EXAMINATION QUESTION PAPER - Course paper

EBA 29101
Mathematics for Business Analytics

Department of Economics

Start date:	03.10.2019	Time 09.00
Finish date:	11.10.2019	Time 12.00

Weight:	Pass / Fail
Total no. of pages:	4 incl. front page
No. of attachments files to question paper:	0
To be answered:	Individually

Answer paper size:	No limit. excl. attachments
Max no. of answer paper attachment files:	0
Allowed answer paper file types:	pdf

Term paper - EBA2911[1] Mathematics for Business Analytics

3 Oct. – 11 Oct. 2019

The problem set has 3 pages. All 26 subproblems have equal weight. To pass 60% score is required.

You are required to give reasons for all answers.

Your answers should be provided digitally, as a .pdf file. You are encouraged to write with a pen (almost always the best) and scan your paper. Check that the resulting file is easy to read, pencil writing can result in weak scans. For more information, see:
https://portal.bi.no/en/examination/digital-examination/digital-submission/

Problem 1

Solve the equations.

a) $x^4 - 5x^2 - 36 = 0$ b) $x - 5\sqrt{x} - 36 = 0$ c) $\frac{1}{x^2} - \frac{5}{x} - 36 = 0$

d) $\sqrt{2x-1} + \sqrt{x-1} = 5$

Problem 2

Solve the inequalities.

a) $\frac{(x-2)}{(x+2)(x-3)} \leqslant 0$ b) $\frac{(x-2)}{(x+2)(x-3)} \leqslant -1$

Problem 3

Write the fourth degree polynomial $0{,}1x^4 - 2{,}4x^3 + 11{,}8x^2 + 31{,}2x + 16{,}9$ as a product of first degree polynomials.

Problem 4

a) Compute how much you have to deposit today for the balance to be 2 million after 10 years if the interest is 2,1%.
b) You have deposited the amount from (a). After 6 years the interest is changed to 2,7%. Compute the balance after 10 years.
c) Explain why the answer in (b) is given by the expression $2\,\text{mill} \cdot \left(\frac{1{,}027}{1{,}021}\right)^4$.
d) Compute the amount you would have to deposit in the case of (b) for the balance to be 3 million after 10 years.
e) Explain why the answer in (d) is given by the expression $\frac{3\,\text{mill}}{1{,}027^4 \cdot 1{,}021^6}$.

Problem 5

We have the cash flow

Year	0	1	5	6
Payment	−20	−20	30	45

Suppose the rate of discount is 10%.
a) Compute the future value after 6 years.

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b) Compute the present value.
c) Suppose the interest is r with annual compounding, and that the future value of the cash flow after n years is K_n. In particular, K_0 is the present value of the cash flow. Check that the equation

$$K_6 = K_0 \cdot (1+r)^6 \qquad (*)$$

is correct in the case (a-b). Explain why $(*)$ is correct for any cash flow.

Problem 6

Kåre considers a mortgage with monthly payments running for 25 years. He reckons he can afford to pay 15 000 each term. The first payment is 5 years from now.
a) Suppose the interest is 6% with monthly compounding. Determine the geometric series that gives the present value of the cash flow and use this to calculate how much Kåre can borrow.
b) Suppose the interest is 6% with continuous compounding. Determine the geometric series that gives the present value of the cash flow and use this to calculate how much Kåre can borrow.

Problem 7

Hege considers to buy a contract for 20 million which should give her n annual payments. The first payment A is due 15 years from now and will increase by 3% each year. Suppose the rate of discount is 5%.
a) Write down the geometric series for the total present value of the payments if $n = 25$. Determine in particular the first term of the series a_1 and the multiplicative factor k. Use this series to compute A (we assume the contract is balanced/fair).
b) Suppose instead that the payments continue forever. Compute A.

Problem 8

a) Determine the expression of the second degree polynomial function $f(x)$ in the upper part of figure 1.
b) Determine the equation of the ellipse in the lower part of figure 1.

Problem 9

Figure 2 shows a hyperbola.
a) Determine the expression of the hyperbolic function $f(x)$.
b) Use the expression in (a) to determine the horizontal and the vertical asymptote.

Problem 10

Determine the quadratic expression of the form $3x^2 + bx + c$ which has the given roots.
a) $x = 5 \pm \sqrt{3}$
b) $x = -11$

Problem 11

Use one parameter to write an expression for all polynomials on the form $x^3 + ax^2 + bx + c$ which have exactly two zeros of distance 3 from each other.

