2 - 3x^3 + 2x^4$

1) -8

2) -4

3) 0

4) ∞

5) $-\infty$

6) -5

7) 1

Exercise 3

Compute the limit: $\lim_{x\to 0}\dfrac{-1 + e^{x^2} - x^2}{x^3}$

1) -1

2) $-\frac{1}{2}$

3) 0

4) $-\frac{2}{3}$

5) $-\infty$

6) 1

7) ∞

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (7 + t)\sin(4t)$ euros.

Compute the average value of the shares along the first 3π months of the year (between $t=0$ and $t=3\pi$).

1) $-\frac{1}{12}$ euros $=$ -0.0833 euros

2) $-\frac{1}{6}$ euros $=$ -0.1667 euros

3) $-\frac{1}{4}$ euros $=$ -0.25 euros

4) $\frac{1}{12}$ euros $=$ 0.0833 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 1 \\ -3 & -2 \end{pmatrix} . \left(X - \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \right) = \begin{pmatrix} 0 & -1 \\ 0 & 3 \end{pmatrix}$$

1) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-x_1 - 2\,x_2 + 5\,x_3 - 2\,x_4 + x_5 == 5$
$x_1 + x_2 - 4\,x_3 + 4\,x_4 - 4\,x_5 == 5$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} 13 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -5 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -2 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} 15 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -6 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 7 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ -1 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -7 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -5 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ 0 \\ ? \\ ? \end{pmatrix}$

5) $\begin{pmatrix} 2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -3 & 1 \\ -2 & 0 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-2\ 0)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(1\ 1)$.

3) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-2\ 1)$.

4) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(1\ 2)$.

5) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(3\ -2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 55

Exercise 1

We have one bank account that offers a periodic compound interes rate of 4% in 9 periods (compounding frequency) where we initially deposit 11 000 euros. How long time is it necessary until the amount of money in the account reaches 16 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **9.***** years.

2) In **4.***** years.

3) In **6.***** years.

4) In **5.***** years.

5) In **0.***** years.

Exercise 2

The population of a city is studied between years t=1 and t=9. In that period the population is given by the function $P(t) = 6 + 144 t - 42 t^2 + 4 t^3$. Determine the intervals of years when the population is between 518 and 1246.

1) Along the interval of years: [2.77778, 8.].

2) Along the interval of years: [8, 9].

3) Along the interval of years: [5.13631, 6.].

4) Along the intervals of years: [5.19895, 6.07337] and [7., 8.].

5) Along the interval of years: [1., 5.37056].

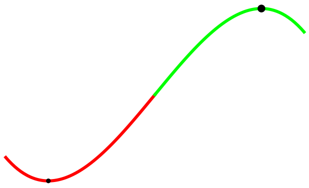
6) Along the interval of years: [3.22694, 7.].

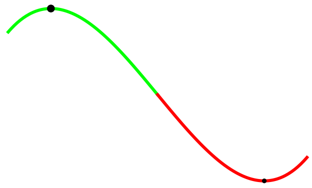
7) Along the intervals of years: [1, 8] and [9, 9].

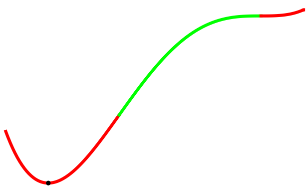
8) Along the interval of years: [2., 6.].

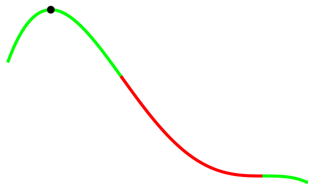
Exercise 3

Study the shape properties of the $f(x) = 1 - 3x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 20\, e^{-1+2t}$ millions of euros/year.

If the initial deposit in the investment fund was 60 millions of euros, compute the depositis available after 3 years.

1) $60 + \frac{10}{e^3} - \frac{10}{e}$ millions of euros = 56.8191 millions of euros

2) $60 - \frac{10}{e} + 10\, e$ millions of euros = 83.504 millions of euros

3) $60 - \frac{10}{e} + 10\, e^3$ millions of euros = 257.1766 millions of euros

4) $60 - \frac{10}{e} + 10\, e^5$ millions of euros = 1540.4528 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & -1 \\ 1 & 0 \end{pmatrix}^{-1} \cdot \left(X - \begin{pmatrix} -3 & -5 \\ 2 & 3 \end{pmatrix} \right) = \begin{pmatrix} -3 & -4 \\ -7 & -8 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$x_1 - 5x_2 + 2x_3 - 3x_4 == -4$
$4x_1 + 4x_2 + 3x_3 - 5x_4 == 9$
$-5x_1 + x_2 - 5x_3 + 8x_4 == -5$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 9 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -2 \\ ? \end{pmatrix}, \begin{pmatrix} 6 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 34 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 10 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 26 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -47 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 7 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 37 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ -7 \end{pmatrix}$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3\ \ 1), (-7\ \ -2) \rangle$

1) $\begin{pmatrix} -1 & -2 \\ -1 & -1 \end{pmatrix}$ 2) $\begin{pmatrix} -1 & -3 \\ -1 & 3 \end{pmatrix}$ 3) $\begin{pmatrix} 0 & -3 \\ 3 & -3 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & 2 \\ -3 & -2 \end{pmatrix}$ 5) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 56

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 10% in 10 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a compound interes rate of 10%. The initial deposit is 10 000 euros. Compute the amount of money in the account after 7 years from the moment of the first deposit.

1) We will have ****6.***** euros.

2) We will have ****8.***** euros.

3) We will have ****7.***** euros.

4) We will have ****5.***** euros.

5) We will have ****3.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty} \dfrac{2-9x+4x^2}{-9-4x+3x^2-6x^3}$

1) $-\infty$

2) 1

3) 0

4) $-\dfrac{3}{8}$

5) $-\dfrac{1}{4}$

6) -1

7) ∞

Exercise 3

Compute the limit: $\lim_{x\to 1}\dfrac{\frac{11}{3}-6x+3x^2-\frac{2x^3}{3}+\mathrm{Log}[x^2]}{1-4x+6x^2-4x^3+x^4}$

1) $-\frac{1}{2}$

2) $-\infty$

3) 1

4) 0

5) $\frac{1}{3}$

6) ∞

7) -2

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (2+9t)\,e^{-3+3t}$ euros .

Compute the average value of the shares along the first
5 months of the year (between t=0 and t=5).

1) $\frac{1}{5}\left(\frac{1}{3e^3}+\frac{17e^3}{3}\right)$ euros = 22.7669 euros

2) $\frac{1}{5}\left(-\frac{10}{3e^6}+\frac{1}{3e^3}\right)$ euros = 0.0017 euros

3) $\frac{1}{5}\left(\frac{8}{3}+\frac{1}{3e^3}\right)$ euros = 0.5367 euros

4) $\frac{1}{5}\left(\frac{1}{3e^3}+\frac{44e^{12}}{3}\right)$ euros = 477414.0581 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix}1 & -1\\ 1 & 0\end{pmatrix}.\left(X-\begin{pmatrix}3 & 2\\ 4 & 3\end{pmatrix}\right)=\begin{pmatrix}1 & 0\\ -4 & -2\end{pmatrix}$$

1) $\begin{pmatrix}-2 & *\\ * & *\end{pmatrix}$ 2) $\begin{pmatrix}0 & *\\ * & *\end{pmatrix}$ 3) $\begin{pmatrix}1 & *\\ * & *\end{pmatrix}$ 4) $\begin{pmatrix}* & 0\\ * & *\end{pmatrix}$ 5) $\begin{pmatrix}* & -1\\ * & *\end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$-4\,x_1 + 7\,x_2 + 5\,x_3 - 2\,x_4 + 8\,x_5 == -7$$
$$-x_1 + 2\,x_2 + 5\,x_5 == -5$$
$$-3\,x_1 + 5\,x_2 + 5\,x_3 - 2\,x_4 + 3\,x_5 == -2$$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 0 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 5 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -12 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} -10 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -7 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ -6 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -7 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ -16 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -6 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -17 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ -10 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -10 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2\ \ 1)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-1\ \ 2)$.

3) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(3\ \ 4)$.

4) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(0\ \ 1)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(0\ \ -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 57

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	51
2	101
3	147

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account.

1) The maximum for the depositis in the account was 17.

2) The maximum for the depositis in the account was 14.

3) The maximum for the depositis in the account was -5.

4) The maximum for the depositis in the account was 261.

5) The maximum for the depositis in the account was 389.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 63\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 3000 + 1000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 95000. (the solution can be found for t between 38 and 43).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Between the months $t=4$ and $t=10$
, the true value of the shares of a company (in euros) are given by the function $C(t)=$
$787+360\,t-48\,t^2+2\,t^3$.

Determine the interval where the value oscillates between the months $t=5$ and $t=6$.

1) It oscillates between 1587 and 1651.

2) It oscillates between 1643 and 1647.

3) It oscillates between 1638 and 1647.

4) It oscillates between 1637 and 1651.

5) It oscillates between 1587 and 1651.

Exercise 4

Compute the area enclosed by the function $f(x)=4\,x+2\,x^2$
and the horizontal axis between the points $x=-5$ and $x=1$.

1) $\frac{269}{6}=44.8333$

2) $\frac{257}{6}=42.8333$

3) 36

4) $\frac{124}{3}=41.3333$

5) $\frac{130}{3}=43.3333$

6) $\frac{136}{3}=45.3333$

7) $\frac{92}{3}=30.6667$

8) $\frac{133}{3}=44.3333$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & 1 & -5 & 3 \\ a & 2 & 2 & 1 \\ 2 & 0 & -3 & 2 \\ -1 & 0 & 5 & -3 \end{pmatrix}$ has determinant -11 ?

1) 2 2) 5 3) 1 4) 4 5) -4

Exercise 6

Determine the values of the parameter , m , for which the linear system

$-x - y + (-2 + m)\, z == 6 - 2\, m$
$y + z == -4$
$-x + z == -2$

has only a solution. For that solution compute the value of variable y

1) $y = -9$.

2) $y = -3$.

3) $y = 7$.

4) $y = 0$.

5) $y = -2$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course and 30% give up the studies.
The students of course 2: 60% finish the degree and 40% repeat the course.

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 5 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 1.856 % in the first course and 98.144 % in the second course.

2) 8.649 % in the first course and 91.351 % in the second course.

3) 14.619 % in the first course and 85.381 % in the second course.

4) 21.457 % in the first course and 78.543 % in the second course.

5) 12.622 % in the first course and 87.378 % in the second course.

6) 2.303 % in the first course and 97.697 % in the second course.

7) 24.2641 % in the first course and 75.7359 % in the second course.

8) 0 % in the first course and 100. % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 58

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	25
2	15
3	9

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the minimum funds available in the investment account .

1) The minimum for the depositis in the account was 7 .

2) The minimum for the depositis in the account was 2 .

3) The minimum for the depositis in the account was 9 .

4) The minimum for the depositis in the account was 5 .

5) The minimum for the depositis in the account was 4 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 65\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 3000 + 2000\,\text{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 114000. (the solution can be found for t between 50 and 55).

1) t = **.0****

2) t = **.2****

3) t = **.4****

4) t = **.6****

5) t = **.8****

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} -2\,e^{x-1} - \cos(1-x) - 1 & x \leq 1 \\ (x-4)\,x - 1 & 1 < x < 2 \\ 2\cos(2-x) - 7 & 2 \leq x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 1$.

4) The function is differentiable for all points except for $x = 2$.

5) The function is differentiable for all points except for $x = 1$ and $x = 2$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{2-3t}{12532113}\right) e^{3+3t}$ per-unit.

The initial deposit in the account is 4000 euros. Compute the deposit after 3 years.

1) 3897.4353 euros

2) 3937.4353 euros

3) 3967.4353 euros

4) 3977.4353 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -1 & 1 & -1 & 1 \\ 2 & a & 2 & 1 \\ 0 & 1 & 2 & -1 \\ 1 & 1 & 0 & 0 \end{pmatrix}$ has determinant 9 ?

1) 4 2) 0 3) 5 4) 1 5) -4

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-2+m)\,x - y - z == 2 - m$
$-x + y == 1$
$-x + 2\,y + z == 1$

has only a solution.

1) We have unique solution for $m \neq 2$.

2) We have unique solution for $m \geq 0$.

3) We have unique solution for $m \neq 5$.

4) We have unique solution for $m \neq 1$.

5) We have unique solution for $m \geq 1$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 30% repeat the course and 10% give
The students of course 2: 60% finish the degree and 40% repeat the course.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 80% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 2.933 % in the first course and 97.067 % in the second course.

2) 14.375 % in the first course and 85.625 % in the second course.

3) 0.707 % in the first course and 99.293 % in the second course.

4) 11.553 % in the first course and 88.447 % in the second course.

5) 21.871 % in the first course and 78.129 % in the second course.

6) 11.879 % in the first course and 88.121 % in the second course.

7) 16.62 % in the first course and 83.38 % in the second course.

8) 51.7926 % in the first course and 48.2074 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 59

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	45
2	83
4	147

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account.

1) The maximum for the depositis in the account was 2.

2) The maximum for the depositis in the account was 11.

3) The maximum for the depositis in the account was 245.

4) The maximum for the depositis in the account was 7.

5) The maximum for the depositis in the account was 195.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 60\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 2000 + 1000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 95000. (the solution can be found for t between 20 and 25).

1) $t = **.1****$

2) $t = **.3****$

3) $t = **.5****$

4) $t = **.7****$

5) $t = **.9****$

Exercise 3

Between the months $t = 2$ and $t = 6$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 9 + 72 t - 24 t^2 + 2 t^3$.

Determine the interval where the value oscillates between the months $t = 3$ and $t = 5$.

1) It oscillates between 20 and 65.

2) It oscillates between 9 and 73.

3) It oscillates between 9 and 73.

4) It oscillates between 21 and 57.

5) It oscillates between 19 and 63.

Exercise 4

Compute the area enclosed by the function $f(x) = -6 x - 3 x^2$ and the horizontal axis between the points $x = 0$ and $x = 3$.

1) 57

2) $\frac{111}{2} = 55.5$

3) 60

4) $\frac{117}{2} = 58.5$

5) 56

6) 58

7) $\frac{115}{2} = 57.5$

8) 54

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -2 & 1 & -1 & 0 \\ 0 & -1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ a & 2 & 1 & 0 \end{pmatrix}$$ has determinant 3 ?

1) -1 2) -2 3) -4 4) 2 5) 3

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-3+m)\ x-y+z==-3+2\ m$
$x+y==1$
$-2\ x+z==-2$

has only a solution. For that solution compute the value of variable x

1) $x=7$.

2) $x=0$.

3) $x=-4$.

4) $x=2$.

5) $x=9$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course, 10% repeat the course and 10% give
The students of course 2: 70% finish the degree, 20% repeat the course and 10% give up the stuc

On the other hand, every year, the amount of students that
starts the degree is equivalent to 60% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 22.244 % in the first course and 77.756 % in the second course.

2) 7.519 % in the first course and 92.481 % in the second course.

3) 44.6222 % in the first course and 55.3778 % in the second course.

4) 17.974 % in the first course and 82.026 % in the second course.

5) 10.239 % in the first course and 89.761 % in the second course.

6) 10.946 % in the first course and 89.054 % in the second course.

7) 25.194 % in the first course and 74.806 % in the second course.

8) 26.304 % in the first course and 73.696 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 60

Exercise 1

Certain parcel of land is devalued from an initial value of 386 000 euros until a final value of 115 000 euros along 6 years. Determine the rate of continuous compound interes for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) The interest rate is **9.***** %.

2) The interest rate is **4.***** %.

3) The interest rate is **0.***** %.

4) The interest rate is **1.***** %.

5) The interest rate is **2.***** %.

Exercise 2

The population of a city is studied between years t=1 and t=10. In that period the population is given by the function $P(t) = 8 + 480t - 78t^2 + 4t^3$. Determine the intervals of years when the population is between 918 and 944.

1) Along the intervals of years: [2.33182, 4.68452] and [9.10958, 10.].

2) Along the intervals of years: [3.68826, 4.18826], [6, 7] and [8.81174, 9.31174].

3) Along the interval of years: [6., 9.].

4) Along the intervals of years: [1, 3.68826], [4.18826, 6], [7, 8.81174] and [9.31174, 10].

5) Along the intervals of years: [1.31535, 2.01362] and [3.2698, 8.].

6) Along the interval of years: [4.49487, 10.].

7) Along the interval of years: [3.55987, 5.].

8) Along the intervals of years: [1., 2.] and [5., 10.5813].

Exercise 3

Study the differentiability of the function f(x) =

$$f(x)=\begin{cases} -2\sin(x+2) - 3\cos(x+2) + 4 & x \le -2 \\ 2e^3(x+2) - 2e^{x+2} + (x+2)(2+3\sin(3)) + 3\cos(x+2) & -2 < x < 1 \\ -2\sin(1-x) - 2\cos(1-x) + 4e^3 + 8 + 9\sin(3) + 3\cos(3) & 1 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x = −2.

4) The function is differentiable for all points except for x = 1.

5) The function is differentiable for all points except for x = −2 and x = 1.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}\left(-6 - t\right)\right)\cos(4\,t)$ per-unit.

The initial deposit in the account is 14 000 euros. Compute the deposit after $3\,\pi$ years.

1) 13 990 euros

2) 13 950 euros

3) 13 930 euros

4) 14 000 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & 1 & -1 & -2 \\ -2 & 1 & -1 & a \\ 3 & 0 & 1 & -2 \\ -2 & -1 & 1 & -1 \end{pmatrix}$$ has determinant -8 ?

1) -2 2) -5 3) -3 4) 5 5) 2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(2 + m)\,x + y + m\,z == 6 + m$
$x + y == 4$
$-x - y + z == -5$

has only a solution.

1) We have unique solution for $m \leq 1$.

2) We have unique solution for $m \neq -3$.

