

Multiple-choice exam: GRA 60352 Mathematics			
Examination date:	19.04.2013	09:00 – 10:00	Total no. of pages: 5 incl. attachments No. of attachments: 1 (1 page)
Permitted examination support material:	A bilingual dictionary and BI-approved calculator TEXAS INSTRUMENTS BA II Plus		
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 the linear system with augmented matrix

$$\left(\begin{array}{cccc|c} 0 & 2 & -3 & 1 & 4 \\ -2 & 8 & -5 & -5 & -2 \\ 1 & -1 & -2 & 4 & 7 \end{array} \right)$$

Which statement is true?

- (a) The linear system is inconsistent.
- (b) The linear system has one degree of freedom
- (c) The linear system has two degrees of freedom
- (d) The linear system has three degrees of freedom
- (e) I prefer not to answer.

QUESTION 2.

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

$$\mathbf{v}_1 = \begin{pmatrix} 0 \\ 2 \\ -3 \\ 1 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} -2 \\ 8 \\ -5 \\ -5 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} 1 \\ -1 \\ -2 \\ 4 \end{pmatrix}$$

Which statement is true?

- (a) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent
- (b) The vectors $\{\mathbf{v}_1, \mathbf{v}_2\}$ are linearly independent, and \mathbf{v}_3 is a linear combination of $\{\mathbf{v}_1, \mathbf{v}_2\}$
- (c) The vectors $\{\mathbf{v}_1, \mathbf{v}_2\}$ are linearly independent, but \mathbf{v}_3 is not a linear combination of $\{\mathbf{v}_1, \mathbf{v}_2\}$
- (d) The vectors $\{\mathbf{v}_1, \mathbf{v}_2\}$ are not linearly independent
- (e) I prefer not to answer.

QUESTION 3.

Compute the rank of the matrix

$$A = \begin{pmatrix} 0 & 2 & -3 & h & 4 \\ -2 & 8 & -5 & -5 & -2 \\ 1 & -1 & -2 & 4 & 7 \end{pmatrix}$$

Which statement is true?

- (a) $\text{rk } A = 2$ for all h
- (b) $\text{rk } A = 3$ for $h \neq 1$ and $\text{rk } A = 2$ for $h = 1$
- (c) $\text{rk } A = 3$ for $h \neq 1$ and $\text{rk } A = 1$ for $h = 1$
- (d) $\text{rk } A = 2$ for $h \neq 1$ and $\text{rk } A = 1$ for $h = 1$
- (e) I prefer not to answer.

QUESTION 4.

Consider the matrix

$$A = \begin{pmatrix} -1 & 3 \\ 4 & 0 \end{pmatrix}$$

Which statement is true?

- (a) A has eigenvalues $\lambda = 3$ and $\lambda = -4$
- (b) A has eigenvalues $\lambda = -1$ and $\lambda = 0$
- (c) A has a single eigenvalue $\lambda = 3$
- (d) A has eigenvalues $\lambda = 3$ and $\lambda = 4$
- (e) I prefer not to answer.

QUESTION 5.

Consider the matrix A and the vectors \mathbf{u}, \mathbf{v} given by

$$A = \begin{pmatrix} -1 & 3 \\ 4 & 0 \end{pmatrix}, \quad \mathbf{u} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, \quad \mathbf{v} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

Which statement is true?

- (a) Both \mathbf{u} and \mathbf{v} are eigenvectors of A
- (b) Neither \mathbf{u} nor \mathbf{v} are eigenvectors of A
- (c) The vector \mathbf{u} is an eigenvector of A , but \mathbf{v} is not
- (d) The vector \mathbf{v} is an eigenvector of A , but \mathbf{u} is not
- (e) I prefer not to answer.

QUESTION 6.

Consider the quadratic form

$$Q(x_1, x_2) = hx_1^2 - 4x_1x_2 + 3x_2^2$$

Which statement is true?

- (a) Q is positive semidefinite for all h
- (b) Q is positive semidefinite when $h \geq 0$, and indefinite otherwise
- (c) Q is positive semidefinite when $h \geq 0$, and negative semidefinite otherwise
- (d) Q is positive semidefinite when $h \geq 4/3$, and indefinite otherwise
- (e) I prefer not to answer.

QUESTION 7.

Consider the function f given by

$$f(x, y) = x^4 + x^2 - 2xy + hy^2$$

Which statement is true?

- (a) f is a convex function for all h
- (b) f is a convex function for $h \geq 0$, and concave otherwise
- (c) f is a convex function for $h \geq 1$, and neither convex nor concave otherwise
- (d) f is a convex function for $h \geq 1$, and concave otherwise
- (e) I prefer not to answer.

QUESTION 8.

The function $f(x, y, z) = x + 2y + 4z$ is defined on the set $D_f = S$, where

$$S = \{(x, y, z) : x^2 - y^2 + z^2 \leq 1 \text{ and } x, y, z \geq 0\}$$

Which statement is true?

- (a) S is closed and bounded, and f has a maximum value on S
- (b) S is closed and not bounded, and f has a maximum value on S
- (c) S is closed and not bounded, and f does not have a maximum value on S
- (d) S is not closed, and f does not have a maximum value on S
- (e) I prefer not to answer.