Multiple-choice exam:	GRA 60352	Mathematics		
Examination date:	11.10.2013	15:00 – 16:00	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	
Ordinary 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 <u>one</u> 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 linear system $A \cdot \mathbf{x} = \mathbf{0}$, where A is a 3×4 matrix with $\operatorname{rk} A = 2$. **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 two 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

$$\mathbf{v}_1 = \begin{pmatrix} 0 \\ h \\ 1 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} h-1 \\ 1 \\ 1 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} h \\ 1 \\ 1 \end{pmatrix}$$

Which statement is true?

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

Question 3.

Compute the rank of the matrix

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

Which statement is true?

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

Question 4.

Consider the matrix

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

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 and the vector $\mathbf{v}$ given by

$$A = \begin{pmatrix} 1 & s \\ 3 & -1 \end{pmatrix}, \quad \mathbf{v} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

Which statement is true?

(a) $\mathbf{v}$ is not an eigenvector of A
(b) $\mathbf{v}$ is an eigenvector of A exactly when $s = 5$
(c) $\mathbf{v}$ is an eigenvector of A exactly when $s = 8$
(d) $\mathbf{v}$ is an eigenvector of A
(e) I prefer not to answer.

Question 6.

Consider the quadratic form

$$f(x_1, x_2, x_3, x_4) = x_1^2 + 3x_1x_4 + 2x_2^2 + 6x_2x_4 + 3x_3^2 + 7x_4^2$$

Which statement is true?

(a) f is positive semidefinite but not positive definite
(b) f is positive definite
(c) f is indefinite
(d) f is negative semidefinite
(e) I prefer not to answer.

Question 7.

Consider the function $f(x, y, z) = x^3 - 3xy^2 - z^4 - 3x + 4z$. **Which statement is true?**

(a) f has a local maximum point
(b) f has a local minimum point
(c) f has stationary points, but all are saddle points
(d) f has no stationary points
(e) I prefer not to answer.

QUESTION 8.

Consider the function f given by

$$f(x, y, z) = x^2 + 4xz + 3y^2 - 2yz + 7z^2 + hx^4$$

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