3) We have unique solution for $m \geq -3$.

4) We have unique solution for $m \neq 1$.

5) We have unique solution for $m \leq -4$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3\ \ 2) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (1\ \ 1) \rangle$

1) $\begin{pmatrix} -3 & 6 \\ -1 & 2 \end{pmatrix}$ 2) $\begin{pmatrix} -3 & -1 \\ -1 & 3 \end{pmatrix}$ 3) $\begin{pmatrix} -3 & -2 \\ 3 & 2 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & -1 \\ 6 & 2 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & 3 \\ -2 & 2 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 61

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=1300−19Q. On the other hand, the production cost per ton is C=900−4Q. In addition, the transportation cost is 370 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 5 .

2) Profit = 9 .

3) Profit = 21 .

4) Profit = 15 .

5) Profit = 24 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -e^{x} - \sin(x) & x \le 0 \\ -1 & 0 < x < 2 \\ -3\sin(2-x) - \cos(2-x) & 2 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for x= 0 .

4) The function is continuous for all the points except for x= 2 .

5) The function is continuous for all the points except for x= 0 and x= 2 .

Exercise 3

Between the months t= 3 and t= 10
, the true value of the shares of a company (in euros) are given by the function $C(t) = 478 + 270t - 42t^2 + 2t^3$.

Determine the interval where the value oscillates between the months t= 7 and t= 9 .

1) It oscillates between 964 and 1028.

2) It oscillates between 964 and 1028.

3) It oscillates between 954 and 997.

4) It oscillates between 964 and 996.

5) It oscillates between 968 and 995.

Exercise 4

Compute the area enclosed by the function $f(x) = 6 + 3x - 6x^2 - 3x^3$ and the horizontal axis between the points $x = -3$ and $x = 1$.

1) 22

2) 0

3) 20

4) $\frac{41}{2} = 20.5$

5) $\frac{43}{2} = 21.5$

6) $\frac{37}{2} = 18.5$

7) $\frac{5}{2} = 2.5$

8) 16

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 0 & -2 & 1 & 1 \\ 1 & 2 & 0 & 1 \\ 1 & 1 & -1 & 1 \\ 1 & a & 1 & 2 \end{pmatrix}$ has determinant -4?

1) 5 2) 2 3) 4 4) 3 5) 1

Exercise 6

Determine the values of the parameter, m, for which the linear system

$-x - y + z == -2$
$-x + y == 0$
$-m x - y + z == -1 - m$

has only a solution. For that solution compute the value of variable z

1) $z = 0$.

2) $z = -8$.

3) $z = -6$.

4) $z = -1$.

5) $z = 1$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 10% repeat the course and 30% give
The students of course 2: 60% finish the degree, 30% repeat the course and 10% give up the stuc

On the other hand, every year, the amount of students that starts the degree is equivalent to 60% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 14.836 % in the first course and 85.164 % in the second course.

2) 58.1139 % in the first course and 41.8861 % in the second course.

3) 4.8 % in the first course and 95.2 % in the second course.

4) 20.682 % in the first course and 79.318 % in the second course.

5) 3.715 % in the first course and 96.285 % in the second course.

6) 26.319 % in the first course and 73.681 % in the second course.

7) 11.526 % in the first course and 88.474 % in the second course.

8) 7.963 % in the first course and 92.037 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 62

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 2% and in the bank B we are paid a periodic compound interes rate of 7% in 8 periods (compounding frequency). We initially deposit 11000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **4.***** years.

2) In **0.***** years.

3) In **8.***** years.

4) In **1.***** years.

5) In **9.***** years.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 3\sin(x) - e^x & x \le 0 \\ -1 & 0 < x < 1 \\ \log(x) - 1 & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 1$.

5) The function is continuous for all the points except for $x = 0$ and $x = 1$.

Exercise 3

Between the months $t = 0$ and $t = 7$, the true value of the shares of a company (in euros) are given by the function $C(t) = 69 - 12t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 0$ and $t = 3$.

1) It oscillates between 8 and 77.

2) It oscillates between 5 and 69.

3) It oscillates between 5 and 167.

4) It oscillates between 14 and 61.

5) It oscillates between 15 and 69.

Exercise 4

Compute the area enclosed by the function $f(x) = 3x - 3x^3$ and the horizontal axis between the points $x = -1$ and $x = 3$.

1) 53

2) $\frac{103}{2} = 51.5$

3) $\frac{93}{2} = 46.5$

4) 48

5) 52

6) 51

7) $\frac{99}{2} = 49.5$

8) $\frac{105}{2} = 52.5$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & -1 & 0 & 0 \\ -1 & 0 & -1 & -2 \\ -2 & 1 & -1 & a \\ 1 & 0 & 0 & -2 \end{pmatrix}$ has determinant -5?

1) -5 2) 2 3) 1 4) -4 5) 3

Exercise 6

Determine the values of the parameter, m, for which the linear system

$x + y + (-1 - m) z == -3 - 2m$
$x + 2y + z == -1$
$x + y + z == 1$

has only a solution. For that solution compute the value of variable y

1) $y = -5$.

2) $y = 7$.

3) $y = -2$.

4) $y = -7$.

5) $y = 2$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course, 10% repeat the course and 10% give
The students of course 2: 80% finish the degree and 20% repeat the course.

On the other hand, every year, the amount of students that starts the degree is equivalent to 70% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 17.93 % in the first course and 82.07 % in the second course.

2) 10.089 % in the first course and 89.911 % in the second course.

3) 11.755 % in the first course and 88.245 % in the second course.

4) 5.917 % in the first course and 94.083 % in the second course.

5) 58.0323 % in the first course and 41.9677 % in the second course.

6) 5.309 % in the first course and 94.691 % in the second course.

7) 6.081 % in the first course and 93.919 % in the second course.

8) 14.096 % in the first course and 85.904 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 63

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	0
1	22
3	54

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 6 .

2) The maximum for the depositis in the account was 7 .

3) The maximum for the depositis in the account was 70 .

4) The maximum for the depositis in the account was −1 .

5) The maximum for the depositis in the account was 72 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 55\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 3000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 84000. (the solution can be found for t between 35 and 40).

1) t = **.0****

2) t = **.2****

3) t = **.4****

4) t = **.6****

5) t = **.8****

Exercise 3

Between the months $t = 2$ and $t = 8$, the true value of the shares of a company (in euros) are given by the function $C(t) = 54 + 84t - 27t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 6$ and $t = 7$.

1) It oscillates between 5 and 130.

2) It oscillates between −4 and 20.

3) It oscillates between 5 and 18.

4) It oscillates between 6 and 17.

5) It oscillates between 5 and 130.

Exercise 4

Compute the area enclosed by the function $f(x) = 2x + 2x^2$ and the horizontal axis between the points $x = -3$ and $x = 0$.

1) $\frac{29}{3} = 9.6667$

2) $\frac{38}{3} = 12.6667$

3) $\frac{73}{6} = 12.1667$

4) $\frac{35}{3} = 11.6667$

5) $\frac{67}{6} = 11.1667$

6) $\frac{44}{3} = 14.6667$

7) $\frac{85}{6} = 14.1667$

8) $\frac{41}{3} = 13.6667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 2 & 2 & -1 & 2 \\ 1 & 0 & -1 & 0 \\ 1 & 1 & 0 & 1 \\ 0 & 2 & 1 & a \end{pmatrix}$$ has determinant 6?

1) 2 2) 3 3) −2 4) −4 5) 1

Exercise 6

Determine the values of the parameter , m , for which the linear system

$m x - y + m z == -m$
$y + z == -2$
$m x - 3 y + (-1 + m) z == 2 - m$

has only a solution. For that solution compute the value of variable x

1) $x = 1$.

2) $x = -2$.

3) $x = 0$.

4) $x = 8$.

5) $x = -7$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 100% pass to the following course.
The students of course 2: 70% finish the degree, 10% repeat the course and 20% give up the stuc

On the other hand, every year, the amount of students that starts the degree is equivalent to 90% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 20.455 % in the first course and 79.545 % in the second course.

2) 15.915 % in the first course and 84.085 % in the second course.

3) 47.3684 % in the first course and 52.6316 % in the second course.

4) 13.415 % in the first course and 86.585 % in the second course.

5) 14.557 % in the first course and 85.443 % in the second course.

6) 8.426 % in the first course and 91.574 % in the second course.

7) 14.965 % in the first course and 85.035 % in the second course.

8) 1.197 % in the first course and 98.803 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 64

Exercise 1

We have two bank accounts, the first in the
bank A and the second in the bank B. In the bank A we obtain a
compound interes rate of 10% and in the bank B we are paid a
continuous compound rate of 2%. We initially deposit
3000 euros in the bank A and 7000
in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **1.***** years.

2) In **0.***** years.

3) In **5.***** years.

4) In **3.***** years.

5) In **9.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus.
We have the following information for several years (in millions of euros):

year	funds
2	-21
4	-33
8	15

Employ an interpolation polynomial to build a function that
yields the funds for each year t. We know that due to the legislation
the funds of such an institution have to be kept between -6 and 33
. Compute (by means of the polynomial obtained before by interpolation) the
periods along which the funds are between the indicated limits inside the
interval of time where we have information (that is to say, from $t=2$ to $t=8$).

1) The funds are inside the limits for the inverval: $[7, 8]$.

2) The funds are inside the limits for the inverval: $[0, 8]$.

3) The funds are inside the limits for the inverval: $[1, 8]$.

4) The funds are inside the limits for the inverval: $[-2, 4]$.

5) The funds are inside the limits for the inverval: $[0, 7]$.

6) The funds are inside the limits for the inverval: $[-1, 3]$.

7) The funds are inside the limits for the inverval: $[-1, 7]$.

8) The funds are inside the limits for the inverval: $[8, 8]$.

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} e^{x+3} - 2\cos(x+3) + 5 & x \le -3 \\ 2x + 2e^{x+3} - 2e^3(x+3) + 3x\sin(3) + 3\cos(x+3) + 5 + 9\sin(3) & -3 < x < 0 \\ 2e^x - 2\cos(x) - 4e^3 + 5 + 9\sin(3) + 3\cos(3) & 0 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -3$.

4) The function is differentiable for all points except for $x = 0$.

5) The function is differentiable for all points except for $x = -3$ and $x = 0$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \frac{1}{13} e^{-6+2t}$ per-unit.

The initial deposit in the account is 5000 euros. Compute the deposit after 3 years.

1) 5245.5584 euros

2) 5206.7927 euros

3) 5195.5584 euros

4) 5175.5584 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & -2 & a & 1 \\ -1 & 1 & -1 & 2 \\ 1 & 0 & 2 & 0 \\ 0 & 0 & -2 & 1 \end{pmatrix}$ has determinant -13 ?

1) 0 2) −3 3) 3 4) 4 5) 5

Exercise 6

Determine the values of the parameter , m , for which the linear system

$$\begin{aligned} (5+m)x + 2y - 3z &= -12 - 2m \\ 2x + y - 2z &= -6 \\ -x + z &= 4 \end{aligned}$$

has only a solution.

1) We have unique solution for $m \neq -1$.

2) We have unique solution for $m \ge 1$.

3) We have unique solution for $m \le 2$.

4) We have unique solution for $m \le 0$.

5) We have unique solution for $m \neq -5$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 10% repeat the course and 30% give
The students of course 2: 80% finish the degree, 10% repeat the course and 10% give up the stuc

On the other hand, every year, the students, in a way or another,
promote their degree in such a way that for every 3 student in the degree
(for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 20.276 % in the first course and 79.724 % in the second course.

2) 3.083 % in the first course and 96.917 % in the second course.

3) 10.368 % in the first course and 89.632 % in the second course.

4) 17.789 % in the first course and 82.211 % in the second course.

5) 27.667 % in the first course and 72.333 % in the second course.

6) 10.123 % in the first course and 89.877 % in the second course.

7) 51.7657 % in the first course and 48.2343 % in the second course.

8) 28.862 % in the first course and 71.138 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 65

Exercise 1

We have one bank account that offers a periodic compound interes rate of 2% in 6 periods (compounding frequency) where we initially deposit 11 000 euros. How long time is it necessary until the amount of money in the account reaches 18 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **7.***** years.

2) In **2.***** years.

3) In **0.***** years.

4) In **4.***** years.

5) In **3.***** years.

Exercise 2

The population of a city is studied between years t=1 and t=9. In that period the population is given by the function $P(t) = 6 + 216\,t - 54\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between 236 and 262.

1) Along the intervals of years: [1.07081, 4.] and [5., 9.45593].

2) Along the interval of years: [3., 6.79121].

3) Along the intervals of years: [1.68826, 2.18826], [4, 5] and [6.81174, 7.31174].

4) Along the intervals of years: [2.21169, 6.] and [7.76865, 8.45843].

5) Along the intervals of years: [2.59977, 5.52691] and [7., 9.].

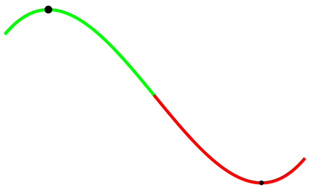
6) Along the intervals of years: [2., 5.] and [7.25977, 8.47747].

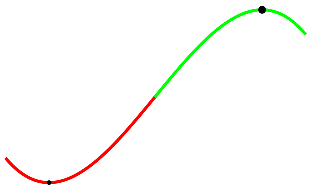
7) Along the interval of years: [1., 3.].

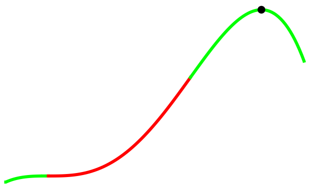
8) Along the intervals of years: [1, 1.68826], [2.18826, 4], [5, 6.81174] and [7.31174, 9].

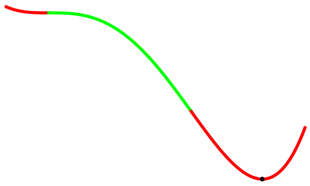
Exercise 3

Study the shape properties of the $f(x) = 5 - 24x + 30x^2 - 16x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 30\,e^{3+t}$ millions of euros/year.

If the initial deposit in the investment fund was 50
millions of euros, compute the depositis available after 3 years.

1) $50 + 30\,e^2 - 30\,e^3$ millions of euros = −330.8944 millions of euros

2) $50 - 30\,e^3 + 30\,e^5$ millions of euros = 3899.8287 millions of euros

3) $50 - 30\,e^3 + 30\,e^4$ millions of euros = 1085.3784 millions of euros

4) $50 - 30\,e^3 + 30\,e^6$ millions of euros = 11550.2977 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X - \begin{pmatrix} 0 & -1 \\ 1 & -1 \end{pmatrix}\right) \cdot \begin{pmatrix} 2 & -1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 4 & -1 \\ 2 & 0 \end{pmatrix}$$

1) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & * \\ 0 & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-4x_1 - 2x_2 + 3x_3 - x_4 == 2$
$2x_1 + x_2 - 2x_3 + x_4 == -4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 3 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 7 \\ ? \end{pmatrix}$

3) $\begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 0 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (5 \;\; -13) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (-8 \;\; 21) \rangle$

1) $\begin{pmatrix} -3 & 0 \\ -2 & -1 \end{pmatrix}$ 2) $\begin{pmatrix} -105 & -65 \\ 168 & 104 \end{pmatrix}$ 3) $\begin{pmatrix} -105 & 168 \\ -65 & 104 \end{pmatrix}$ 4) $\begin{pmatrix} -105 & 273 \\ -40 & 104 \end{pmatrix}$ 5) $\begin{pmatrix} -105 & -40 \\ 273 & 104 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 66

Exercise 1

We have one bank account that offers a compound interes rate of 3% where we initially deposit 11 000 euros. How long time is it necessary until the amount of money in the account reaches 15 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **4.***** years.

2) In **0.***** years.

3) In **3.***** years.

4) In **1.***** years.

5) In **2.***** years.

Exercise 2

The population of a city is studied between years $t=1$ and $t=9$. In that period the population is given by the function $P(t)=4+144t-48t^2+4t^3$. Determine the intervals of years when the population is between 68 and 112.

1) Along the intervals of years: $[3., 4.20031]$ and $[7.75372, 9.]$.

2) Along the intervals of years: $[2.37012, 3.]$ and $[4., 5.22123]$.

3) Along the interval of years: $[1., 3.]$.

4) Along the intervals of years: $[1, 1]$, $[1.1459, 3]$, $[4, 7.4641]$ and $[7.8541, 9]$.

5) Along the intervals of years: $[1, 1.1459]$, $[3, 4]$ and $[7.4641, 7.8541]$.

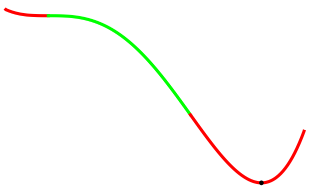
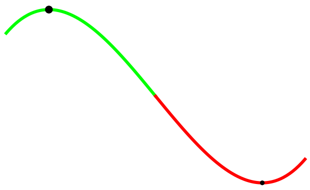
6) Along the interval of years: $[2., 9.]$.

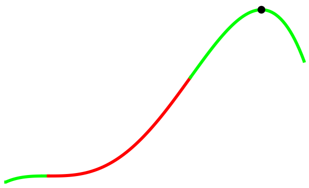
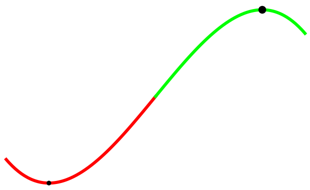
7) Along the intervals of years: $[1.34144, 5.7353]$ and $[8.61922, 9.]$.

8) Along the interval of years: $[1., 9.]$.

Exercise 3

Study the shape properties of the $f(x) = 4 + 48x + 48x^2 + 20x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1)  2) 

3)  4) 

● Big point: maximum	• Small point: minimum
Red line: convexity	Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 20\, e^{-3+t}$ millions of euros/year.

