

GRA 60352

Mathematics

Department of Economics

Start date: 08.01.2020 Time 09.00

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Weight: 20% of GRA 6035

Total no. of pages: 5 incl. front page

Answer sheets: Answer sheets for multiple-choice examinations

Examination support materials permitted: BI-approved exam calculator. Simple calculator. Bilingual dictionary.

Question 1.

Consider the linear system with augmented matrix

$$\left(\begin{array}{cccc|c} 1 & -1 & 1 & 4 & 4 \\ 0 & 0 & 3 & 7 & 1 \\ 0 & 0 & 6 & 13 & 2 \end{array}\right)$$

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.

Let the vectors \mathbf{v}_1 , \mathbf{v}_2 , \mathbf{v}_3 and \mathbf{v}_4 be the column vectors of the matrix

$$A = \begin{pmatrix} 1 & -1 & 1 & 4 \\ 0 & 0 & 3 & 7 \\ 0 & 0 & 6 & 13 \end{pmatrix}$$

Which statement is true?

- a) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3, \mathbf{v}_4\}$ are linearly independent
- b) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent and $\text{rk } A = 3$
- c) The vectors $\{\mathbf{v}_1, \mathbf{v}_3, \mathbf{v}_4\}$ are linearly independent and $\text{rk } A = 3$
- d) The vectors $\{\mathbf{v}_3, \mathbf{v}_4\}$ are linearly independent and $\text{rk } A = 2$
- e) I prefer not to answer.

Question 3.

Consider the matrix

$$A = \begin{pmatrix} 7 & 0 & 2 \\ 0 & 2 & 0 \\ 2 & 0 & 7 \end{pmatrix}$$

Which statement is true?

- a) A has three distinct eigenvalues
- b) A has an eigenvalue of multiplicity two, and another eigenvalue of multiplicity one
- c) A has four eigenvalues of multiplicity one
- d) A has one eigenvalues of multiplicity one, and no other eigenvalues
- e) I prefer not to answer.

Question 4.

Consider the matrix

$$A = \begin{pmatrix} 3 & 6 & -1 & -t \\ 4 & t & -t & 1 \end{pmatrix}$$

Which statement is true?

- a) For $t = 0$, we have that $\text{rk}(A) = 2$, otherwise $\text{rk}(A) = 3$
- b) For $t = 0$ and $t = 8$, we have that $\text{rk}(A) = 1$, otherwise $\text{rk}(A) = 2$
- c) For $t = 0$, $t = 8$ and $t = 3/4$, we have that $\text{rk}(A) = 1$, otherwise $\text{rk}(A) = 2$
- d) For all values of t , we have that $\text{rk}(A) = 2$
- e) I prefer not to answer.

Question 5.

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

$$A = \begin{pmatrix} 0.40 & 0.20 & 0.20 \\ 0.40 & 0.60 & 0.10 \\ 0.20 & 0.20 & 0.70 \end{pmatrix}, \quad \mathbf{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

Which statement is true?

- a) $v_1 < 0.20$
- b) $v_1 = 0.20$
- c) $0.20 < v_1 < 0.25$
- d) $v_1 \geq 0.25$
- e) I prefer not to answer.

Question 6.

Consider the quadratic form

$$f(x, y, z) = 2xy - 2x^2 - y^2 + 2xz - z^2$$

Which statement is true?

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

Question 7.

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

- a) All stationary points of f are saddle points
- b) The function f has both a saddle point and a local minimum point.
- c) The function f has a local minimum point, and f is convex.
- d) The function f has a global minimum point, and f is convex.
- e) I prefer not to answer.

Question 8.

Let A be a 4×4 matrix, such that $\text{Null}(A)$ is spanned by $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ with

$$\mathbf{v}_1 = \begin{pmatrix} 1 \\ 1 \\ 0 \\ 1 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} 7 \\ 0 \\ 1 \\ 4 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} 4 \\ -3 \\ 1 \\ 1 \end{pmatrix}$$

Which statement is true?

- a) The linear system $A\mathbf{x} = \mathbf{0}$ has one degree of freedom.
- b) $\text{rk } A = 1$
- c) $\text{rk } A = 2$
- d) $\text{rk } A = 3$
- e) I prefer not to answer.

SVARARK TIL FLERVALGSEKSAMEN

ANSWER SHEET FOR MULTIPLE CHOICE EXAMINATION

Eksamenskode:
Examination code:

G R A 6 0 3 5 2

Initialer:
Personal initials:

NN

ID-nummer: (SKAL fylles ut!)
ID-number: (MUST be filled in!)

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Skriv tydelig!

Fyll ut med

Annuler kryss med

Helt fylt rute blir ikke registrert



Write clearly!

Record answer with

Cancel a cross with

Compl. filled boxes will not be registered



Dette svararket leses kun av en maskin. Ikke noe av det du skriver utenom de definerte feltene blir lest eller tatt hensyn til.
Ikke kluss på arket. Be heller om et nytt.

This answer sheet is only read by a machine. Answers or comments written on the examination paper or outside the boxes will not be graded.
Do not scribble on this sheet.
Please ask for a new answer sheet if you need one.

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