

# EBA 29101

## Mathematics for Business Analytics

Department of Economics

<b>Start date:</b>	09.10.2020	Time 09.00
<b>Finish date:</b>	16.10.2020	Time 12.00

<b>Weight:</b>	Pass / Fail
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<b>Total no. of pages:</b>	4 incl. front page
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<b>No. of attachments files to question paper:</b>	0
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<b>To be answered:</b>	Individually
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<b>Answer paper size:</b>	No limit. excl. attachments
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<b>Max no. of answer paper attachment files:</b>	0
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<b>Allowed answer paper file types:</b>	pdf
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## Term paper - EBA2911<sup>1</sup> Mathematics for Business Analytics

9 Oct. – 16 Oct. 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

a) Calculate the sum

$$\frac{10\,000}{1,01^{36}} + \frac{10\,000}{1,01^{37}} + \frac{10\,000}{1,01^{38}} + \dots + \frac{10\,000}{1,01^{215}}$$

Describe a financial situation where the sum is used.

b) Describe a financial situation where the sum

$$\frac{10\,000}{e^{0,36}} + \frac{10\,000}{e^{0,37}} + \frac{10\,000}{e^{0,38}} + \dots + \frac{10\,000}{e^{2,15}}$$

is used.

### Problem 2

Hege is considering an investment proposition given by the cash flow

Year	0	2	8	9	10
Payment	-30	-30	40	40	40

Suppose the discount rate is 15%.

- Calculate the present value of the cash flow.
- Calculate the future value of the cash flow after 7 years.
- For the investment to have 15% as internal rate of return Hege suggests an extra payment after 7 years. Determine this payment.

### Problem 3

Solve the equations.

- $3(x-2)(4x-7)(9+x) = 0$
- $x^6 - 6x^3 = 16$
- $\sqrt{3x+4} - \sqrt{x-7} = 5$
- $\frac{e^{0,2x}}{e^{0,2x} - 10} = 11$
- $\ln(x) - \ln(x-3) = 1,12$

### Problem 4

Solve the inequalities.

- $\frac{x^2 - 4x + 5}{x - 4} \geq 0$
- $\frac{2x - 12}{(x - 3)(x + 4)} \geq 1$
- $e^{-0,1x} \leq 20$
- $\ln(x - 1) \leq 3$

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<sup>1</sup>Exam code EBA29101

### Problem 5

We have  $f(x) = x^4 - 14x^3 + 53x^2 - 40x - 1$  and  $g(x) = x(x-1)(x-5)$ .

- Calculate the remainder of the polynomial division  $f(x) : g(x)$ .
- Determine the asymptotes of the rational function  $\frac{f(x)}{g(x)}$ .

### Problem 6

A part of the graph of the second degree polynomial function  $f(x)$  is seen in figure 1. Determine the zeros of  $f(x)$ .

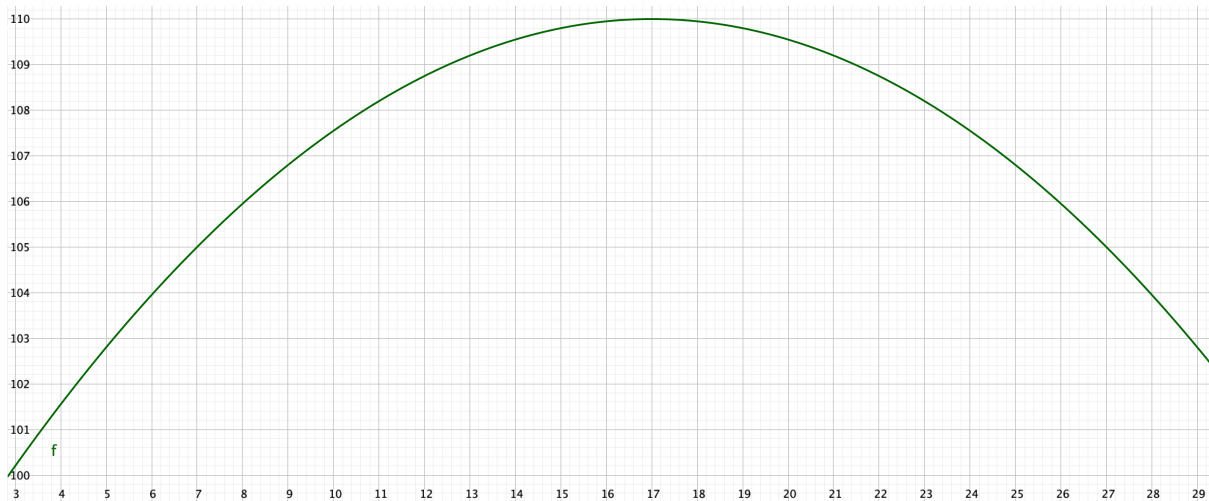


Figure 1: Parabola

### Problem 7

Figure 2 shows a part of an ellipse.