If the initial deposit in the investment fund was 20
millions of euros, compute the depositis available after 3 years.

1) $20 - \frac{20}{e^3} + \frac{20}{e^2}$ millions of euros = 21.711 millions of euros

2) $20 + \frac{20}{e^4} - \frac{20}{e^3}$ millions of euros = 19.3706 millions of euros

3) $40 - \frac{20}{e^3}$ millions of euros = 39.0043 millions of euros

4) $20 - \frac{20}{e^3} + \frac{20}{e}$ millions of euros = 26.3618 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X - \begin{pmatrix} 7 & -2 \\ -3 & 1 \end{pmatrix}\right) \cdot \begin{pmatrix} 4 & -7 \\ -1 & 2 \end{pmatrix}^{-1} = \begin{pmatrix} -10 & -34 \\ 7 & 24 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$3\,x_1 - 3\,x_2 - 3\,x_3 - 8\,x_4 == -2$
$-2\,x_1 + 5\,x_2 - x_3 - 3\,x_4 == 4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 3 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -4 \end{pmatrix}, \begin{pmatrix} ? \\ 1 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 5 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ 3 \end{pmatrix}$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ -14 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 25 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -49 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ 39 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 24 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 21 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 28 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 20 \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (1\ \ 2),\ (1\ \ 3) \rangle$

1) $\begin{pmatrix} -2 & -3 \\ 0 & 0 \end{pmatrix}$ 2) $\begin{pmatrix} 1 & 2 \\ -2 & 2 \end{pmatrix}$ 3) $\begin{pmatrix} 2 & -1 \\ -2 & 2 \end{pmatrix}$ 4) $\begin{pmatrix} -1 & -1 \\ 2 & 0 \end{pmatrix}$ 5) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 67

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
2	99
4	63
5	48

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the minimum funds available in the investment account .

1) The minimum for the depositis in the account was 19 .

2) The minimum for the depositis in the account was 24 .

3) The minimum for the depositis in the account was 12 .

4) The minimum for the depositis in the account was -1 .

5) The minimum for the depositis in the account was 3 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 97\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 3000 + 2000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 129000. (the solution can be found for t between 10 and 15).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2\sin(3-x) - 2\cos(3-x) + 3 & x \le 3 \\ -e^3 (x-3) + e^{x-3} - x + 2x\sin(3) + 2\cos(3-x) + 1 - 6\sin(3) & 3 < x < 6 \\ \sin(6-x) + 3\cos(6-x) - 2e^3 - 8 + 6\sin(3) + 2\cos(3) & 6 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 3$.

4) The function is differentiable for all points except for $x = 6$.

5) The function is differentiable for all points except for $x = 3$ and $x = 6$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{-2 + 3t}{1200}\right) e^{-1+2t}$ per-unit.

The initial deposit in the account is 16 000 euros. Compute the deposit after 2 years.

1) 16347.0532 euros

2) 16437.0532 euros

3) 16417.0532 euros

4) 16387.0532 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -1 & 3 & 3 & -2 \\ 1 & -1 & -2 & 2 \\ -1 & 1 & 2 & a \\ 1 & -4 & -3 & -1 \end{pmatrix}$$ has determinant 0 ?

1) −2 2) 0 3) 5 4) 2 5) −1

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-3 + m)\, x - y - z == -2 + m$

$m\, x + y == m$

$x + y + z == 0$

has only a solution.

1) We have unique solution for $m \neq -1$.

2) We have unique solution for $m \neq 5$.

3) We have unique solution for $m \geq -2$.

4) We have unique solution for $m \leq 5$.

5) We have unique solution for $m \neq 2$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -2 & 2 & 0 \\ -1 & 1 & 0 \\ -1 & 1 & 0 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(1\ 1\ 1)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-2\ 0\ 0)$.

3) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(-1\ -2\ 2)$.

4) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(2\ 3\ 1)$.

5) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(1\ 1\ 0)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 68

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=5000-14Q. On the other hand, the production cost per ton is C=3000-4Q. In addition, the transportation cost is 1860 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 350 .

2) Profit = 828 .

3) Profit = 252 .

4) Profit = 490 .

5) Profit = 677 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 3\sin(x+1) - e^{x+1} & x \le -1 \\ -3\sin(x+1) + \cos(x+1) - 2 & -1 < x < 1 \\ \sin(1-x) + 2\cos(1-x) & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for x= -1 .

4) The function is continuous for all the points except for x= 1 .

5) The function is continuous for all the points except for x= -1 and x= 1 .

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} 1 - 2e^{x-2} & x \le 2 \\ \frac{3x^2}{2} - 8x + 9 & 2 < x < 4 \\ 2(x-3)\log(x-3) + 1 & 4 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x= 2 .

4) The function is differentiable for all points except for x= 4 .

5) The function is differentiable for all points except for x= 2 and x= 4 .

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(5 + 6t)\right)\cos(9t)$ per-unit.

The initial deposit in the account is 12 000 euros. Compute the deposit after 2π years.

1) 12 000 euros

2) 11 990 euros

3) 12 010 euros

4) 12 040 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 0 & 0 & 1 & 2 \\ 2 & 3 & -1 & 0 \\ 1 & 2 & 0 & -2 \\ -2 & 1 & 1 & a \end{pmatrix}$$ has determinant 29 ?

1) −3 2) 2 3) 5 4) 1 5) −5

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-5 + m)\, x - y - 3 z == -9 + 2 m$
$3 x + y + 2 z == 6$
$4 x + y + 3 z == 7$

has only a solution.

1) We have unique solution for $m \leq 3$.

2) We have unique solution for $m \geq -3$.

3) We have unique solution for $m \neq 0$.

4) We have unique solution for $m \neq 1$.

5) We have unique solution for $m \neq -1$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 20% repeat the course and 10% give
The students of course 2: 70% finish the degree, 20% repeat the course and 10% give up the stuc

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 2 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 56.0374 % in the first course and 43.9626 % in the second course.

2) 4.968 % in the first course and 95.032 % in the second course.

3) 20.496 % in the first course and 79.504 % in the second course.

4) 33.978 % in the first course and 66.022 % in the second course.

5) 34.9 % in the first course and 65.1 % in the second course.

6) 30.678 % in the first course and 69.322 % in the second course.

7) 4.639 % in the first course and 95.361 % in the second course.

8) 25.59 % in the first course and 74.41 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 69

Exercise 1

We have a bank account that initially offers a compound interes rate of 2% , and after 3 years the conditions are modified and then we obtain a continuous compound rate of 3% . The initial deposit is 15 000 euros. Compute the amount of money in the account after 9 years from the moment of the first deposit.

1) We will have ****3.***** euros.

2) We will have ****7.***** euros.

3) We will have ****0.***** euros.

4) We will have ****2.***** euros.

5) We will have ****6.***** euros.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 2\,e^{x+1} + 2\sin(x+1) & x \leq -1 \\ -x - 1 & -1 < x < 0 \\ \sin(x) & 0 \leq x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 0$.

5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

Exercise 3

Between the months $t = 2$ and $t = 9$, the true value of the shares of a company (in euros) are given by the function $C(t) = 48 + 72\,t - 24\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 6$ and $t = 9$.

1) It oscillates between 48 and 210.

2) It oscillates between 48 and 112.

3) It oscillates between 39 and 203.

4) It oscillates between 47 and 212.

5) It oscillates between 50 and 219.

Exercise 4

Compute the area enclosed by the function $f(x) = -12x - 10x^2 - 2x^3$ and the horizontal axis between the points $x = -5$ and $x = -2$.

1) $\frac{137}{3} = 45.6667$

2) $\frac{131}{3} = 43.6667$

3) $\frac{277}{6} = 46.1667$

4) $\frac{81}{2} = 40.5$

5) $\frac{253}{6} = 42.1667$

6) $\frac{271}{6} = 45.1667$

7) $\frac{265}{6} = 44.1667$

8) $\frac{140}{3} = 46.6667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & 2 & 1 & 1 \\ -1 & a & 1 & 0 \\ 0 & -1 & 0 & 1 \\ -1 & -2 & 0 & -2 \end{pmatrix}$ has determinant -6 ?

1) -5 2) 5 3) 4 4) 1 5) -4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-1 + m)\, x - y + z == 3 - 2m$
$-x + y + z == -1$
$-x + z == 1$

has only a solution. For that solution compute the value of variable z

1) $z = 4$.

2) $z = 0$.

3) $z = -1$.

4) $z = 2$.

5) $z = 8$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course and 30% repeat the course.
The students of course 2: 70% finish the degree, 10% repeat the course and 20% give up the stuc

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 2 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 4.136 % in the first course and 95.864 % in the second course.

2) 25.727 % in the first course and 74.273 % in the second course.

3) 10.466 % in the first course and 89.534 % in the second course.

4) 6.737 % in the first course and 93.263 % in the second course.

5) 26.411 % in the first course and 73.589 % in the second course.

6) 50. % in the first course and 50. % in the second course.

7) 36.409 % in the first course and 63.591 % in the second course.

8) 24.047 % in the first course and 75.953 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 70

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
0	298
1	252
3	172

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the minimum funds available in the investment account .

1) The minimum for the depositis in the account was -2 .

2) The minimum for the depositis in the account was 10 .

3) The minimum for the depositis in the account was 12 .

4) The minimum for the depositis in the account was 108 .

5) The minimum for the depositis in the account was -9 .

Exercise 2

Study the continuity of the function $f(x) =$

$$\begin{cases} 2\,e^{x} - 3\sin(x) & x \leq 0 \\ -3\sin(x) - 2\cos(x) - 2 + 3\sin(3) + 2\cos(3) & 0 < x < 3 \\ \sin(3-x) - 2\cos(3-x) & 3 \leq x \end{cases}$$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 3$.

5) The function is continuous for all the points except for $x = 0$ and $x = 3$.

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} -\cos(2-x) - 5 & x \leq 2 \\ 2\,e^{3}\,(x-2) - 2\,e^{x-2} - 2x + 3x\sin(3) + 3\cos(2-x) - 3 - 6\sin(3) & 2 < x < 5 \\ -2\,e^{x-5} + 3\cos(5-x) + 4\,e^{3} - 14 + 9\sin(3) + 3\cos(3) & 5 \leq x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 2$.

4) The function is differentiable for all points except for $x = 5$.

5) The function is differentiable for all points except for $x = 2$ and $x = 5$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \frac{1}{10}\cos(-3+9t)$ per-unit.

The initial deposit in the account is 1000 euros. Compute the deposit after 4π years.

1) 1010 euros

2) 1090 euros

3) 920 euros

4) 1000 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 0 & a & 2 & 1 \\ 0 & -2 & 1 & 3 \\ -1 & 0 & -2 & -4 \\ 1 & -1 & 0 & -3 \end{pmatrix}$ has determinant 33 ?

1) -5 2) 2 3) 4 4) 5 5) 0

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-2+m)\,x - y + z == -4 + 2\,m$
$-x + y == -1$
$x - 2\,y + z == 1$

has only a solution.

1) We have unique solution for $m \geq -2$.

2) We have unique solution for $m \neq 5$.

3) We have unique solution for $m \leq 4$.

4) We have unique solution for $m \neq 3$.

5) We have unique solution for $m \neq 2$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -8 & -14 & -6 \\ 2 & 4 & 2 \\ 6 & 10 & 4 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(1\ 0\ -1)$.

2) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-1\ 1\ -1)$.

3) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-2\ -2\ -2)$.

4) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-2\ 0\ -1)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(1\ -3\ 0)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, $(1,1,-1)$ and $(1,0,1)$) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, $\lambda=1$ with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and $\lambda=3$ with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ($(1,1,-1)$, $(0,1,1)$ and $(1,0,1)$) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only $(2,1)$ but also the rest of its linear combinations (as $(4,2)=2(2,1)$, $(6,3)=3(2,1)$, etc.) although they are not independent with $(2,1)$.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 71

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=15000−17Q. On the other hand, the production cost per ton is C=7000−12Q. In addition, the transportation cost is 7780 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 1027 .

2) Profit = 1442 .

3) Profit = 1093 .

4) Profit = 3445 .

5) Profit = 2420 .

Exercise 2

From an initial deposit 10000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) = 10000\left(\frac{-8-3t+8t^2}{-7+6t+8t^2}\right)^{9-6t+4t^2}$. Determine the future tendency for the deposits that we will have after a large number of years.

1) 0

2) ∞

3) $10000\, e^2$

4) $10000\, e$

5) $-\infty$

6) $\frac{10000}{e^3}$

7) 10000

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-x^2+\text{Sin}[x^2]}{x^4}$

1) -1

2) $-\frac{2}{3}$

3) $-\infty$

4) -2

5) 1

6) ∞

7) 0

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = 20\, e^{3+3t}$ euros.

Compute the average value of the shares along the first 6 months of the year (between t=0 and t=6).

1) $\frac{1}{6}\left(-\frac{20\, e^3}{3}+\frac{20\, e^9}{3}\right)$ euros $=$ 8981.1093 euros

2) $\frac{1}{6}\left(-\frac{20\, e^3}{3}+\frac{20\, e^{21}}{3}\right)$ euros $=$ 1.4654×10^9 euros

3) $\frac{1}{6}\left(-\frac{20\, e^3}{3}+\frac{20\, e^6}{3}\right)$ euros $=$ 425.937 euros

4) $\frac{1}{6}\left(\frac{20}{3}-\frac{20\, e^3}{3}\right)$ euros $=$ -21.2062 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}.X.\begin{pmatrix}3 & 1\\ -1 & 0\end{pmatrix}=\begin{pmatrix}-2 & -1\\ -1 & 0\end{pmatrix}$$

1) $\begin{pmatrix}0 & *\\ * & *\end{pmatrix}$ 2) $\begin{pmatrix}1 & *\\ * & *\end{pmatrix}$ 3) $\begin{pmatrix}-1 & *\\ * & *\end{pmatrix}$ 4) $\begin{pmatrix}* & -2\\ * & *\end{pmatrix}$ 5) $\begin{pmatrix}* & 0\\ * & *\end{pmatrix}$

Exercise 6

Find the solution of the linear system

$-7 x_1 + 7 x_2 + x_3 - x_4 - 2 x_5 == 5$
$5 x_1 - 2 x_2 + x_3 + 2 x_4 + 3 x_5 == -2$
$2 x_1 - 5 x_2 - 2 x_3 - x_4 - x_5 == -3$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 7 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix}, \begin{pmatrix} 10 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -9 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 8 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -18 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 2 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ 11 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 11 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 12 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 3 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -5 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -8 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} -2 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 12 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 14 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 4 \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 7 & 4 \\ -9 & -5 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-2 \;\; 2)$.

2) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(2 \;\; -3)$.

3) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(-1 \;\; 0)$.

4) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(2 \;\; -3)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(-1 \;\; -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle (1,1,-1) \rangle$ and λ=3 with eigenvectors $\langle (1,0,1) \rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle (1,1,-1),(0,1,1) \rangle$ and λ=3 with eigenvectors $\langle (1,0,1) \rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle (2,1) \rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 72

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=50000−16Q. On the other hand, the production cost per ton is C=20000+4Q. In addition, the transportation cost is 28680 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 9930 .

2) Profit = 21 780 .

3) Profit = 15 451 .

4) Profit = 34 517 .

5) Profit = 8398 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -\sin(x+1) & x \le -1 \\ x+1 & -1 < x < 0 \\ e^{x} + \sin(x) & 0 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 0$.

5) The function is continuous for all the points except for $x = -1$ and $x = 0$.

Exercise 3

Between the months $t = 3$ and $t = 10$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 1202 + 540\,t - 57\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 7$ and $t = 9$.

1) It oscillates between 2363 and 2903.

2) It oscillates between 2875 and 2903.

3) It oscillates between 2868 and 2894.

4) It oscillates between 2875 and 2907.

5) It oscillates between 2902 and 2903.

Exercise 4

Compute the area enclosed by the function $f(x) = -8 + 8x + 2x^2 - 2x^3$ and the horizontal axis between the points $x = 0$ and $x = 3$.

1) $\frac{89}{6} = 14.8333$

2) $\frac{17}{6} = 2.8333$

3) $\frac{95}{6} = 15.8333$

4) $\frac{101}{6} = 16.8333$

5) $\frac{46}{3} = 15.3333$

6) $\frac{21}{2} = 10.5$

7) $\frac{77}{6} = 12.8333$

8) $\frac{49}{3} = 16.3333$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 2 & 1 & -1 & -2 \\ -1 & -1 & 1 & 0 \\ 1 & 1 & 1 & a \\ -1 & 0 & 1 & 2 \end{pmatrix}$ has determinant -1?

1) -5 2) -2 3) 2 4) 1 5) -1

Exercise 6

Determine the values of the parameter, m, for which the linear system

$m x - y + z == 2 m$
$(-3 + m) x + 2 y - z == -4 + 2 m$
$x - y + z == 2$

has only a solution. For that solution compute the value of variable y

1) $y = -7$.

2) $y = 2$.

3) $y = 5$.

4) $y = 7$.

5) $y = 4$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 80% finish the degree and 20% give up the studies.

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 3 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 51.5933 % in the first course and 48.4067 % in the second course.

2) 34.808 % in the first course and 65.192 % in the second course.

3) 25.213 % in the first course and 74.787 % in the second course.

4) 27.982 % in the first course and 72.018 % in the second course.

5) 34.762 % in the first course and 65.238 % in the second course.

6) 30.205 % in the first course and 69.795 % in the second course.

7) 7.707 % in the first course and 92.293 % in the second course.

8) 22.644 % in the first course and 77.356 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 73

Exercise 1

We have one bank account that offers a compound interes rate of 4% where we initially deposit 11000 euros. How long time is it necessary until the amount of money in the account reaches 20000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **0.***** years.

2) In **1.***** years.

3) In **2.***** years.

4) In **7.***** years.

5) In **5.***** years.