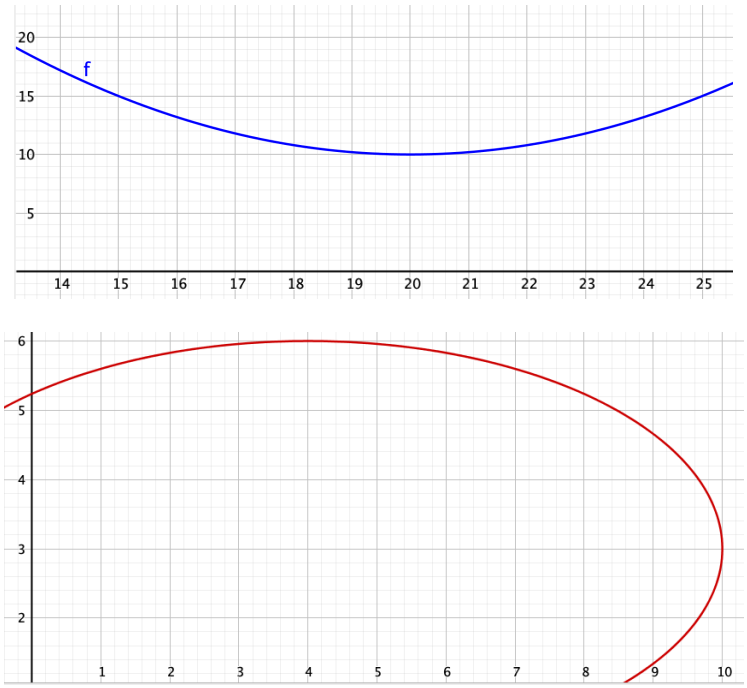

Figure 1: Parabola and ellipse

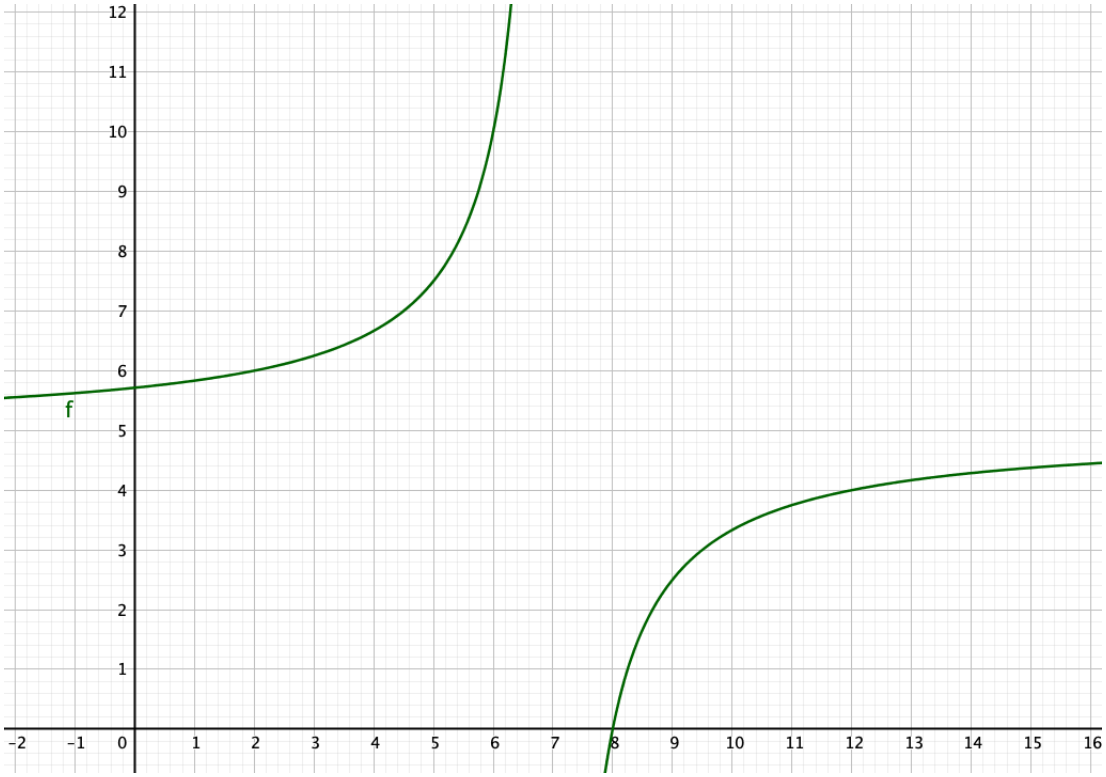

Figure 2: Hyperbola