- Determine the equation of the ellipse.
- The point  $P = (10, 3)$  is on the ellipse and the line  $L$  passes through  $P$  and has slope  $-0,3$ . Determine the other intersection point between the ellipse and the line  $L$ .



Figure 2: Ellipse

### Problem 8

A part of the graph of the hyperbola function  $f(x)$  is shown in figure 3. Determine the expression of  $f(x)$ .

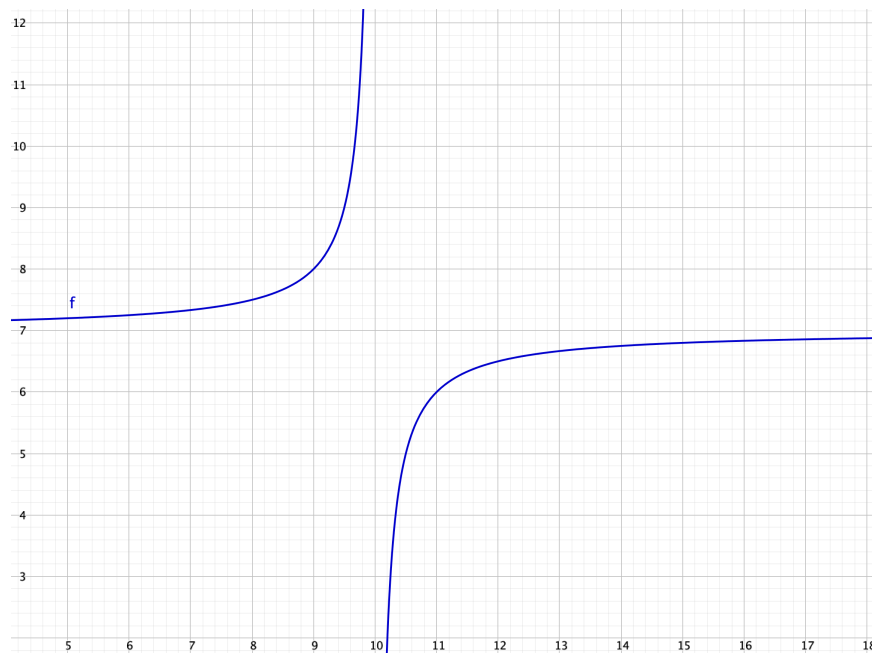


Figure 3: Hyperbola

### Problem 9

Determine the inverse function  $g(x)$ . Also determine the domain of definition  $D_g$  and the range  $R_g$ .

- $f(x) = -0,5x + 10$  with domain of definition  $D_f = [0, 20]$ .
- $f(x) = 2\ln(x + 3) - 1$  with domain of definition  $D_f = \langle -3, \infty \rangle$ .

### Problem 10

We imagine a cash flow with two payments:

Year	$m$	$n$
Payment	$-A$	$B$

We assume continuous compounding.

- Suppose  $m = 0$ ,  $n = 3$ ,  $A = 10$  and  $B = 18$ . Calculate the internal rate of return (IRR) of the cash flow.
  - Suppose  $m = 5$ ,  $n = 8$ ,  $A = 10$  and  $B = 18$ . Calculate the IRR of the cash flow.
  - Suppose  $m = 5$ ,  $n = 11$ ,  $A = 10$  and  $B = 18$ . Calculate the IRR of the cash flow.
- Assume the numbers  $m$ ,  $n$ ,  $A$  and  $B$  are greater or equal to 0. Determine an expression for the IRR of the cash flow which uses the variables  $m$ ,  $n$ ,  $A$  and  $B$ .
- Suppose  $A = 10$  and  $B = 18$ . Explain why the IRR only depends on the length of the time interval between the two payments (irrespective of when the first payment happens). Also explain why twice as long time interval between the payments halves the IRR.