Exercise 2

The deposits in certain account between the months t=1 and t=9 is given by the function $C(t) = 7 + 192\,t - 60\,t^2 + 4\,t^3$. Determine the months for which the deposit is between −217 and 71 euros.

1) Along the intervals of months: [2.74604, 4.] and [6., 7.] .

2) Along the intervals of months: [2.21694, 4.] and [7., 9.] .

3) Along the intervals of months: [1.0508, 2.] and [5., 9.] .

4) Along the intervals of months: [2., 3.7936] and [4.15934, 5.] .

5) Along the interval of months: [6., 8.78202] .

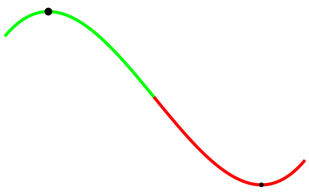
6) Along the intervals of months: [4, 7] and [8.89898, 9] .

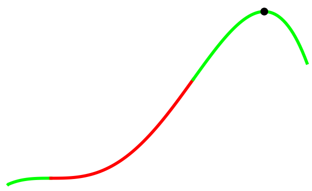
7) Along the interval of months: [4., 8.] .

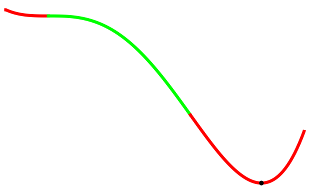
8) Along the intervals of months: [1, 4], [7, 8.89898] and [9, 9] .

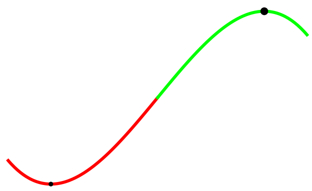
Exercise 3

Study the shape properties of the $f(x) = 4 + 12x + 9x^2 + 2x^3$ to decide which amongst the following ones is the representation of the function.

1)


2)


3)


4)


● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 20\, e^{-1+t}$ millions of euros/year.

If the initial deposit in the investment fund was 40 millions of euros, compute the depositis available after 3 years.

1) $40 - \frac{20}{e} + 20\, e$ millions of euros = 87.008 millions of euros

2) $40 + \frac{20}{e^2} - \frac{20}{e}$ millions of euros = 35.3491 millions of euros

3) $60 - \frac{20}{e}$ millions of euros = 52.6424 millions of euros

4) $40 - \frac{20}{e} + 20\, e^2$ millions of euros = 180.4235 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X + \begin{pmatrix} 0 & -1 \\ 1 & 1 \end{pmatrix}\right) . \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 6 & 4 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$2x_1 - 2x_2 - x_3 + x_4 == -5$
$8x_1 - 2x_2 - 5x_3 + 3x_4 == 3$
$5x_1 - 2x_2 - 3x_3 + 2x_4 == -1$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 7 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 0 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} 10 \\ ? \\ ? \\ ? \end{pmatrix}$

3) $\begin{pmatrix} ? \\ ? \\ -6 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 3 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 6 \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 5 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (1 \ \ -2), \ (1 \ \ -1) \rangle$

1) $\begin{pmatrix} -1 & -1 \\ -1 & -1 \end{pmatrix}$ 2) $\begin{pmatrix} -2 & 2 \\ 3 & 1 \end{pmatrix}$ 3) $\begin{pmatrix} -2 & 1 \\ -3 & 2 \end{pmatrix}$ 4) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ 5) $\begin{pmatrix} -1 & 1 \\ -3 & -3 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 74

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interes rate of 5% and in the bank B we are paid a continuous compound rate of 9%. We initially deposit 6000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **6.***** years.

3) In **0.***** years.

4) In **1.***** years.

5) In **3.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	28
3	49
6	52

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 37 and 44. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from t=0 to t=6).

1) The funds are inside the limits for the inverval: [1,2].

2) The funds are inside the limits for the inverval: [6,9].

3) The funds are inside the limits for the intervals: [1,2] y [6,8].

4) The funds are inside the limits for the inverval: [2,6].

5) The funds are inside the limits for the inverval: [0,2].

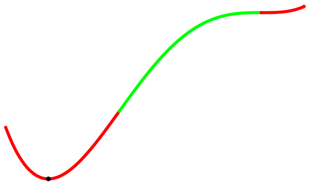
6) The funds are inside the limits for the inverval: [0,9].

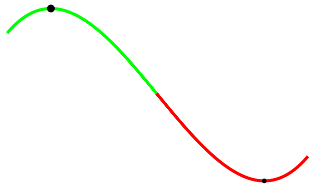
7) The funds are inside the limits for the inverval: [2,9].

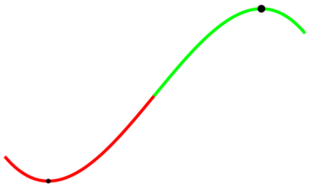
8) The funds are inside the limits for the intervals: [0,1] y [8,9].

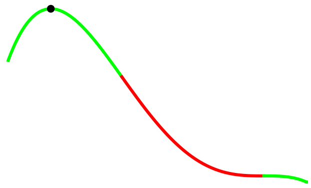
Exercise 3

Study the shape properties of the $f(x) = 2 + 6x^2 - 8x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 3t + 2t^2 + 3t^3$ millions of euros/year.

If the initial deposit in the investment fund was 20 millions of euros, compute the depositis available after 3 years.

1) $\frac{449}{4}$ millions of euros = 112.25 millions of euros

2) $\frac{130}{3}$ millions of euros = 43.3333 millions of euros

3) $\frac{275}{12}$ millions of euros = 22.9167 millions of euros

4) $\frac{836}{3}$ millions of euros = 278.6667 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 2 & 3 \\ 1 & 2 \end{pmatrix} . \left(X + \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \right) = \begin{pmatrix} 3 & 4 \\ 2 & 2 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$-2x_1 + 3x_2 + x_3 - 3x_4 == -5$$
$$-x_1 + x_2 + 5x_3 + 3x_4 == -3$$

taking as parameters, if it is necessary, the
last variables and solving for the first ones (that is to say,
apply Gauss elimination technique selecting columns from left to right)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -3 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -7 \\ ? \end{pmatrix}, \begin{pmatrix} -3 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ -10 \\ ? \\ ? \end{pmatrix}$

3) $\begin{pmatrix} 4 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 14 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 9 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 11 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 10 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ -3 \end{pmatrix} + \left\langle \begin{pmatrix} 12 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 9 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3\ \ 2) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (4\ \ 3) \rangle$

1) $\begin{pmatrix} -3 & -3 \\ 3 & 0 \end{pmatrix}$ 2) $\begin{pmatrix} -9 & 6 \\ -12 & 8 \end{pmatrix}$ 3) $\begin{pmatrix} -9 & -6 \\ 12 & 8 \end{pmatrix}$ 4) $\begin{pmatrix} -9 & 12 \\ -6 & 8 \end{pmatrix}$ 5) $\begin{pmatrix} -9 & -12 \\ 6 & 8 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 75

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
2	134
3	104
4	78

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the minimum funds available in the investment account.

1) The minimum for the depositis in the account was 4.

2) The minimum for the depositis in the account was 5.

3) The minimum for the depositis in the account was 10.

4) The minimum for the depositis in the account was 24.

5) The minimum for the depositis in the account was 6.

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 97\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 5000 + 1000\,\mathrm{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 131000. (the solution can be found for t between 9 and 14).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2\,e^{x-1} - 3\sin(1)\sin(x) - 3\cos(1)\cos(x) + 2 & x \le 1 \\ -x^2 + 4x - 2 & 1 < x < 2 \\ 2 & 2 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 1$.

4) The function is differentiable for all points except for $x = 2$.

5) The function is differentiable for all points except for $x = 1$ and $x = 2$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{56}(-3 + 3t)\right) e^{2t}$ per-unit.

The initial deposit in the account is 9000 euros. Compute the deposit after 1 year.

1) 8476.2107 euros

2) 8486.2107 euros

3) 8536.2107 euros

4) 8576.2107 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} a & 1 & 2 & 2 \\ -1 & 0 & 3 & 2 \\ -2 & 1 & -1 & -1 \\ 0 & 0 & 4 & 3 \end{pmatrix}$$ has determinant 3 ?

1) −1 2) −2 3) −3 4) 0 5) 5

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-4 + m)\,x - 2y + z == -7 + m$
$3x + 3y - 2z == 8$
$-x - y + z == -3$

has only a solution.

1) We have unique solution for $m \le 4$.

2) We have unique solution for $m \le 6$.

3) We have unique solution for $m \ne 5$.

4) We have unique solution for $m \ne 1$.

5) We have unique solution for $m \ne 2$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3 \;\; 2) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (1 \;\; 1) \rangle$

1) $\begin{pmatrix} -3 & -2 \\ -1 & 3 \end{pmatrix}$ 2) $\begin{pmatrix} -3 & 6 \\ -1 & 2 \end{pmatrix}$ 3) $\begin{pmatrix} -3 & 3 \\ -2 & 2 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & -1 \\ 6 & 2 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & -2 \\ 3 & 2 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 76

Exercise 1

We have a bank account that initially offers a compound interes rate of 6% , and after 4 years the conditions are modified and then we obtain a compound interes rate of 6% . The initial deposit is 10 000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

1) We will have ****5.***** euros.

2) We will have ****4.***** euros.

3) We will have ****0.***** euros.

4) We will have ****6.***** euros.

5) We will have ****9.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to\infty}\left(\frac{-1+x-2x^2+x^3}{-5-5x+4x^2+x^3}\right)^{9+2x}$

1) $\frac{1}{e^5}$

2) 1

3) $\frac{1}{e^4}$

4) ∞

5) 0

6) $\frac{1}{e^{12}}$

7) $-\infty$

Exercise 3

Compute the limit: $\lim_{x\to 1}\frac{\frac{11}{3}-6x+3x^2-\frac{2x^3}{3}+\mathrm{Log}\left[x^2\right]}{1-4x+6x^2-4x^3+x^4}$

1) -1

2) $-\infty$

3) ∞

4) 0

5) $-\frac{1}{2}$

6) -2

7) 1

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (1 + 5t)\, e^{2+2t}$ euros .

Compute the average value of the shares along the first 5 months of the year (between t=0 and t=5).

1) $\frac{1}{5}\left(-\frac{13}{4} + \frac{3 e^{2}}{4}\right)$ euros = 0.4584 euros

2) $\frac{1}{5}\left(\frac{3 e^{2}}{4} + \frac{17 e^{6}}{4}\right)$ euros = 344.0228 euros

3) $\frac{1}{5}\left(\frac{3 e^{2}}{4} + \frac{7 e^{4}}{4}\right)$ euros = 20.2177 euros

4) $\frac{1}{5}\left(\frac{3 e^{2}}{4} + \frac{47 e^{12}}{4}\right)$ euros = 382474.8682 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} -1 & -3 \\ 1 & 2 \end{pmatrix} . \left(X - \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix}\right) = \begin{pmatrix} -4 & 4 \\ 2 & -3 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$3 x_1 - 5 x_2 - 9 x_3 + 6 x_4 - 3 x_5 == 4$
$x_1 - x_2 - x_3 + 4 x_4 - 3 x_5 == -2$
$-2 x_1 + 3 x_2 + 5 x_3 - 5 x_4 + 3 x_5 == -1$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 8 \end{pmatrix}$

2) $\begin{pmatrix} -8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 6 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ 0 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -3 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -7 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 3 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} -8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -5 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 5 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} -4 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -8 \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 3 & -2 \\ 3 & -2 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-1 \;\; -1)$.

2) The matrix is diagonalizable and $\lambda = 4$ is an eigenvalue with eigenvector $(-1 \;\; 2)$.

3) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-1 \;\; 2)$.

4) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(1 \;\; -1)$.

5) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(2 \;\; 3)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 77

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	50
2	88
4	152

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 200 .

2) The maximum for the depositis in the account was 11 .

3) The maximum for the depositis in the account was −6 .

4) The maximum for the depositis in the account was −8 .

5) The maximum for the depositis in the account was 250 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 60\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 3000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 104000. (the solution can be found for t between 24 and 29) .

1) t = **.0****

2) t = **.2****

3) t = **.4****

4) t = **.6****

5) t = **.8****

Exercise 3

Between the months $t = 3$ and $t = 8$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 390 + 210\,t - 36\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 4$ and $t = 6$.

1) It oscillates between 750 and 790.

2) It oscillates between 782 and 790.

3) It oscillates between 788 and 785.

4) It oscillates between 785 and 788.

5) It oscillates between 784 and 780.

Exercise 4

Compute the area enclosed by the function $f(x) = -18 - 15\,x - 3\,x^2$
and the horizontal axis between the points $x = -3$ and $x = 3$.

1) 163

2) $\frac{333}{2} = 166.5$

3) $\frac{335}{2} = 167.5$

4) $\frac{331}{2} = 165.5$

5) 165

6) 168

7) 166

8) 167

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & -1 & 1 \\ a & 1 & 2 & 1 \end{pmatrix}$$ has determinant 3?

1) -1 2) 4 3) 2 4) -4 5) -3

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-2+m)\,x-y-z==-1+m$
$-x+y-z==-2$
$x+z==1$

has only a solution. For that solution compute the value of variable z

1) $z=-1$.

2) $z=0$.

3) $z=8$.

4) $z=7$.

5) $z=-5$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 10% repeat the course and 30% give
The students of course 2: 60% finish the degree and 40% give up the studies.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 60% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 18.061 % in the first course and 81.939 % in the second course.

2) 6.493 % in the first course and 93.507 % in the second course.

3) 19.78 % in the first course and 80.22 % in the second course.

4) 52.0797 % in the first course and 47.9203 % in the second course.

5) 19.523 % in the first course and 80.477 % in the second course.

6) 36.781 % in the first course and 63.219 % in the second course.

7) 26.686 % in the first course and 73.314 % in the second course.

8) 10.815 % in the first course and 89.185 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 78

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	2
3	−6
5	−30

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 2 .

2) The maximum for the depositis in the account was −4 .

3) The maximum for the depositis in the account was 1 .

4) The maximum for the depositis in the account was −3 .

5) The maximum for the depositis in the account was −70 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 50\,000\, e^{t/100}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 3000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 103000. (the solution can be found for t between 68 and 73).

1) t = **.1****

2) t = **.3****

3) t = **.5****

4) t = **.7****

5) t = **.9****

Exercise 3

Between the months $t = 0$ and $t = 4$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 31 + 36t - 15t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 3$ and $t = 4$.

1) It oscillates between 31 and 63.

2) It oscillates between 57 and 71.

3) It oscillates between 58 and 63.

4) It oscillates between 58 and 59.

5) It oscillates between 52 and 72.

Exercise 4

Compute the area enclosed by the function $f(x) = 6 + x - x^2$
and the horizontal axis between the points $x = -4$ and $x = 1$.

1) $\frac{175}{6} = 29.1667$

2) $\frac{89}{3} = 29.6667$

3) $\frac{169}{6} = 28.1667$

4) $\frac{92}{3} = 30.6667$

5) $\frac{83}{3} = 27.6667$

6) $\frac{157}{6} = 26.1667$

7) $\frac{181}{6} = 30.1667$

8) $\frac{5}{6} = 0.8333$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 2 & 2 & 1 & 1 \\ 2 & 1 & -1 & 0 \\ 1 & 0 & 1 & 0 \\ a & 2 & 1 & -2 \end{pmatrix}$$ has determinant 16 ?

1) 3 2) 1 3) −2 4) −5 5) 5

Exercise 6

Determine the values of the parameter, m, for which the linear system

$m x - 2 y + z == 4 - 2 m$
$2 x + 2 y - z == -8$
$-3 x - 3 y + 2 z == 12$

has only a solution. For that solution compute the value of variable y

1) $y = 7$.

2) $y = 6$.

3) $y = -2$.

4) $y = -4$.

5) $y = 0$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 20% repeat the course and 10% give
The students of course 2: 60% finish the degree, 10% repeat the course and 30% give up the stuc

On the other hand, every year, the students of the last course, in a way or
another, promote their degree in such a way that for every 9 students in the
las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 35.575 % in the first course and 64.425 % in the second course.

2) 23.1707 % in the first course and 76.8293 % in the second course.

3) 34.692 % in the first course and 65.308 % in the second course.

4) 39.325 % in the first course and 60.675 % in the second course.

5) 1.047 % in the first course and 98.953 % in the second course.

6) 39.074 % in the first course and 60.926 % in the second course.

7) 32.2581 % in the first course and 67.7419 % in the second course.

8) 12.93 % in the first course and 87.07 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 79

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interes rate of 9% in 9 periods (compounding frequency) and in the bank B we are paid a periodic compound interes rate of 6% in 12 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 6000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **6.***** years.

3) In **7.***** years.

4) In **1.***** years.

5) In **0.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	16
3	−2
7	30

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 6 and 16. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=7$).

1) The funds are inside the limits for the inverval: $[0,1]$.

2) The funds are inside the limits for the inverval: $[0,7]$.

3) The funds are inside the limits for the intervals: $[0,1]$ y $[5,6]$.

4) The funds are inside the limits for the inverval: $[5,7]$.

5) The funds are inside the limits for the intervals: $[0,1]$ y $[6,7]$.

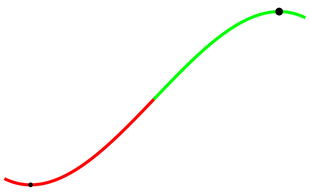
6) The funds are inside the limits for the inverval: $[-2,3]$.

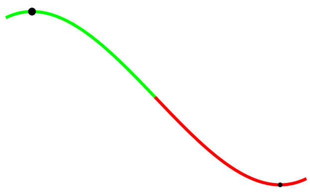
7) The funds are inside the limits for the inverval: $[0,0]$.

