

**EBA2911 Mathematics for Business Analytics**  
**autumn 2019**  
**Exercises**

*... if I couldn't formulate a problem in economic theory mathematically, I didn't know what I was doing.*

R. Lucas

**Lecture 6**

Sec. 4.7, 3.4-5, 2.6

**Polynomial division. Factorisation. Rational and radical equations. Inequalities.**

Here are recommended exercises from the textbook [SHSC].

Section 4.7 exercise 1-6

Section 3.4 exercise 1, 2

Section 3.5 exercise 2-4

Section 2.6 exercise 1-4, 7

**Problems for the exercise session**

**Wednesday 18 Sept. from 14 o'clock in B2-085**

**Problem 1** Perform the polynomial division with remainder.

- a)  $(x^2 + 4x - 21) : (x - 3)$     b)  $(x^2 + 4x - 21) : (x - 4)$     c)  $(x^3 + x^2 - 23x + 42) : (x + 6)$   
d)  $(x^3 + x^2 - 23x + 42) : (x + 1)$     e)  $(x^4 + x^2 + 1) : (x^2 - x + 1)$     f)  $(x^2 + 3x - 7) : (x - a)$

**Problem 2** Factor the polynomial in factors of the least possible degree (e.g. by guessing on a zero and perform polynomial division).

- a)  $x^2 + 4x - 221$     b)  $x^3 + 6x^2 - x - 30$     c)  $x^3 - 3x^2 + 5x - 15$   
d)  $x^4 + 10x^3 + 35x^2 + 50x + 24$

**Problem 3** Solve the equations.

- a)  $\frac{5x + 1}{x^2 + x + 1} = -2$     b)  $\frac{x - 1}{x^2 + x + 1} = 1$     c)  $\frac{1}{1 + \frac{1}{x}} = \frac{1}{x}$     d)  $\frac{(x - 1)(x - 3)}{(x - 2)(x - 4)} = 2$

**Problem 4** Determine the values of  $a$  such that the equation has solutions.

- a)  $x^2 + 2ax + 9 = 0$     b)  $\frac{1}{x + a} = \frac{2}{2x + 3}$     c)  $\frac{(x - 1)(x - 3)}{(x - 2)(x - 4)} = a$

**Problem 5** Solve the equations.

- a)  $\sqrt{2x + 3} = x + 2$     b)  $\sqrt{4x + 1} = x - 1$     c)  $\sqrt{x + 2} + \sqrt{x - 3} = 5$   
d)  $\sqrt{2x + 1} - \sqrt{x + 4} = 1$     e)  $\frac{1}{\sqrt{x - 1}} - \frac{1}{\sqrt{x + 1}} = 2$     f)  $\frac{1}{\sqrt{x - 1}} - \frac{1}{\sqrt{x + 1}} = -1$

**Problem 6** Determine the values of  $a$  such that the equation  $\frac{1}{\sqrt{x - 1}} - \frac{1}{\sqrt{x + 1}} = a$  has solutions.

**Problem 7** Solve the inequalities.

a)  $2x + 3 \leq 5x + 2$

b)  $-4x + 1 \geq x - 1$

c)  $x + 2 < 3 + 5x$

d)  $(x - 5)(x + 4) < 0$

e)  $(2x + 5)(7 - x) \geq 0$

f)  $\frac{(x - 2)(x + 3)}{(x - 5)(x + 4)} < 0$

g)  $\frac{-5}{(6 - x)(-12 - 3x)} \geq 0$

h)  $(x - 5)(x + 4) < 10$

i)  $(2x + 5)(7 - x) \geq 35$

j)  $\frac{(x - 2)(x + 3)}{(x - 5)(x + 4)} < 1$

k)  $\frac{-5}{(6 - x)(-12 - 3x)} \geq \frac{5}{72}$

**Problem 8** Determine  $a$  such that the inequality has solutions.

a)  $x^2 + 6x \leq a$

b)  $(x + a)^2 < a$

## Fasit

### Problem 1

- a)  $x + 7$                                 b)  $x + 8 + \frac{11}{x-4}$                                 c)  $x^2 - 5x + 7$   
 d)  $x^2 - 23 + \frac{65}{x+1}$                                 e)  $x^2 + x + 1$                                 f)  $x + a + 3 + \frac{a^2 + 3a - 7}{x - a}$

### Problem 2

- a)  $(x - 13)(x + 17)$                                 b)  $(x - 2)(x + 3)(x + 5)$                                 c)  $(x - 3)(x^2 + 5)$   
 d)  $(x + 1)(x + 2)(x + 3)(x + 4)$

### Problem 3

- a)  $x = -3, x = -\frac{1}{2}$                                 b) no solutions                                c)  $x = \frac{1}{2} \pm \frac{\sqrt{5}}{2}$                                 d)  $x = 4 \pm \sqrt{3}$

### Problem 4

- a)  $a \leq -3$  or  $a \geq 3$                                 b)  $a = \frac{3}{2}$                                 c) All values of  $a$  give solutions

### Problem 5

- a)  $x = -1$                                 b)  $x = 6$                                 c)  $x = 7$   
 d)  $x = 12$                                 e)  $x = 2$                                 f) no solutions

### Problem 6

$$a \leq -2 \text{ or } a > 0$$

### Problem 7

- a)  $x \geq \frac{1}{3}$ , alternative way of writing:  $x \in [\frac{1}{3}, \infty)$   
 b)  $x \leq \frac{2}{5}$ , alternative:  $x \in (-\infty, \frac{2}{5}]$   
 c)  $x > -\frac{1}{4}$ , alternative:  $x \in (-\frac{1}{4}, \infty)$   
 d)  $-4 < x < 5$ , alternative:  $x \in (-4, 5)$   
 e)  $-\frac{5}{2} \leq x \leq 7$ , alternative:  $x \in [-\frac{5}{2}, 7]$   
 f)  $-4 < x < -3$  eller  $2 < x < 5$ , alternative:  $x \in (-4, -3) \cup (2, 5)$   
 g)  $-4 < x < 6$ , alternative:  $x \in (-4, 6)$   
 h)  $-5 < x < 6$ , alternative:  $x \in (-5, 6)$   
 i)  $0 \leq x \leq \frac{9}{2}$ , alternative:  $x \in [0, \frac{9}{2}]$   
 j)  $x < -7$  eller  $-4 < x < 5$ , alternative:  $x \in (-\infty, -7) \cup (-4, 5)$   
 k)  $-4 < x \leq 0$  eller  $2 \leq x < 6$ , alternative:  $x \in (-4, 0] \cup [2, 6)$

### Problem 8

- a)  $a \geq -9$                                 b)  $0 < a$