EXAMINATION QUESTION PAPER - Course paper

EBA 29101
Mathematics for Business Analytics

Department of Economics

Start date:	04.03.2020	Time 09.00
Finish date:	11.03.2020	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
Re-sit	Ordinary

Term paper - EBA2911[1] Mathematics for Business Analytics

4 March – 11 March 2020

The problem set has 3 pages. All 25 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) $6x(x-4)(2x+5)(10-3x)=0$

b) $\dfrac{2}{x+1}+\dfrac{3x}{x+2}=2$

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

d) $x+\dfrac{x^2}{1.03}+\dfrac{x^3}{1.03^2}+\cdots+\dfrac{x^{19}}{1.03^{18}}+\dfrac{x^{20}}{1.03^{19}}=0$

Problem 2

Solve the inequalities.

a) $\dfrac{(x-10)(x+20)}{(x-30)}\geqslant 0$

b) $\dfrac{x(x-10)}{(x-5)}\geqslant -10$

Problem 3

Write the polynomial $f(x)=x^4-14x^3+50x^2-14x+49$ as a product of polynomials of lowest possible degree.

Problem 4

You are supposed to be paid 200 000 every year for n years with the first payment 6 years from now. Assume the interest is 5% with yearly compounding.

a) Write down the geometric series which gives the present value of the cash flow.
b) Use the geometric series to compute the present value of the cash flow if $n=10$, $n=20$ and $n=50$.
c) Use the geometric series to compute the present value of the cash flow if if the payments continue forever.

Problem 5

A pharmaceutical company plans to test a new drug and then sell the patent. The testing lasts for 8 years. The patent is sold immediately after testing ends.

a) In one cost model 250 million is payed at the beginning of every year. Suppose the rate of discount is set to 15%. What should the patent cost for the rate of discount to equal the internal rate of return for the cash flow?
b) In another cost model the total costs of 1.2 billion is payed at the beginning of the test period. Suppose the patent is sold for 3.6 billion. Calculate the internal rate of return for the cash flow.

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Problem 6

Kåre considers a mortgage with monthly payments running for 30 years. He reckons he can afford to pay 10 000 each term. The first payment is 4 years from now.

a) Suppose the interest is 3% 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) Kåre chooses to take the mortgage. But after 10 years from now the interest is changed to 6%. Compute the new monthly payment.

Problem 7

Hege considers to buy a contract for 80 million which should give her 12 annual payments. The first payment A is due 3 years from now and the payment will increase by 10% each year. Suppose the rate of discount is 5%.

a) Write down the geometric series for the total present value of the payments. Determine in particular the first term of the series a_1, the multiplicative factor k and the number of terms n.
b) Use this series to compute A (we assume the contract is balanced/fair).