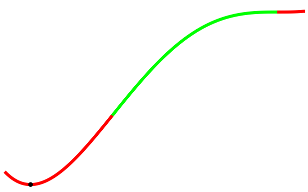
8) The funds are inside the limits for the inverval: $[0,5]$.

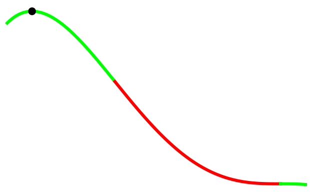
Exercise 3

Study the shape properties of the $f(x) = 4 + 12x - 6x^2 - 4x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 2t + 2t^2 + 3t^3$ millions of euros/year.

If the initial deposit in the investment fund was 90
millions of euros, compute the depositis available after 2 years.

1) $\frac{1022}{3}$ millions of euros = 340.6667 millions of euros

2) $\frac{711}{4}$ millions of euros = 177.75 millions of euros

3) $\frac{334}{3}$ millions of euros = 111.3333 millions of euros

4) $\frac{1109}{12}$ millions of euros = 92.4167 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} . X . \begin{pmatrix} -1 & 2 \\ -2 & 3 \end{pmatrix} = \begin{pmatrix} 2 & -4 \\ 3 & -5 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$4x_1 - 9x_2 - 4x_3 - 4x_4 == 2$
$x_1 - 2x_2 + 4x_3 + 3x_4 == 1$
$3x_1 - 7x_2 - 8x_3 - 7x_4 == 1$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -47 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -36 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ 0 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 4 \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -5 \\ ? \\ ? \end{pmatrix}$

4) $\begin{pmatrix} ? \\ ? \\ 0 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -20 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -16 \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} 3 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -42 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -36 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (-2 \;\; -1) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (5 \;\; 2) \rangle$

1) $\begin{pmatrix} 4 & -10 \\ 2 & -5 \end{pmatrix}$ 2) $\begin{pmatrix} 4 & 2 \\ -10 & -5 \end{pmatrix}$ 3) $\begin{pmatrix} -3 & 1 \\ -1 & 3 \end{pmatrix}$ 4) $\begin{pmatrix} -2 & 2 \\ -2 & -1 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & 2 \\ 0 & 1 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 80

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=15000−5Q. On the other hand, the production cost per ton is C=6000+19Q. In addition, the transportation cost is 8040 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 11 018 .

2) Profit = 12 978 .

3) Profit = 11 936 .

4) Profit = 9984 .

5) Profit = 9600 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} -2\,e^{x} - \sin(x) & x \le 0 \\ 2\,e^{x} + 3\sin(x) - 2\,e - 1 - 3\sin(1) & 0 < x < 1 \\ \sin(1-x) - \cos(1-x) & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x=0$.

4) The function is continuous for all the points except for $x=1$.

5) The function is continuous for all the points except for $x=0$ and $x=1$.

Exercise 3

Between the months $t=3$ and $t=7$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 145 + 120\,t - 27\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t=5$ and $t=6$.

1) It oscillates between 326 and 335.

2) It oscillates between 328 and 324.

3) It oscillates between 316 and 348.

4) It oscillates between 320 and 321.

5) It oscillates between 320 and 325.

Exercise 4

Compute the area enclosed by the function $f(x) = 18x - 15x^2 + 3x^3$ and the horizontal axis between the points $x = -5$ and $x = 1$.

1) 1327

2) $\frac{2653}{2} = 1326.5$

3) $\frac{2651}{2} = 1325.5$

4) 1314

5) $\frac{2655}{2} = 1327.5$

6) $\frac{2647}{2} = 1323.5$

7) $\frac{2657}{2} = 1328.5$

8) 1328

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 2 & 0 & 1 & 0 \\ a & -2 & 1 & 1 \\ 1 & -1 & 1 & 2 \\ -2 & -1 & 2 & 1 \end{pmatrix}$$ has determinant 17 ?

1) 2 2) 5 3) −5 4) 0 5) 4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$$(-1+m)\,x + m\,y + m\,z == 2 - 2\,m$$
$$4\,x + y + 3\,z == -8$$
$$-2\,x - y - 2\,z == 4$$

has only a solution. For that solution compute the value of variable y

1) $y = -3$.

2) $y = 1$.

3) $y = 0$.

4) $y = 6$.

5) $y = 8$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 70% finish the degree and 30% give up the studies.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 60% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 31.733 % in the first course and 68.267 % in the second course.

2) 24.373 % in the first course and 75.627 % in the second course.

3) 26.839 % in the first course and 73.161 % in the second course.

4) 6.895 % in the first course and 93.105 % in the second course.

5) 2.706 % in the first course and 97.294 % in the second course.

6) 32.336 % in the first course and 67.664 % in the second course.

7) 50. % in the first course and 50. % in the second course.

8) 11.653 % in the first course and 88.347 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 81

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interes rate of 5% and in the bank B we are paid a continuous compound rate of 9% . We initially deposit 8000 euros in the bank A and 3000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **3.***** years.

2) In **9.***** years.

3) In **4.***** years.

4) In **0.***** years.

5) In **7.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
2	50
4	66
8	74

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 59 and 66 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

1) The funds are inside the limits for the inverval: $[4, 8]$.

2) The funds are inside the limits for the inverval: $[0, 4]$.

3) The funds are inside the limits for the inverval: $[8, 11]$.

4) The funds are inside the limits for the inverval: $[3, 4]$.

5) The funds are inside the limits for the intervals: $[0, 3]$ y $[10, 11]$.

6) The funds are inside the limits for the intervals: $[3, 4]$ y $[8, 10]$.

7) The funds are inside the limits for the inverval: $[0, 11]$.

8) The funds are inside the limits for the inverval: $[4, 11]$.

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} e^{x+3} + 2\cos(x+3) - 3 & x \le -3 \\ -\frac{3x^2}{2} - 8x - \frac{21}{2} & -3 < x < -2 \\ -2e^{x+2} - \cos(x+2) + \frac{5}{2} & -2 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -3$.

4) The function is differentiable for all points except for $x = -2$.

5) The function is differentiable for all points except for $x = -3$ and $x = -2$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{72}(3 + 2t)\right) e^{-3+t}$ per-unit.

The initial deposit in the account is 3000 euros. Compute the deposit after 3 years.

1) 3364.0303 euros

2) 3284.0303 euros

3) 3334.0303 euros

4) 3304.0303 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -3 & 2 & -4 & 3 \\ 2 & 1 & 3 & -2 \\ 1 & 1 & 0 & 0 \\ -1 & a & 1 & -2 \end{pmatrix}$ has determinant -17?

1) -3 2) 0 3) 1 4) -5 5) 4

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(3 + m)\,x + y + z == 5 + m$
$x + y + z == 3$
$x + z == 1$

has only a solution.

1) We have unique solution for $m \neq 0$.

2) We have unique solution for $m \neq -5$.

3) We have unique solution for $m \le 1$.

4) We have unique solution for $m \ge 1$.

5) We have unique solution for $m \le -1$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 60% pass to the following course, 20% repeat the course and 20% give
The students of course 2: 60% finish the degree and 40% give up the studies.

On the other hand, every year, the amount of students that starts the degree is equivalent to 40% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 50. % in the first course and 50. % in the second course.

2) 14.074 % in the first course and 85.926 % in the second course.

3) 20.324 % in the first course and 79.676 % in the second course.

4) 26.535 % in the first course and 73.465 % in the second course.

5) 6.88 % in the first course and 93.12 % in the second course.

6) 5.301 % in the first course and 94.699 % in the second course.

7) 20.894 % in the first course and 79.106 % in the second course.

8) 31.151 % in the first course and 68.849 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 82

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=60000-17Q$. On the other hand, the production cost per ton is $C=50000+9Q$. In addition, the transportation cost is 8648 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 29 756 .

2) Profit = 17 576 .

3) Profit = 24 385 .

4) Profit = 14 150 .

5) Profit = 6993 .

Exercise 2

The population of certain country (in millions of habitants) is given by the function $P(t)=22\left(\frac{-6+3t+4t^2+3t^3}{6-7t-2t^2+3t^3}\right)^{2+7t}$. Determine the future tendency for this population.

1) $\frac{22}{e^5}$

2) 0

3) ∞

4) $-\infty$

5) 22

6) $\frac{22}{e^4}$

7) $22\,e^{14}$

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-1+\frac{x^4}{2}+\mathrm{Cos}[x^2]}{x^5}$

1) $-\frac{1}{2}$

2) $-\infty$

3) ∞

4) 1

5) $\frac{1}{2}$

6) 0

7) $-\frac{2}{3}$

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (4+3t+t^2)\log(5t)$ euros.

Compute the average value of shares between month 1 and month 2 (between t=1 and t=2).

1) $-\frac{152}{9}-\frac{35\,\mathrm{Log}[5]}{6}+\frac{69\,\mathrm{Log}[15]}{2}$ euros = 67.1505 euros

2) $\frac{1}{2}\left(-\frac{152}{9}-\frac{35\,\mathrm{Log}[5]}{6}+\frac{69\,\mathrm{Log}[15]}{2}\right)$ euros = 33.5752 euros

3) $-\frac{253}{36}-\frac{35\,\mathrm{Log}[5]}{6}+\frac{50\,\mathrm{Log}[10]}{3}$ euros = 21.9603 euros

4) $\frac{1}{2}\left(-\frac{121}{4}-\frac{35\,\mathrm{Log}[5]}{6}+\frac{184\,\mathrm{Log}[20]}{3}\right)$ euros = 72.0499 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\left(X+\begin{pmatrix}1 & -1\\ 0 & 1\end{pmatrix}\right).\begin{pmatrix}1 & -2\\ 2 & -3\end{pmatrix}=\begin{pmatrix}0 & -1\\ 1 & -1\end{pmatrix}$$

1) $\begin{pmatrix}-2 & *\\ * & *\end{pmatrix}$ 2) $\begin{pmatrix}-1 & *\\ * & *\end{pmatrix}$ 3) $\begin{pmatrix}0 & *\\ * & *\end{pmatrix}$ 4) $\begin{pmatrix}1 & *\\ * & *\end{pmatrix}$ 5) $\begin{pmatrix}* & -2\\ * & *\end{pmatrix}$

Exercise 6

Find the solution of the linear system

$3 x_1 - 3 x_3 - x_4 - 4 x_5 == 5$
$-x_1 + 5 x_3 + 2 x_4 + 7 x_5 == -3$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} 0 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 5 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 1 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 4 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -1 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -4 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ ? \\ -6 \\ ? \end{pmatrix}$

4) $\begin{pmatrix} ? \\ ? \\ ? \\ 24 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -15 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -3 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -3 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -2 \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -8 & 9 \\ -4 & 4 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(3\ \ 2)$.

2) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(-2\ \ 0)$.

3) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(3\ \ -2)$.

4) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-2\ \ 1)$.

5) The matrix is diagonalizable and $\lambda = 4$ is an eigenvalue with eigenvector $(0\ \ 2)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 83

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 4% and in the bank B we are paid a continuous compound rate of 9% . We initially deposit 6000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **1.***** years.

2) In **5.***** years.

3) In **9.***** years.

4) In **7.***** years.

5) In **0.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	17
3	26
6	−19

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between −23 and 26 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from t= 0 to t= 6).

1) The funds are inside the limits for the inverval: [6 , 6] .

2) The funds are inside the limits for the inverval: [1 , 6] .

3) The funds are inside the limits for the inverval: [0 , 3] .

4) The funds are inside the limits for the inverval: [−1 , 6] .

5) The funds are inside the limits for the inverval: [−2 , 6] .

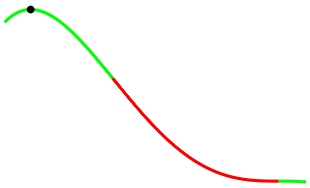
6) The funds are inside the limits for the inverval: [3 , 6] .

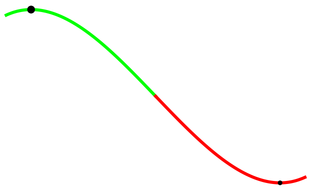
7) The funds are inside the limits for the intervals: [0 , 1] y [3 , 6] .

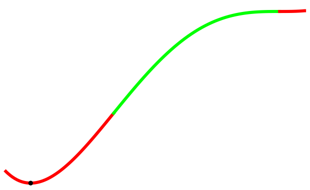
8) The funds are inside the limits for the inverval: [0 , 6] .

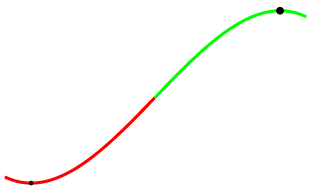
Exercise 3

Study the shape properties of the $f(x) = 3 + 24x^2 - 16x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points -2, -1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 3 + t + 2t^3$ millions of euros/year.

If the initial deposit in the investment fund was 70
millions of euros, compute the depositis available after 3 years.

1) 86 millions of euros

2) 218 millions of euros

3) 124 millions of euros

4) 74 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix} . \left(X + \begin{pmatrix} 9 & 5 \\ -2 & -1 \end{pmatrix} \right) = \begin{pmatrix} 17 & 10 \\ -26 & -15 \end{pmatrix}$$

1) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$2x_1 + 3x_2 + 2x_3 + 2x_4 == -4$
$-x_1 - x_2 + 4x_3 - 4x_4 == 1$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 2 \\ ? \end{pmatrix}, \begin{pmatrix} -3 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -9 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ ? \\ -10 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 5 \\ ? \end{pmatrix}, \begin{pmatrix} -1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 13 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 8 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} 3 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 13 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 8 \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ 0 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 14 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -10 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (5 \ \ -2) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (-2 \ \ 1) \rangle$

1) $\begin{pmatrix} -2 & 0 \\ 2 & 3 \end{pmatrix}$ 2) $\begin{pmatrix} -5 & -10 \\ 2 & 4 \end{pmatrix}$ 3) $\begin{pmatrix} -5 & 2 \\ -10 & 4 \end{pmatrix}$ 4) $\begin{pmatrix} -2 & -2 \\ 0 & 2 \end{pmatrix}$ 5) $\begin{pmatrix} -3 & 2 \\ -2 & 3 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 84

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=110000-17Q$. On the other hand, the production cost per ton is $C=100000-Q$. In addition, the transportation cost is 8784 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 19037 .

2) Profit = 23104 .

3) Profit = 25796 .

4) Profit = 34088 .

5) Profit = 7014 .

Exercise 2

From an initial deposit 10000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) = 10000\left(\frac{3+4t-5t^2+9t^3}{2-t-4t^2+9t^3}\right)^{-2+5t+7t^2}$. Determine the future tendency for the deposits that we will have after a large number of years.

1) 0

2) $\frac{10000}{e^5}$

3) 10000

4) $\frac{10000}{e^4}$

5) $-\infty$

6) $10000\,e^2$

7) ∞

Exercise 3

Compute the limit: $\lim_{x\to 0} \frac{-1+\frac{x^4}{2}+\text{Cos}[x^2]}{x^5}$

1) $-\infty$

2) 1

3) 0

4) ∞

5) -2

6) -1

7) $-\frac{2}{3}$

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = (2+2t+2t^2)\log(3t)$ euros.

Compute the average value of shares between month 1 and month 2 (between t=1 and t=2).

1) $-2\left(-\frac{49}{36}+\frac{11\,\text{Log}[3]}{6}\right)+2\left(-\frac{33}{4}+\frac{33\,\text{Log}[9]}{2}\right)$ euros = 54.7024 euros

2) $\frac{1}{2}\left(-2\left(-\frac{49}{36}+\frac{11\,\text{Log}[3]}{6}\right)+2\left(-\frac{136}{9}+\frac{100\,\text{Log}[12]}{3}\right)\right)$ euros = 67.0661 euros

3) $\frac{1}{2}\left(-2\left(-\frac{49}{36}+\frac{11\,\text{Log}[3]}{6}\right)+2\left(-\frac{33}{4}+\frac{33\,\text{Log}[9]}{2}\right)\right)$ euros = 27.3512 euros

4) $-2\left(-\frac{49}{36}+\frac{11\,\text{Log}[3]}{6}\right)+2\left(-\frac{35}{9}+\frac{20\,\text{Log}[6]}{3}\right)$ euros = 14.8063 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} -3 & -1 \\ 16 & 5 \end{pmatrix}.X.\begin{pmatrix} 1 & -1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 4 \\ 0 & -21 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & * \\ -2 & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$5\,x_1 + 5\,x_2 + 3\,x_4 - 4\,x_5 == -1$
$-5\,x_1 - 8\,x_2 + 3\,x_3 + 2\,x_4 - 3\,x_5 == -2$
$3\,x_2 - 3\,x_3 - 5\,x_4 + 7\,x_5 == 3$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ -7 \\ ? \\ ? \end{pmatrix}$

2) $\begin{pmatrix} ? \\ 7 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ 2 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -37 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -46 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 11 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -35 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -47 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 9 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ ? \\ ? \\ 2 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -36 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -46 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 6 \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 43 & 121 \\ -16 & -45 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(11\ \ -4)$.

2) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-1\ \ 0)$.

3) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(0\ \ -2)$.

4) The matrix is diagonalizable and $\lambda = -1$ is an eigenvalue with eigenvector $(11\ \ -4)$.

5) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(-1\ \ 1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 85

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=8000−16Q. On the other hand, the production cost per ton is C=5000−Q. In addition, the transportation cost is 2250 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 11 197 .

2) Profit = 11 152 .

3) Profit = 12 172 .

4) Profit = 9375 .

5) Profit = 11 124 .

Exercise 2

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \frac{4 + 9x + 4x^2}{6 + 8x + x^2 + 3x^3}$. Determine the expected cost per unit when a large amount of units is produced.

1) ∞

2) 0

3) $-\frac{1}{2}$

4) $\frac{1}{2}$

5) $-\infty$

6) $-\frac{2}{9}$

7) 11 000

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-x^2+\mathrm{Sin}[x^2]}{x^4}$

1) $\frac{2}{3}$

2) $-\infty$

3) 0

4) 1

5) ∞

6) -1

7) $-\frac{2}{3}$

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = 30\,e^{t}$ euros .

