

Multiple-choice exam: GRA 60352 Mathematics			
Examination date:	07.03.2016	18:00 – 19:00	Total no. of pages: 5 incl. attachments No. of attachments: 1 (1 page)
Permitted examination support material:	A bilingual dictionary and BI-approved calculator		
Answer sheets:	Answer sheet for multiple-choice examinations Counts 20% of GRA 6035 The questions have equal weight		
Re-take exam	Responsible department: Economics		

PLEASE READ THE FOLLOWING BEFORE YOU BEGIN!

- Students must themselves assure that the examination papers are complete.
- Students must provide the following information on the answer sheet:
 - Examination code
 - Personal initials
 - ID-nr

The ID-nr must be recorded with both the appropriate numbers and by putting an “X” by the corresponding number in the columns below.

- Do not use pencils or pens with green ink when filling in answer sheets. Answer sheets must not be used for rough drafts.
- **All answers must be recorded with an “X” under the letter you believe corresponds with the correct answer.**
- **Cancel an “X” by filling in the box completely (boxes that are completely filled in will not be registered). “X” in two boxes for one question will be registered as a wrong answer.**
- The attached example shows you how the answer sheet would be filled in if A were the correct answer for question 1, B correct for question 2, C correct for question 3 and D correct for question 4. An “X” under E indicates that you choose not to answer question 5.
- **Your answers are to be recorded on the answer sheet. Answers written on the examination papers and not on the answer sheets will not be graded.**
- There is only one right answer for each question. Because the questions are weighted equally, it can be to your advantage to answer the easiest questions first.
- Wrong answers are given -1 point, unanswered questions get 0 points (indicated by an “X” next to E”) and correct answers are given 3 points.
- You can keep the examination papers.

This exam has 8 questions

QUESTION 1.

Consider a homogeneous linear system $A \cdot \mathbf{x} = \mathbf{0}$, where A is a 5×4 matrix with $\text{rk } A = 3$. **Which statement is true?**

- (a) The linear system has a unique solution
- (b) The linear system is inconsistent
- (c) The linear system has one degree of freedom
- (d) The linear system has more than one degree of freedom
- (e) I prefer not to answer.

QUESTION 2.

Consider the vectors $\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3$, given by

$$\mathbf{v}_1 = \begin{pmatrix} 1 \\ -1 \\ s \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} 3 \\ 2 \\ s+1 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} 5 \\ 0 \\ s+3 \end{pmatrix}$$

Which statement is true?

- (a) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent for all s
- (b) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent exactly when $s = 0$ or $s = 1$
- (c) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent exactly when $s \neq 1$
- (d) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent exactly when $s = 1$
- (e) I prefer not to answer.

QUESTION 3.

Compute the rank of the matrix

$$A = \begin{pmatrix} 1 & 4 & -7 & 3 \\ 2 & -2 & 8 & 0 \\ 2 & 10 & t-16 & 1-t \end{pmatrix}$$

Which statement is true?

- (a) $\text{rk } A = 2$ for all t
- (b) $\text{rk } A = 3$ for $t \neq -6$ and $\text{rk } A = 2$ for $t = -6$
- (c) $\text{rk } A = 3$ for $t \neq -5$ and $\text{rk } A = 2$ for $t = -5$
- (d) $\text{rk } A = 3$ for all t
- (e) I prefer not to answer.

QUESTION 4.

Consider the matrix

$$A = \begin{pmatrix} 1 & 0 & 2 \\ 0 & -2 & 0 \\ 1 & 0 & -3 \end{pmatrix}$$

Which statement is true?

- (a) A has three positive eigenvalues
- (b) A has two positive and one negative eigenvalue
- (c) A has one positive and two negative eigenvalues
- (d) A has three negative eigenvalues
- (e) I prefer not to answer.

QUESTION 5.

Consider the matrix A given by

$$A = \begin{pmatrix} 1 & s & 1-s \\ 0 & 2 & s \\ 0 & 0 & 3 \end{pmatrix}$$

Which statement is true?

- (a) A is diagonalizable for all s
- (b) A is diagonalizable exactly when $s = 1$
- (c) A is diagonalizable exactly when $s \neq 1$
- (d) A is diagonalizable exactly when $s = 0$
- (e) I prefer not to answer.

QUESTION 6.

A Markov chain $\mathbf{x}_{t+1} = A\mathbf{x}_t$ has transition matrix A given by

$$A = \begin{pmatrix} 0.65 & 0.21 \\ 0.35 & 0.79 \end{pmatrix}$$

and equilibrium state $\mathbf{x} = \begin{pmatrix} x \\ y \end{pmatrix}$. Which statement is true?

- (a) $x = 5$ and $y = 3$
- (b) $x = 3$ and $y = 5$
- (c) $x = 3/5$ and $y = 5/3$
- (d) $x = 3/8$ and $y = 5/8$
- (e) I prefer not to answer.

QUESTION 7.

Consider the function $f(x, y) = \ln(xy - 1)$ defined on the region $D_f = \{(x, y) : xy > 1, x, y > 0\}$ in the first quadrant. Which statement is true?

- (a) f is concave but not convex
- (b) f is convex but not concave
- (c) f is both convex and concave
- (d) f is neither convex nor concave
- (e) I prefer not to answer.

QUESTION 8.

We consider the function $f(x, y) = 12 - 25x^{1/5}y^{3/5}$ defined on the region $D_f = \{(x, y) : x > 0, y > 0\}$.

Which statement is true?

- (a) f is concave but not convex
- (b) f is convex but not concave
- (c) f is both convex and concave
- (d) f is neither convex nor concave
- (e) I prefer not to answer.