Problem 8

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

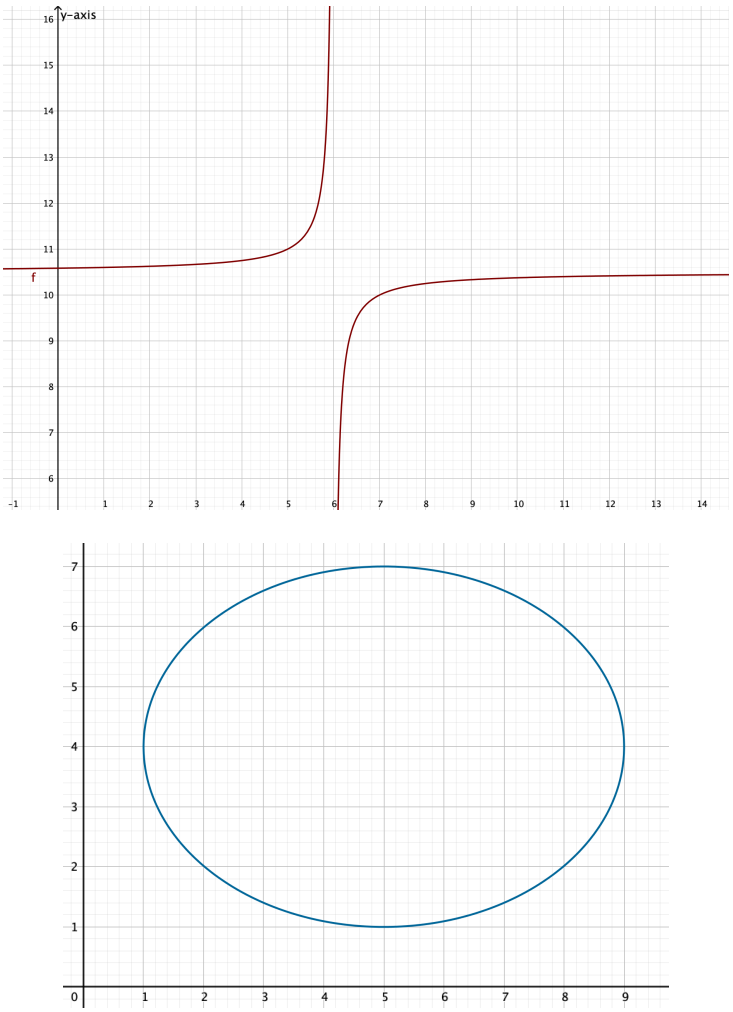

Figure 1: Hyperbola and ellipse

Problem 9

We have a second degree polynomial function $f(x)$ with graph as in figure 2.

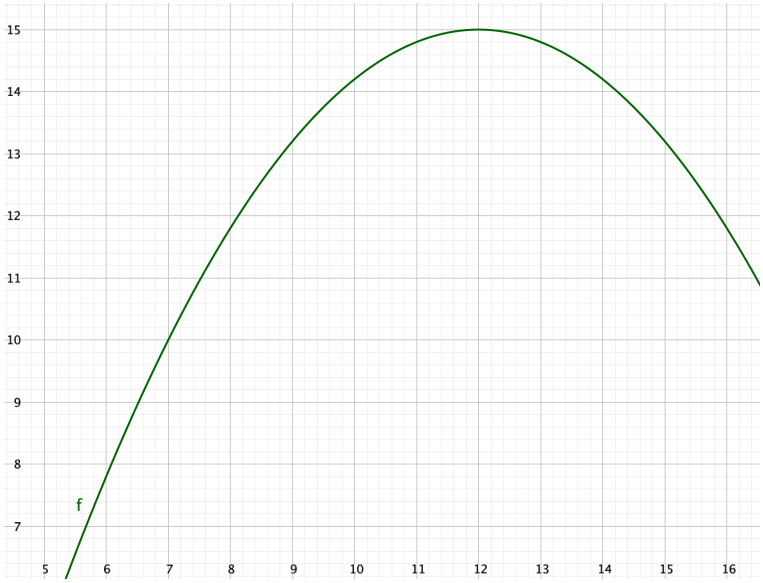

Figure 2: The graph of the second degree polynomial function $f(x)$

a) Calculate $f(17)$.
b) Calculate the zeros of $f(x)$.

Problem 10

a) Determine the quadratic expression of the form $ax^2 + bx + 12$ which has the roots $x = 2 \pm \sqrt{2}$.
b) Determine the quadratic expression of the form $ax^2 - 7x + c$ which has the roots $x = 2$ and $x = 5$.
c) Determine the quadratic expression of the form $a(x-s)^2 + d$ such that the only root is $x = 4$ and the point $(7, 1)$ is contained in the graph.

Problem 11

Use two parameters to write an expression for all third degree polynomials on the form $x^3 + ax^2 + bx + c$ which have exactly three zeros such that the distance from the largest zero to the middle one is twice the distance from the the smallest zero to the middle one.

Problem 12

Suppose the cost function is $C(x) = 7200 + 3x$ and the revenue function is $R(x) = ax$. Determine which values of a gives positive profit for $x > 150$ and negative profit for $x < 150$.