Compute the average value of the shares along the first 6 months of the year (between t=0 and t=6).

1) $\frac{1}{6}\left(-30+30\,e^{6}\right)$ euros = 2012.144 euros

2) $\frac{1}{6}\left(-30+\frac{30}{e}\right)$ euros = −3.1606 euros

3) $\frac{1}{6}\left(-30+30\,e^{2}\right)$ euros = 31.9453 euros

4) $\frac{1}{6}\left(-30+30\,e\right)$ euros = 8.5914 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 2 & -3 \\ -3 & 5 \end{pmatrix}^{-1}.X-\begin{pmatrix} 1 & 0 \\ 4 & 1 \end{pmatrix}=\begin{pmatrix} 2 & -3 \\ -2 & -3 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$-5\,x_1 - 5\,x_2 - x_3 + 3\,x_4 + 2\,x_5 == -4$$
$$4\,x_1 + 2\,x_2 + 3\,x_3 - 8\,x_4 - 5\,x_5 == 1$$
$$-x_1 - 3\,x_2 + 2\,x_3 - 5\,x_4 - 3\,x_5 == -3$$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 0 \end{pmatrix}$

2) $\begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -17 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 34 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ -1 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -2 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 25 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -22 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ 2 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ ? \\ 26 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -19 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -2 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 10 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -2 \\ ? \end{pmatrix}, \begin{pmatrix} 3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-1 \ \ 1)$.

2) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(0 \ \ -1)$.

3) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(1 \ \ -2)$.

4) The matrix is diagonalizable and $\lambda = -3$ is an eigenvalue with eigenvector $(-2 \ \ -2)$.

5) The matrix is diagonalizable and $\lambda = -5$ is an eigenvalue with eigenvector $(-1 \ \ 1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors ⟨(1,1,-1)⟩ and λ=3 with eigenvectors ⟨(1,0,1)⟩, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors ⟨(1,1,-1),(0,1,1)⟩ and λ=3 with eigenvectors ⟨(1,0,1)⟩, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by ⟨(2,1)⟩, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 86

Exercise 1

We have a bank account that initially offers a compound interes rate of 9% , and after 2 years the conditions are modified and then we obtain a continuous compound rate of 5% . The initial deposit is 9000 euros. Compute the amount of money in the account after 3 years from the moment of the first deposit.

1) We will have ****3.***** euros.

2) We will have ****2.***** euros.

3) We will have ****0.***** euros.

4) We will have ****5.***** euros.

5) We will have ****1.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to\infty} -3+7x+x^2-x^3-4x^4-9x^5$

1) $-\infty$

2) 1

3) -9

4) ∞

5) -7

6) 0

7) -6

Exercise 3

Compute the limit: $\lim_{x\to 0}\frac{-x^2+\mathrm{Sin}[x^2]}{x^4}$

1) 0

2) ∞

3) 1

4) -2

5) $-\frac{1}{3}$

6) $-\infty$

7) -1

Exercise 4

The true value of certain shares oscillates along the year.
The following function yields the value of the shares for each month t:

$V(t) = 20\, e^{-1+2t}$ euros .

Compute the average value of the shares along the first 5 months of the year (between t=0 and t=5).

1) $\frac{1}{5}\left(\frac{10}{e^3} - \frac{10}{e}\right)$ euros = −0.6362 euros

2) $\frac{1}{5}\left(-\frac{10}{e} + 10\, e\right)$ euros = 4.7008 euros

3) $\frac{1}{5}\left(-\frac{10}{e} + 10\, e^9\right)$ euros = 16205.4321 euros

4) $\frac{1}{5}\left(-\frac{10}{e} + 10\, e^3\right)$ euros = 39.4353 euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} -1 & 0 \\ -2 & -1 \end{pmatrix} . X + \begin{pmatrix} 0 & 1 \\ -1 & 2 \end{pmatrix} = \begin{pmatrix} 0 & 2 \\ -1 & 3 \end{pmatrix}$$

1) $\begin{pmatrix} 0 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$x_1 - 2x_2 + x_3 - 2x_4 + 3x_5 == -2$$
$$2x_1 - 3x_2 + x_3 + 2x_4 - 5x_5 == 5$$
$$-5x_1 + 8x_2 - 3x_3 - 2x_4 + 7x_5 == -8$$

taking as parameters, if it is necessary, the
last variables and solving for the first ones (that is to say,
apply Gauss elimination technique selecting columns from left to right)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ 6 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 0 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -8 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} 18 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ -5 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 10 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} -3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -9 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} 13 \\ ? \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 3 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ -3 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 9 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ 9 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -10 \\ ? \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 11 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 4 & 6 \\ -4 & -6 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(0\ \ -1)$.

2) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-3\ \ 2)$.

3) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(-1\ \ 0)$.

4) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-1\ \ 1)$.

5) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-2\ \ 1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 87

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P=13000-20Q$. On the other hand, the production cost per ton is $C=8000-8Q$. In addition, the transportation cost is 4016 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 13 858 .

2) Profit = 17 345 .

3) Profit = 26 775 .

4) Profit = 24 669 .

5) Profit = 20 172 .

Exercise 2

From an initial deposit 19000, the interest rate varies every year in such a way that the total amount of money in the account is given by the function $C(t) = 19\,000\left(\frac{8-3t+7t^2+6t^3}{-8-5t-7t^2+6t^3}\right)^{-5-9t+2t^2}$. Determine the future tendency for the deposits that we will have after a large number of years.

1) $19\,000$

2) ∞

3) $-\infty$

4) $\frac{19\,000}{e^5}$

5) $\frac{19\,000}{e^3}$

6) 0

7) $\frac{19\,000}{e^4}$

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} 2\,(\cos(x) + 2) & x \le 0 \\ x + x\,(-\log(3)) + (x+1)\log(x+1) + 6 & 0 < x < 2 \\ -2\sin(2-x) + \cos(2-x) + 7 + \log(3) & 2 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 0$.

4) The function is differentiable for all points except for $x = 2$.

5) The function is differentiable for all points except for $x = 0$ and $x = 2$.

Exercise 4

Certain bank account offers a variable continuous compound
interes rate. The interest rate for each year is given by the function

$I(t) = \frac{1}{10}\cos(7 + 3t)$ per-unit.

The initial deposit in the account is 11000 euros. Compute the deposit after 5π years.

1) 10568.6084 euros

2) 10518.6084 euros

3) 10618.6084 euros

4) 10528.6084 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 1 & -1 & 1 & a \\ 4 & 3 & 1 & 1 \\ 1 & 1 & 1 & -1 \\ 1 & 1 & 0 & 2 \end{pmatrix}$ has determinant 6 ?

1) 5 2) −3 3) 3 4) −4 5) −5

Exercise 6

Determine the values of the parameter , m , for which the linear system

$$-x + y - z == -2$$
$$-m\,x + y - z == -2\,m$$
$$m\,x + z == 2 + 2\,m$$

has only a solution.

1) We have unique solution for $m \geq -1$.

2) We have unique solution for $m \neq 3$.

3) We have unique solution for $m \leq 4$.

4) We have unique solution for $m \neq -1$.

5) We have unique solution for $m \geq 3$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 70% finish the degree and 30% give up the studies.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 70% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 32.344 % in the first course and 67.656 % in the second course.

2) 35.742 % in the first course and 64.258 % in the second course.

3) 29.617 % in the first course and 70.383 % in the second course.

4) 51.7834 % in the first course and 48.2166 % in the second course.

5) 32.847 % in the first course and 67.153 % in the second course.

6) 36.152 % in the first course and 63.848 % in the second course.

7) 43.456 % in the first course and 56.544 % in the second course.

8) 30.343 % in the first course and 69.657 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 88

Exercise 1

We have one bank account that offers a compound interes rate of 1% where we initially deposit 11 000 euros. How long time is it necessary until the amount of money in the account reaches 15 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **8.***** years.

2) In **6.***** years.

3) In **1.***** years.

4) In **0.***** years.

5) In **3.***** years.

Exercise 2

The population of a city is studied between years $t=1$ and $t=9$. In that period the population is given by the function $P(t) = 72t - 30t^2 + 4t^3$. Determine the intervals of years when the population is between 0 and 46.

1) Along the interval of years: $[1, 1]$.

2) That number of mice is reach for no interval of years.

3) Along the interval of years: $[1, 9]$.

4) Along the intervals of years: $[3., 4.25327]$ and $[8., 9.]$.

5) Along the intervals of years: $[3., 7.20848]$ and $[8., 9.60006]$.

6) Along the intervals of years: $[2., 5.]$ and $[7.43188, 9.]$.

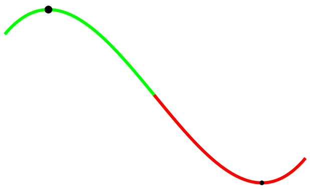
7) Along the intervals of years: $[4.04888, 5.48552]$ and $[7., 9.]$.

8) Along the interval of years: $[6., 8.20651]$.

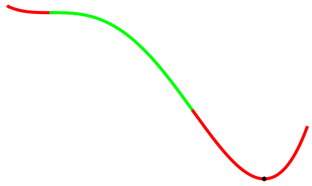
Exercise 3

Study the shape properties of the $f(x) = 2 + 12x + 9x^2 + 2x^3$
to decide which amongst the following ones is the representation of the function.

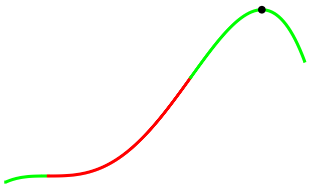
1)



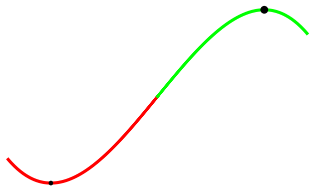
2)



3)



4)



● Big point: maximum • Small point: minimum

Red line: convexity Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 10\,e^{2+2t}$ millions of euros/year.

If the initial deposit in the investment fund was 20
millions of euros, compute the depositis available after 3 years.

1) $20 - 5\,e^2 + 5\,e^8$ millions of euros = 14887.8447 millions of euros

2) $20 - 5\,e^2 + 5\,e^6$ millions of euros = 2000.1987 millions of euros

3) $20 - 5\,e^2 + 5\,e^4$ millions of euros = 256.0455 millions of euros

4) $25 - 5\,e^2$ millions of euros = −11.9453 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 7 & 9 \\ 3 & 4 \end{pmatrix}^{-1} . \left(X + \begin{pmatrix} -1 & -1 \\ 2 & 1 \end{pmatrix} \right) = \begin{pmatrix} -31 & -8 \\ 24 & 6 \end{pmatrix}$$

1) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & -2 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$3\,x_1 + 5\,x_2 + x_3 + 2\,x_4 == 4$
$4\,x_1 + 2\,x_3 + 5\,x_4 == -4$
$10\,x_1 + 10\,x_2 + 4\,x_3 + 9\,x_4 == 4$

taking as parameters, if it is necessary, the first variables and solving for the last ones (that is to say, apply Gauss elimination technique selecting columns from right to left). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -4 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -27 \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 31 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ -5 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ 13 \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ 28 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -25 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} -9 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 0 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} -1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -1 \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle\, (-1\ \ -5),\ (-1\ \ -6)\,\rangle$

1) $\begin{pmatrix} -1 & -2 \\ -1 & 3 \end{pmatrix}$ 2) $\begin{pmatrix} -2 & -3 \\ 2 & -2 \end{pmatrix}$ 3) $\begin{pmatrix} -2 & -1 \\ 0 & 3 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & 0 \\ 1 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 89

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a periodic compound interes rate of 5% in 12 periods (compounding frequency) and in the bank B we are paid a compound interes rate of 10% . We initially deposit 6000 euros in the bank A and 1000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **6.***** years.

2) In **9.***** years.

3) In **2.***** years.

4) In **1.***** years.

5) In **0.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
0	10
3	-20
5	-20

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between -20 and -14 . Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=0$ to $t=5$).

1) The funds are inside the limits for the inverval: $[2,3]$.

2) The funds are inside the limits for the intervals: $[2,3]$ y $[5,6]$.

3) The funds are inside the limits for the inverval: $[2,5]$.

4) The funds are inside the limits for the inverval: $[0,5]$.

5) The funds are inside the limits for the inverval: $[5,5]$.

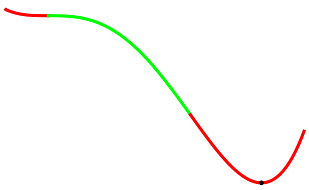
6) The funds are inside the limits for the intervals: $[0,3]$ y $[5,6]$.

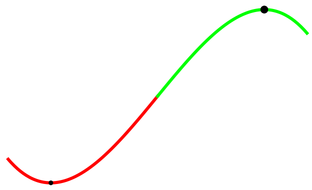
7) The funds are inside the limits for the intervals: $[2,3]$ y $[5,5]$.

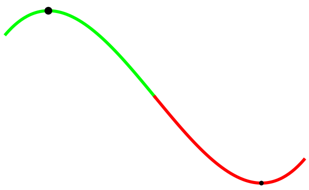
8) The funds are inside the limits for the inverval: $[0,2]$.

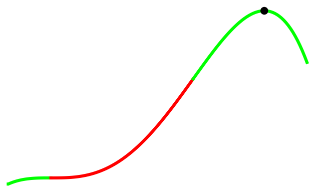
Exercise 3

Study the shape properties of the $f(x) = 2 - 24x + 30x^2 - 16x^3 + 3x^4$ to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

● Big point: maximum • Small point: minimum

Red line: convexity — Green line: concavity

Indication: To find the maximun and minimum points of the function, try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to another being the speed of that variation determined by the function

$v(t) = 2t + 3t^3 + t^4$ millions of euros/year.

If the initial deposit in the investment fund was 30 millions of euros, compute the depositis available after 3 years.

1) $\frac{2214}{5}$ millions of euros = 442.8 millions of euros

2) $\frac{2967}{20}$ millions of euros = 148.35 millions of euros

3) $\frac{639}{20}$ millions of euros = 31.95 millions of euros

4) $\frac{262}{5}$ millions of euros = 52.4 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}^{-1} .X. \begin{pmatrix} 2 & -5 \\ -3 & 8 \end{pmatrix} = \begin{pmatrix} 5 & -13 \\ 3 & -8 \end{pmatrix}$$

1) $\begin{pmatrix} 1 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} * & 1 \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & 2 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & * \\ -2 & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$$8x_1 + 3x_2 + 10x_3 - x_4 == -7$$
$$2x_1 + x_2 + 4x_3 - 3x_4 == -3$$
$$-3x_1 - x_2 - 3x_3 - x_4 == 2$$

taking as parameters, if it is necessary, the last variables and solving for the first ones (that is to say, apply Gauss elimination technique selecting columns from left to right). Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ -5 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -4 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -4 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 4 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 4 \\ ? \\ ? \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ ? \\ 1 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -8 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -3 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ -7 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} -2 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ 8 \\ ? \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} -3 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ 10 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -6 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -8 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ -6 \\ ? \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} 1 \\ ? \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} -4 \\ ? \\ ? \\ ? \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (3 \ \ -7) \rangle$
- $\lambda_2 = 0$, with eigenvectors $V_2 = \langle (-5 \ \ 12) \rangle$

1) $\begin{pmatrix} -36 & -21 \\ 60 & 35 \end{pmatrix}$ 2) $\begin{pmatrix} -36 & 84 \\ -15 & 35 \end{pmatrix}$ 3) $\begin{pmatrix} -36 & -15 \\ 84 & 35 \end{pmatrix}$ 4) $\begin{pmatrix} -2 & 2 \\ 0 & 0 \end{pmatrix}$ 5) $\begin{pmatrix} -36 & 60 \\ -21 & 35 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 90

Exercise 1

We have a bank account that initially offers a periodic compound interes rate of 9% in 3 periods (compounding frequency), and after 3 years the conditions are modified and then we obtain a continuous compound rate of 1%. The initial deposit is 5000 euros. Compute the amount of money in the account after 2 years from the moment of the first deposit.

1) We will have ****0.***** euros.

2) We will have ****5.***** euros.

3) We will have ****4.***** euros.

4) We will have ****3.***** euros.

5) We will have ****1.***** euros.

Exercise 2

Compute the limit: $\lim_{x \to -\infty} -1 + 9x - 5x^2 + 8x^3 + 7x^4$

1) -3

2) 1

3) -8

4) ∞

5) -7

6) $-\infty$

7) 0

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} -2\sin(x+1) - 3\cos(x+1) - 3 & x \leq -1 \\ 2\left(-e^{x+1} + e^2 (x+1) + x\sin(2) + \cos(x+1) - 3 + \sin(2)\right) & -1 < x < 1 \\ 2\left(\cos(1-x) + e^2 - 4 + 2\sin(2) + \cos(2)\right) & 1 \leq x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -1$.

4) The function is differentiable for all points except for $x = 1$.

5) The function is differentiable for all points except for $x = -1$ and $x = 1$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \frac{e^{-1+t}}{14}$ per-unit.

The initial deposit in the account is 18 000 euros. Compute the deposit after 1 year.

1) 18831.3536 euros

2) 18891.3536 euros

3) 18841.3536 euros

4) 18861.3536 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -1 & -1 & 0 & 0 \\ a & -2 & 1 & 0 \\ -1 & 2 & 1 & 1 \\ -2 & -5 & -2 & -1 \end{pmatrix}$ has determinant 0 ?

1) −2 2) −4 3) −1 4) 4 5) 0

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(-1 + m)\, x + y - 2\, z == -3 + m$
$-x + y - z == -2$
$x - y + 2\, z == 3$

has only a solution.

1) We have unique solution for $m \geq -3$.

2) We have unique solution for $m \neq 3$.

3) We have unique solution for $m \geq -3$.

4) We have unique solution for $m \neq 0$.

5) We have unique solution for $m \neq -3$.

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle\, (-4 \;\; 17)\, \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle\, (-1 \;\; 4)\, \rangle$

1) $\begin{pmatrix} 33 & -136 \\ 8 & -33 \end{pmatrix}$ 2) $\begin{pmatrix} -2 & -1 \\ 2 & -2 \end{pmatrix}$ 3) $\begin{pmatrix} 33 & 8 \\ -136 & -33 \end{pmatrix}$ 4) $\begin{pmatrix} -2 & -3 \\ 2 & 3 \end{pmatrix}$ 5) $\begin{pmatrix} -2 & -2 \\ -3 & 0 \end{pmatrix}$

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 91

Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a compound interes rate of 10% and in the bank B we are paid a periodic compound interes rate of 6% in 7 periods (compounding frequency). We initially deposit 2000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **8.***** years.

2) In **5.***** years.

3) In **9.***** years.

4) In **1.***** years.

5) In **0.***** years.

Exercise 2

The funds of a public institution alternate periods of deficit and surplus. We have the following information for several years (in millions of euros):

year	funds
2	33
4	33
8	−15

Employ an interpolation polynomial to build a function that yields the funds for each year t. We know that due to the legislation the funds of such an institution have to be kept between 17 and 27. Compute (by means of the polynomial obtained before by interpolation) the periods along which the funds are between the indicated limits inside the interval of time where we have information (that is to say, from $t=2$ to $t=8$).

1) The funds are inside the limits for the inverval: $[0,6]$.

2) The funds are inside the limits for the inverval: $[6,8]$.

3) The funds are inside the limits for the inverval: $[0,1]$.

4) The funds are inside the limits for the inverval: $[1,8]$.

5) The funds are inside the limits for the inverval: $[1,6]$.

6) The funds are inside the limits for the intervals: $[0,1]$ y $[5,8]$.

7) The funds are inside the limits for the inverval: $[5,6]$.

8) The funds are inside the limits for the intervals: $[0,0]$ y $[5,6]$.

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} 4 - 2\cos(x+3) & x \le -3 \\ x - 2x\sin(2) + \sin(x+3) - x\cos(2) - 2\cos(x+3) + 7 - 6\sin(2) - 3\cos(2) & -3 < x < -1 \\ e^{x+1} + \cos(x+1) + 4 - 3\sin(2) - 4\cos(2) & -1 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = -3$.

4) The function is differentiable for all points except for $x = -1$.

5) The function is differentiable for all points except for $x = -3$ and $x = -1$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(6 - 2t)\right)\cos(9t)$ per-unit.

The initial deposit in the account is 12 000 euros. Compute the deposit after 2π years.

1) 12 060 euros

2) 12 070 euros

3) 12 000 euros

4) 11 980 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & 1 & 1 & -1 \\ -1 & 0 & -1 & 1 \\ -2 & 0 & 1 & a \\ 2 & 2 & 1 & -2 \end{pmatrix}$$ has determinant 1 ?

1) -3 2) 3 3) 5 4) -1 5) 2

Exercise 6

Determine the values of the parameter , m , for which the linear system

$(1 + m)x - 2y - z == -1 + 2m$
$x + y == 4$
$x + 2y + z == 5$

has only a solution.

1) We have unique solution for $m \ge -5$.

2) We have unique solution for $m \ne -4$.

3) We have unique solution for $m \le 0$.

4) We have unique solution for $m \le -3$.

5) We have unique solution for $m \ne -3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course, 10% repeat the course and 10% give
The students of course 2: 60% finish the degree and 40% give up the studies.

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 3 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 35.1351 % in the first course and 64.8649 % in the second course.

2) 16.896 % in the first course and 83.104 % in the second course.

3) 15.082 % in the first course and 84.918 % in the second course.

4) 24.83 % in the first course and 75.17 % in the second course.

5) 49.2604 % in the first course and 50.7396 % in the second course.

6) 21.698 % in the first course and 78.302 % in the second course.

7) 16.616 % in the first course and 83.384 % in the second course.

8) 7.716 % in the first course and 92.284 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 92

Exercise 1

Deposits in certain investment account vary from year to year alternating gains and looses periods. We have the following data about the deposits for different years:

year	deposits
1	37
2	63
4	103

By means of a interpolation polynomial, obtain the function that yields the deposits in the account for every year t. Employ that function to determine the maximum funds available in the investment account .

1) The maximum for the depositis in the account was 13 .

2) The maximum for the depositis in the account was 135 .

3) The maximum for the depositis in the account was 19 .

4) The maximum for the depositis in the account was 8 .

5) The maximum for the depositis in the account was 127 .

Exercise 2

The population in certain turistic area increases exponentially and is given by the function $P(t) = 57\,000\, e^{t/50}$ that indicates the number of resident citizens for every year t. At the same time, depending on the season, the city receives a variable number of tourists given by the trigonometric function $I(t) = 4000 + 1000 \operatorname{Sin}\left[\frac{t}{2\pi}\right]$ that yields the amount of visitors in the area for every moment t (t in years). Determine how many years are necessary until the total nomber of habitants is 102000. (the solution can be found for t between 27 and 32).

1) $t = **.1****$

2) $t = **.3****$

3) $t = **.5****$

4) $t = **.7****$

5) $t = **.9****$

Exercise 3

Between the months $t = 3$ and $t = 10$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 404 + 210\,t - 36\,t^2 + 2\,t^3$.

Determine the interval where the value oscillates between the months $t = 6$ and $t = 10$.

1) It oscillates between 788 and 905.

2) It oscillates between 796 and 804.

3) It oscillates between 796 and 904.

4) It oscillates between 802 and 900.

5) It oscillates between 764 and 904.

Exercise 4

Compute the area enclosed by the function $f(x) = 6 - 5\,x + x^2$
and the horizontal axis between the points $x = -4$ and $x = 1$.

1) $\frac{565}{6} = 94.1667$

2) $\frac{275}{3} = 91.6667$

3) $\frac{281}{3} = 93.6667$

4) $\frac{278}{3} = 92.6667$

5) $\frac{559}{6} = 93.1667$

6) $\frac{547}{6} = 91.1667$

7) $\frac{272}{3} = 90.6667$

8) $\frac{535}{6} = 89.1667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 0 & 1 & 1 & 0 \\ 1 & a & 2 & 1 \\ 0 & 2 & 0 & -1 \\ 1 & 0 & 1 & 1 \end{pmatrix} \text{ has determinant } 0\,?$$

1) -3 2) 1 3) -4 4) 0 5) 5

Exercise 6

Determine the values of the parameter , m , for which the linear system

$m x + z == 2 - m$
$-x + y == 1$
$y + z == 2$

has only a solution. For that solution compute the value of variable x

1) $x = 7$.

2) $x = -1$.

3) $x = -5$.

4) $x = -6$.

5) $x = -9$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 100% pass to the following course.
The students of course 2: 70% finish the degree and 30% repeat the course.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 90% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 27.814 % in the first course and 72.186 % in the second course.

2) 30.53 % in the first course and 69.47 % in the second course.

3) 24.569 % in the first course and 75.431 % in the second course.

4) 7.181 % in the first course and 92.819 % in the second course.

5) 2.019 % in the first course and 97.981 % in the second course.

6) 37.5 % in the first course and 62.5 % in the second course.

7) 44.7657 % in the first course and 55.2343 % in the second course.

8) 7.029 % in the first course and 92.971 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 93

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P = 150000 - 17Q$. On the other hand, the production cost per ton is $C = 70000 + 19Q$. In addition, the transportation cost is 77624 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 34 407 .

2) Profit = 56 274 .

3) Profit = 26 076 .

4) Profit = 48 664 .

5) Profit = 39 204 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} e^{x} - \sin(x) & x \le 0 \\ -\log(x+1) + 2 + \log(2) & 0 < x < 1 \\ 2\sin(1-x) + 2\cos(1-x) & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 1$.

5) The function is continuous for all the points except for $x = 0$ and $x = 1$.

Exercise 3

Between the months $t = 3$ and $t = 8$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 140 + 126t - 30t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 7$ and $t = 8$.

1) It oscillates between 246 and 250.

2) It oscillates between 238 and 302.

3) It oscillates between 238 and 302.

4) It oscillates between 230 and 253.

5) It oscillates between 238 and 252.

Exercise 4

Compute the area enclosed by the function $f(x) = -18x + 15x^2 - 3x^3$ and the horizontal axis between the points $x = -3$ and $x = 2$.

1) $\frac{1149}{4} = 287.25$

2) $\frac{1155}{4} = 288.75$

3) $\frac{1147}{4} = 286.75$

4) $\frac{1153}{4} = 288.25$

5) $\frac{1151}{4} = 287.75$

6) $\frac{1145}{4} = 286.25$

7) $\frac{1139}{4} = 284.75$

8) $\frac{1075}{4} = 268.75$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} a & 1 & 1 & 1 \\ -1 & 2 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ -2 & 1 & 0 & 0 \end{pmatrix}$$ has determinant -6 ?

1) 5 2) −2 3) 4 4) −5 5) 2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-3 + m)\, x + y + z == 4 - m$
$-2x + y + z == 3$
$-3x + y + 2z == 5$

has only a solution. For that solution compute the value of variable y

1) $y = -7$.

2) $y = 3$.

3) $y = -1$.

4) $y = 8$.

5) $y = 0$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 80% pass to the following course and 20% give up the studies.
The students of course 2: 70% finish the degree and 30% give up the studies.

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 6 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 15.697 % in the first course and 84.303 % in the second course.

2) 36.4004 % in the first course and 63.5996 % in the second course.

3) 8.617 % in the first course and 91.383 % in the second course.

4) 17.533 % in the first course and 82.467 % in the second course.

5) 0.894 % in the first course and 99.106 % in the second course.

6) 30.851 % in the first course and 69.149 % in the second course.

7) 17.2414 % in the first course and 82.7586 % in the second course.

8) 11.318 % in the first course and 88.682 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 94

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=1300-9Q. On the other hand, the production cost per ton is C=800+3Q. In addition, the transportation cost is 404 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 192 .

2) Profit = 269 .

3) Profit = 170 .

4) Profit = 250 .

5) Profit = 254 .

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} \sin(x) - 2e^x & x \le 0 \\ -x - 2 & 0 < x < 1 \\ -1 & 1 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for x = 0 .

4) The function is continuous for all the points except for x = 1 .

5) The function is continuous for all the points except for x = 0 and x = 1 .

Exercise 3

Between the months t = 3 and t = 10
, the true value of the shares of a company (in euros) are given by the function $C(t) = 484 + 300t - 45t^2 + 2t^3$.

Determine the interval where the value oscillates between the months t = 6 and t = 10 .

1) It oscillates between 984 and 1096.

2) It oscillates between 990 and 1105.

3) It oscillates between 978 and 1098.

4) It oscillates between 984 and 1109.

5) It oscillates between 984 and 1109.

Exercise 4

Compute the area enclosed by the function $f(x) = 3 + x - 3x^2 - x^3$ and the horizontal axis between the points $x = -3$ and $x = 4$.

1) $\frac{489}{4} = 122.25$

2) $\frac{483}{4} = 120.75$

3) $\frac{409}{4} = 102.25$

4) $\frac{441}{4} = 110.25$

5) $\frac{485}{4} = 121.25$

6) $\frac{481}{4} = 120.25$

7) $\frac{473}{4} = 118.25$

8) $\frac{487}{4} = 121.75$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} a & 1 & 2 & 1 \\ 2 & 4 & 3 & 2 \\ -2 & -1 & 0 & 0 \\ 2 & -2 & -1 & -1 \end{pmatrix}$ has determinant 0 ?

1) -4 2) 5 3) -1 4) 2 5) -5

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-5 + m)\, x - 2y - 2z == 1 - m$
$2x + y + z == 0$
$x + z == -1$

has only a solution. For that solution compute the value of variable x

1) $x = 9$.

2) $x = 0$.

3) $x = -1$.

4) $x = -4$.

5) $x = -3$.

Exercise 7

Certain degree consists of 2 courses. The data about the
students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 80% finish the degree and 20% repeat the course.

On the other hand, every year, the amount of students that
starts the degree is equivalent to 20% of the students in the last course

Determine the future tendency for the % of students that will be in the different courses.

1) 7.746 % in the first course and 92.254 % in the second course.

2) 6.404 % in the first course and 93.596 % in the second course.

3) 12.5 % in the first course and 87.5 % in the second course.

4) 0.213 % in the first course and 99.787 % in the second course.

5) 6.769 % in the first course and 93.231 % in the second course.

6) 4.521 % in the first course and 95.479 % in the second course.

7) 31.8729 % in the first course and 68.1271 % in the second course.

8) 6.875 % in the first course and 93.125 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 95

Exercise 1

We have a bank account that initially offers a compound interes rate of 3% , and after 4 years the conditions are modified and then we obtain a continuous compound rate of 7% . The initial deposit is 13 000 euros. Compute the amount of money in the account after 6 years from the moment of the first deposit.

1) We will have ****7.***** euros.

2) We will have ****1.***** euros.

3) We will have ****0.***** euros.

4) We will have ****2.***** euros.

5) We will have ****8.***** euros.

Exercise 2

Compute the limit: $\lim_{x\to-\infty} \dfrac{1+8x+x^2}{-6-5x+2x^2-7x^3}$

1) 0

2) $-\infty$

3) $-\dfrac{3}{4}$

4) -1

5) 1

6) ∞

7) $-\dfrac{1}{2}$

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} e^{x+1} + 2\cos(x+1) + 4 & x \le -1 \\ \frac{1}{3}\left(-x^2 + x + 23\right) & -1 < x < 2 \\ \sin(2-x) - 2\cos(2-x) + 9 & 2 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x=-1$.

4) The function is differentiable for all points except for $x=2$.

5) The function is differentiable for all points except for $x=-1$ and $x=2$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(7 + 8t)\right)(\cos(2\pi t) + 1)$ per-unit.

The initial deposit in the account is 19 000 euros. Compute the deposit after 2 years.

1) 25647.3173 euros

2) 25717.3173 euros

3) 25687.3173 euros

4) 25707.3173 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} 0 & a & 1 & -1 \\ 0 & -2 & -1 & 1 \\ 0 & -1 & 2 & -1 \\ 1 & -2 & -3 & 1 \end{pmatrix}$ has determinant -2 ?

1) -4 2) -1 3) -3 4) -2 5) 0

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(3 + m)x + 3y + 3z == m$
$x + y + z == 0$
$2x + 2y + 3z == -2$

has only a solution.

1) We have unique solution for $m \le 3$.

2) We have unique solution for $m \ge -3$.

3) We have unique solution for $m \ne 2$.

4) We have unique solution for $m \le -3$.

5) We have unique solution for $m \ne -3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 20% repeat the course and 10% give
The students of course 2: 80% finish the degree and 20% give up the studies.

On the other hand, every year, the students of the last course, in a way or another, promote their degree in such a way that for every 9 students in the las course (course 2), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 24.254 % in the first course and 75.746 % in the second course.

2) 30.7692 % in the first course and 69.2308 % in the second course.

3) 36.1473 % in the first course and 63.8527 % in the second course.

4) 38.716 % in the first course and 61.284 % in the second course.

5) 11.924 % in the first course and 88.076 % in the second course.

6) 8.445 % in the first course and 91.555 % in the second course.

7) 32.849 % in the first course and 67.151 % in the second course.

8) 4.735 % in the first course and 95.265 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 96

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula P=80000−15Q. On the other hand, the production cost per ton is C=10000+20Q. In addition, the transportation cost is 67620 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit = 40 460 .

2) Profit = 36 264 .

3) Profit = 34 735 .

4) Profit = 62 459 .

5) Profit = 26 163 .

Exercise 2

A factory produces certain type of devices. The marginal cost (cost of producing one unit) decreases when we produce a large amount of units and it is given by the function $C(x) = \dfrac{9 + 2x + 5x^2 + 7x^3 + 6x^4}{5 + 9x + 8x^2 + 3x^3 + 6x^4}$. Determine the expected cost per unit when a large amount of units is produced.

1) 0

2) 1

3) $\dfrac{109}{100}$

4) ∞

5) $-\infty$

6) $-\dfrac{3}{2}$

7) 1000

Exercise 3

Study the differentiability of the function $f(x) = \begin{cases} e^x - 2\cos(x) - 3 & x \le 0 \\ x - 2x^2 & 0 < x < 1 \\ \sin(1-x) + 3\cos(1-x) - 4 & 1 \le x \end{cases}$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for x= 0 .

4) The function is differentiable for all points except for x= 1 .

5) The function is differentiable for all points except for x= 0 and x= 1 .

Exercise 4

Certain bank account offers a variable continuous compound
interes rate. The interest rate for each year is given by the function

$I(t) = \left(\frac{1}{100}(5 + 7t)\right)(\cos(2\pi t) + 1)$ per-unit.

The initial deposit in the account is 4000 euros. Compute the deposit after 2 years.

1) 5134.9966 euros

2) 5084.9966 euros

3) 5144.9966 euros

4) 5124.9966 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & -1 & 2 & 2 \\ 1 & 1 & a & 1 \\ 2 & -1 & 1 & 0 \\ -2 & 1 & 2 & 1 \end{pmatrix}$$ has determinant 22 ?

1) 5 2) −5 3) 4 4) 1 5) 0

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(-3 + m)\,x + y - z == -1 + m$
$4\,x + y + z == 4$
$-x - y == -2$

has only a solution.

1) We have unique solution for $m \neq 1$.

2) We have unique solution for $m \neq 2$.

3) We have unique solution for $m \neq -2$.

4) We have unique solution for $m \geq -3$.

5) We have unique solution for $m \leq 3$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} 2 & 0 & 4 \\ -4 & -2 & -4 \\ 2 & 2 & 0 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = 2$ is an eigenvalue with eigenvector $(\,-2\;\;-1\;\;-2\,)$.

2) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(\,-2\;\;-1\;\;-1\,)$.

3) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(\,1\;\;-1\;\;0\,)$.

4) The matrix is diagonalizable and $\lambda = 3$ is an eigenvalue with eigenvector $(\,-2\;\;1\;\;0\,)$.

5) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(\,1\;\;0\;\;-1\,)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 97

Exercise 1

Certain parcel of land is devalued from an initial value of 433 000 euros until a final value of 104 000 euros along 7 years. Determine the rate of compound interes for that devaluation.

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) The interest rate is **9.***** %.

2) The interest rate is **8.***** %.

3) The interest rate is **2.***** %.

4) The interest rate is **4.***** %.

5) The interest rate is **1.***** %.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} 0 & x \le 0 \lor 0 < x < 2 \\ 3\log(x-1) & 2 \le x \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 2$.

5) The function is continuous for all the points except for $x = 0$ and $x = 2$.

Exercise 3

Study the differentiability of the function $f(x) =$

$$\begin{cases} -e^{x-2} - 2\sin(2)\sin(x) - 2\cos(2)\cos(x) + 5 & x \le 2 \\ 2e(x-2) - 2e^{x-2} - x + x\sin(1) + \cos(2-x) + 5 - 2\sin(1) & 2 < x < 3 \\ -e^{x-3} + \cos(3-x) + 5 + \sin(1) + \cos(1) & 3 \le x \end{cases}$$

1) The function is differentiable for all points.

2) The function is not differentiable at any point.

3) The function is differentiable for all points except for $x = 2$.

4) The function is differentiable for all points except for $x = 3$.

5) The function is differentiable for all points except for $x = 2$ and $x = 3$.

Exercise 4

Certain bank account offers a variable continuous compound interes rate. The interest rate for each year is given by the function

$I(t) = (\frac{1}{100}(2+5t))(\cos(2\pi t)+2)$ per-unit.

The initial deposit in the account is 17 000 euros. Compute the deposit after 2 years.

1) 22553.2068 euros

2) 22503.2068 euros

3) 22493.2068 euros

4) 22513.2068 euros

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} -2 & 1 & 0 & 0 \\ a & 0 & 1 & -1 \\ 1 & 1 & 1 & 0 \\ 2 & 0 & 0 & -1 \end{pmatrix}$$ has determinant -8 ?

1) -2 2) -3 3) -5 4) 0 5) -1

Exercise 6

Determine the values of the parameter, m, for which the linear system

$m x - y - z == 3 + m$
$x + y + z == -2$
$x + 2 y + 3 z == -6$

has only a solution.

1) We have unique solution for $m \neq -1$.

2) We have unique solution for $m \neq -2$.

3) We have unique solution for $m \leq 2$.

4) We have unique solution for $m \neq -2$.

5) We have unique solution for $m \geq -3$.

Exercise 7

Diagonalize the matrix $\begin{pmatrix} -3 & 1 & 3 \\ -4 & 1 & 4 \\ -2 & 1 & 2 \end{pmatrix}$ and select the correct option amongst the ones below:

1) The matrix is diagonalizable and $\lambda = -2$ is an eigenvalue with eigenvector $(-2\ \ -2\ \ 1)$.

2) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(-1\ \ 0\ \ -1)$.

3) The matrix is diagonalizable and $\lambda = 0$ is an eigenvalue with eigenvector $(3\ \ 0\ \ 0)$.

4) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(0\ \ 1\ \ -3)$.

5) The matrix is diagonalizable and $\lambda = 1$ is an eigenvalue with eigenvector $(-1\ \ 0\ \ -1)$.

6) The matrix is not diagonalizable.

Remark: TO GIVE AN ANSWER FOR THE EXERCISE, THE FIRST THING TO CHECK IS WHETHER THE MATRIX IS DIAGONALIZABLE or not (a matrix is diagonalizable whenever the total number of independent eigenvectors obtained for all the eigenvalues is equal to the size of the matrix). For instance, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we would have only two independent eigenvectors (namely, (1,1,-1) and (1,0,1)) and the matrix is not diagonalizable. For example, consider a matrix of size 3x3 with only two eigenvalues, λ=1 with eigenvectors $\langle(1,1,-1),(0,1,1)\rangle$ and λ=3 with eigenvectors $\langle(1,0,1)\rangle$, then we have three independet eigenvectors ((1,1,-1),(0,1,1) and (1,0,1)) for a matrix of size 3 and therefore this matrix is diagonalizable. On the other hand, it is necessary to recall that every eigenvalue has infinity asociated eigenvectors. For instance, if the eigenvectors for certain eigenvalue are given by $\langle(2,1)\rangle$, we will have as eigenvector not only (2,1) but also the rest of its linear combinations (as (4,2)=2(2,1), (6,3)=3(2,1), etc.) although they are not independent with (2,1).

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 98

Exercise 1

A firm sells Q tons of certain product. The price received per ton is given by the formula $P = 15000 - 13Q$. On the other hand, the production cost per ton is $C = 4000 - 11Q$. In addition, the transportation cost is 10880 per ton. Compute the maximum profit that can be obtained selling this product.

1) Profit $= 1723$.

2) Profit $= 1256$.

3) Profit $= 1987$.

4) Profit $= 2050$.

5) Profit $= 1800$.

Exercise 2

Study the continuity of the function $f(x) = \begin{cases} e^x + 2\sin(x) & x \le 0 \\ 1 - 2\log(x+1) & 0 < x < 3 \end{cases}$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = 0$.

4) The function is continuous for all the points except for $x = 3$.

5) The function is continuous for all the points except for $x = 0$ and $x = 3$.

Exercise 3

Between the months $t = 3$ and $t = 9$
, the true value of the shares of a company (in euros) are given by the function $C(t) = 277 + 180t - 33t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 4$ and $t = 8$.

1) It oscillates between 601 and 602.

2) It oscillates between 605 and 619.

3) It oscillates between 574 and 682.

4) It oscillates between 607 and 620.

5) It oscillates between 597 and 629.

Exercise 4

Compute the area enclosed by the function $f(x) = -12 - 2x + 8x^2 - 2x^3$ and the horizontal axis between the points $x = 1$ and $x = 5$.

1) $\frac{173}{3} = 57.6667$

2) $\frac{349}{6} = 58.1667$

3) $\frac{137}{3} = 45.6667$

4) $\frac{167}{3} = 55.6667$

5) $\frac{343}{6} = 57.1667$

6) $\frac{176}{3} = 58.6667$

7) $\frac{160}{3} = 53.3333$

8) $\frac{355}{6} = 59.1667$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$\begin{pmatrix} -1 & 1 & -1 & 1 \\ 1 & 2 & -2 & 1 \\ a & 1 & 1 & 2 \\ 1 & 1 & 0 & 0 \end{pmatrix}$ has determinant 7 ?

1) 1   2) −3   3) −2   4) 2   5) 3

Exercise 6

Determine the values of the parameter, m, for which the linear system

$(4 + m)x - y - 2z == -4 - m$
$-2x + y + z == 2$
$-5x + y + 2z == 5$

has only a solution. For that solution compute the value of variable y

1) $y = 2$.

2) $y = -6$.

3) $y = -1$.

4) $y = 0$.

5) $y = 9$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 90% pass to the following course and 10% repeat the course.
The students of course 2: 80% finish the degree and 20% repeat the course.

On the other hand, every year, the students, in a way or another, promote their degree in such a way that for every 3 student in the degree (for al the courses), a new student is convinced to enrole in the degree.

Determine the future tendency for the % of students that will be in the different courses.

1) 9.223 % in the first course and 90.777 % in the second course.

2) 20.5882 % in the first course and 79.4118 % in the second course.

3) 5.098 % in the first course and 94.902 % in the second course.

4) 28.389 % in the first course and 71.611 % in the second course.

5) 21.616 % in the first course and 78.384 % in the second course.

6) 39.378 % in the first course and 60.622 % in the second course.

7) 42.9179 % in the first course and 57.0821 % in the second course.

8) 40.231 % in the first course and 59.769 % in the second course.

Mathematics 1 - ADE - English - 2024/2025
Exam-training for serial number: 99

Exercise 1

We have one bank account that offers a continuous compound rate of 5% where we initially deposit 12 000 euros. How long time is it necessary until the amount of money in the account reaches 14 000 euros?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **7.***** years.

2) In **0.***** years.

3) In **5.***** years.

4) In **3.***** years.

5) In **9.***** years.

Exercise 2

The population of a city is studied between years t=1 and t=10. In that period the population is given by the function $P(t) = 756\,t - 96\,t^2 + 4\,t^3$. Determine the intervals of years when the population is between 1944 and 1960.

1) Along the interval of years: [3., 5.45118].

2) Along the intervals of years: [1., 7.24893] and [8.00108, 9.4372].

3) Along the intervals of years: [3.15509, 8.30006] and [9.50245, 10.].

4) Along the intervals of years: [1, 6], [7, 7], [9, 9] and [10, 10].

5) Along the interval of years: [1.01068, 2.].

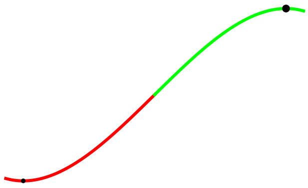
6) Along the intervals of years: [2.44626, 4.] and [5., 6.47937].

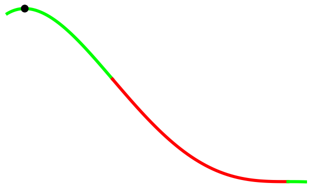
7) Along the interval of years: [6, 10].

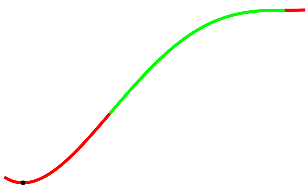
8) Along the interval of years: [2.25753, 3.65683].

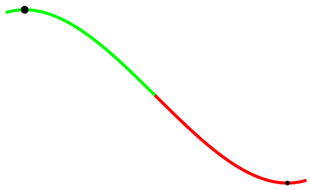
Exercise 3

Study the shape properties of the $f(x) = 5 + 48x - 12x^3 + 3x^4$
to decide which amongst the following ones is the representation of the function.

1) 

2) 

3) 

4) 

Big point: maximum

Small point: minimum

Red line: convexity

Green line: concavity

Indication: To find the maximun and minimum points of the function,
try (with Ruffini) the points −2, −1, 0, 1, 2. To solve this exercise
it is necessary to determine the increasing and decreasing intervals.

Exercise 4

The deposits of an investment fund vary from one year to
another being the speed of that variation determined by the function

$v(t) = 10\,e^{-2+2t}$ millions of euros/year.

If the initial deposit in the investment fund was 70
millions of euros, compute the depositis available after 1 year.

1) $70 - \frac{5}{e^2} + 5\,e^4$ millions of euros = 342.3141 millions of euros

2) $75 - \frac{5}{e^2}$ millions of euros = 74.3233 millions of euros

3) $70 - \frac{5}{e^2} + 5\,e^2$ millions of euros = 106.2686 millions of euros

4) $70 + \frac{5}{e^4} - \frac{5}{e^2}$ millions of euros = 69.4149 millions of euros

Exercise 5

Solve for the matrix X in the following equation:

$$\begin{pmatrix} 5 & 3 \\ -2 & -1 \end{pmatrix} . X . \begin{pmatrix} -1 & -1 \\ 2 & 1 \end{pmatrix}^{-1} = \begin{pmatrix} 18 & 10 \\ -7 & -4 \end{pmatrix}$$

1) $\begin{pmatrix} -2 & * \\ * & * \end{pmatrix}$ 2) $\begin{pmatrix} -1 & * \\ * & * \end{pmatrix}$ 3) $\begin{pmatrix} 2 & * \\ * & * \end{pmatrix}$ 4) $\begin{pmatrix} * & -1 \\ * & * \end{pmatrix}$ 5) $\begin{pmatrix} * & 0 \\ * & * \end{pmatrix}$

Exercise 6

Find the solution of the linear system

$x_1 - 2x_2 + 3x_3 + x_4 == -1$
$-4x_2 - 2x_3 - x_4 == -2$
$x_1 + 2x_2 + 5x_3 + 2x_4 == 1$

taking as parameters, if it is necessary, the
first variables and solving for the last ones (that is to say,
apply Gauss elimination technique selecting columns from right to left)
. Express the solution by means of linear combinations.

1) $\begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 6 \end{pmatrix} \right\rangle$

2) $\begin{pmatrix} ? \\ -1 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ -1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 7 \\ ? \end{pmatrix} \right\rangle$

3) $\begin{pmatrix} ? \\ ? \\ -4 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 1 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 9 \\ ? \end{pmatrix} \right\rangle$

4) $\begin{pmatrix} ? \\ ? \\ -3 \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ ? \\ ? \\ 2 \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -16 \end{pmatrix} \right\rangle$

5) $\begin{pmatrix} ? \\ -4 \\ ? \\ ? \end{pmatrix} + \left\langle \begin{pmatrix} ? \\ -2 \\ ? \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ 9 \\ ? \end{pmatrix}, \begin{pmatrix} ? \\ ? \\ ? \\ -5 \end{pmatrix} \right\rangle$

Exercise 7

Compute a matrix with the following eigenvalues and eigenvectors:

- $\lambda_1 = -1$, with eigenvectors $V_1 = \langle (-3 \;\; 8) \rangle$
- $\lambda_2 = 1$, with eigenvectors $V_2 = \langle (-5 \;\; 13) \rangle$

1) $\begin{pmatrix} 79 & 30 \\ -208 & -79 \end{pmatrix}$ 2) $\begin{pmatrix} 79 & -48 \\ 130 & -79 \end{pmatrix}$ 3) $\begin{pmatrix} 79 & 130 \\ -48 & -79 \end{pmatrix}$ 4) $\begin{pmatrix} -3 & -1 \\ -1 & -3 \end{pmatrix}$ 5) $\begin{pmatrix} 79 & -208 \\ 30 & -79 \end{pmatrix}$

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Exercise 1

We have two bank accounts, the first in the bank A and the second in the bank B. In the bank A we obtain a continuous compound rate of 1% and in the bank B we are paid a continuous compound rate of 10% . We initially deposit 15 000 euros in the bank A and 7000 in B. How long time is it necessary until the money in both accounts is exactly the same?

Remark: To obtain a correct answer it is necessary to work with at least 5 decimal digits.

1) In **5.***** years.

2) In **8.***** years.

3) In **0.***** years.

4) In **1.***** years.

5) In **3.***** years.

Exercise 2

Study the continuity of the function $f(x) =$

$$\begin{cases} e^{x+1} - 3\sin(x+1) & x \leq -1 \\ 2\sin(x+1) + \cos(x+1) + 2 - 2\sin(2) - \cos(2) & -1 < x < 1 \\ 2e^{x-1} - 3\sin(1-x) & 1 \leq x \end{cases}$$

1) The functions is continuous for all points.

2) The functions is not continuous at any point.

3) The function is continuous for all the points except for $x = -1$.

4) The function is continuous for all the points except for $x = 1$.

5) The function is continuous for all the points except for $x = -1$ and $x = 1$.

Exercise 3

Between the months $t = 0$ and $t = 4$, the true value of the shares of a company (in euros) are given by the function $C(t) = 6 + 12t - 9t^2 + 2t^3$.

Determine the interval where the value oscillates between the months $t = 0$ and $t = 4$.

1) It oscillates between 10 and 11.

2) It oscillates between -1 and 39.

3) It oscillates between -3 and 36.

4) It oscillates between 6 and 38.

5) It oscillates between 13 and 41.

Exercise 4

Compute the area enclosed by the function $f(x) = 6 - x - 4x^2 - x^3$ and the horizontal axis between the points $x = -4$ and $x = 5$.

1) $\frac{3617}{12} = 301.4167$

2) $\frac{3925}{12} = 327.0833$

3) $\frac{1179}{4} = 294.75$

4) $\frac{3937}{12} = 328.0833$

5) $\frac{3919}{12} = 326.5833$

6) $\frac{3631}{12} = 302.5833$

7) $\frac{3901}{12} = 325.0833$

8) $\frac{3943}{12} = 328.5833$

Exercise 5

Compute the value for parameter a in such a way that the matrix

$$\begin{pmatrix} 1 & -2 & 1 & -1 \\ -1 & 2 & -1 & 2 \\ 1 & 0 & 0 & -1 \\ -2 & a & -1 & 1 \end{pmatrix}$$ has determinant 1 ?

1) -4 2) 4 3) 3 4) -1 5) -2

Exercise 6

Determine the values of the parameter, m, for which the linear system

$$x + y - 2z == 1$$
$$-x - y + (4 + m) z == -3 - m$$
$$-x - 2y + 3z == -1$$

has only a solution. For that solution compute the value of variable z

1) $z = -5$.

2) $z = 8$.

3) $z = 7$.

4) $z = -1$.

5) $z = -3$.

Exercise 7

Certain degree consists of 2 courses. The data about the students that repeat a course or pass to the following one reveal that:

The students of course 1: 70% pass to the following course, 10% repeat the course and 20% give
The students of course 2: 60% finish the degree and 40% repeat the course.

On the other hand, every year, the amount of students that starts the degree is equivalent to 10% of the total number of students in the degree (in all the courses).

Determine the future tendency for the % of students that will be in the different courses.

1) 4.01 % in the first course and 95.99 % in the second course.

2) 24.284 % in the first course and 75.716 % in the second course.

3) 5.436 % in the first course and 94.564 % in the second course.

4) 0 % in the first course and 100. % in the second course.

5) 16.154 % in the first course and 83.846 % in the second course.

6) 20.7107 % in the first course and 79.2893 % in the second course.

7) 14.33 % in the first course and 85.67 % in the second course.

8) 13.492 % in the first course and 86.508 % in the second course.