C. HECKMAN 242

Final Exam MW 3:00, A

Name: ________________________________

Instructions:

- The exam consists of five (5) problems, some of which may have several parts. It has five (5) pages (including this one); you should make sure that you have all of them before you start.
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- Show all work in detail or your answer will not receive ANY credit. Write neatly and box all answers. If you need extra space for work, you may get scratch paper from the Testing Center; do not use your own paper.
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Signature

1. Let $A = \begin{bmatrix} -1 & -2 & -4 \\ -1 & -6 & -8 \\ 1 & 4 & 6 \end{bmatrix}$.

a. [15 points] Find the eigenvalues of A.

b. [10 points] One of the eigenvalues of A is 1. Find a basis for the eigenspace of this eigenvalue.

2. [30 points] For the matrix A below, find a basis for the null space of A, a basis for the row space of A, a basis for the column space of A, the rank of A, and the nullity of A.

$$A = \begin{bmatrix} -5 & 0 & 20 \\ -2 & 0 & 8 \\ 4 & 0 & -16 \end{bmatrix}$$

3. [10 points] Let $\vec{v}_1 = \begin{bmatrix} -1 \\ -4 \\ -3 \\ 4 \end{bmatrix}$, $\vec{v}_2 = \begin{bmatrix} -4 \\ 0 \\ 4 \\ 5 \end{bmatrix}$, $\vec{v}_3 = \begin{bmatrix} 1 \\ -12 \\ -13 \\ 7 \end{bmatrix}$, and $\vec{v}_4 = \begin{bmatrix} 3 \\ 5 \\ 5 \\ 2 \end{bmatrix}$. The set $\{\vec{v}_1, \vec{v}_2, \vec{v}_3, \vec{v}_4\}$ is linearly dependent. Find a nontrivial linear combination of these vectors that adds up to $\vec{0}$.

4. [15 points] Find the values of x that make $AB = BA$, where $A = \begin{bmatrix} 1 & -2 \\ x & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & x \\ -2 & x \end{bmatrix}$.

5. Do the following, for the following set of data points: $(-2, 12)$, $(-1, 7)$, $(2, 16)$, $(5, 187)$.

a. [10 points] Find the line $y = ax + b$ which best fits these points.

b. [10 points] Find the parabola $y = ax^2 + bx$ passing through the origin which best fits these points.

C. HECKMAN 242

Final Exam MW 3:00, B

Name: ______________________________

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Signature

1. Let $A = \begin{bmatrix} 0 & 0 & 0 \\ 34 & -10 & -24 \\ -14 & 4 & 10 \end{bmatrix}$.

a. [15 points] Find the eigenvalues of A.

b. [10 points] One of the eigenvalues of A is 2. Find a basis for the eigenspace of this eigenvalue.

2. [30 points] For the matrix A below, find a basis for the null space of A, a basis for the row space of A, a basis for the column space of A, the rank of A, and the nullity of A.

$$A = \begin{bmatrix} 0 & -1 & 4 & -1 \\ 1 & -5 & 17 & -5 \\ -1 & 0 & 3 & -5 \\ -2 & -5 & 26 & -2 \end{bmatrix}$$

3. [10 points] Let $\vec{v}_1 = \begin{bmatrix} 0 \\ -4 \\ -1 \\ -1 \end{bmatrix}$, $\vec{v}_2 = \begin{bmatrix} 3 \\ -5 \\ -4 \\ 4 \end{bmatrix}$, $\vec{v}_3 = \begin{bmatrix} -3 \\ 2 \\ -5 \\ -1 \end{bmatrix}$, and $\vec{v}_4 = \begin{bmatrix} -3 \\ 6 \\ 29 \\ -15 \end{bmatrix}$. The set $\{\vec{v}_1, \vec{v}_2, \vec{v}_3, \vec{v}_4\}$ is linearly dependent. Find a nontrivial linear combination of these vectors that adds up to $\vec{0}$.

4. [15 points] Find the values of x that make $AB = BA$, where $A = \begin{bmatrix} x & 0 \\ -6 & -7 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 0 \\ x & x \end{bmatrix}$.

5. Do the following, for the following set of data points: $(-1, 3)$, $(1, -5)$, $(2, -21)$, $(5, -189)$.

   a. [10 points] Find the line $y = ax + b$ which best fits these points.

   b. [10 points] Find the parabola $y = ax^2 + bx$ passing through the origin which best fits these points.

C. HECKMAN 242

Final Exam MW 4:30, C

Name: ______________________________

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Signature

1. Let $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ 2 & -5 & -2 \end{bmatrix}$.

a. [15 points] Find the eigenvalues of A.

b. [10 points] One of the eigenvalues of A is -2. Find a basis for the eigenspace of this eigenvalue.

2. [30 points] For the matrix A below, find a basis for the null space of A, a basis for the row space of A, a basis for the column space of A, the rank of A, and the nullity of A.

$$A = \begin{bmatrix} 3 & -9 & -4 & -24 \\ -1 & 3 & 3 & 13 \\ 4 & -12 & -5 & -31 \\ -3 & 9 & 4 & 24 \end{bmatrix}$$

3. [10 points] Let $\vec{v}_1 = \begin{bmatrix} -3 \\ -4 \\ 0 \\ -1 \end{bmatrix}$, $\vec{v}_2 = \begin{bmatrix} 2 \\ 0 \\ -2 \\ -4 \end{bmatrix}$, $\vec{v}_3 = \begin{bmatrix} 6 \\ 16 \\ 6 \\ 16 \end{bmatrix}$, and $\vec{v}_4 = \begin{bmatrix} -3 \\ -4 \\ 4 \\ -5 \end{bmatrix}$. The set $\{\vec{v}_1, \vec{v}_2, \vec{v}_3, \vec{v}_4\}$ is linearly dependent. Find a nontrivial linear combination of these vectors that adds up to $\vec{0}$.

4. [15 points] Find the values of x that make $AB = BA$, where $A = \begin{bmatrix} 2 & x \\ 0 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & x \\ 0 & x \end{bmatrix}$.

5. Do the following, for the following set of data points: $(-3, -15)$, $(2, -30)$, $(4, -148)$, $(5, -255)$.

   a. [10 points] Find the parabola $y = ax^2 + bx + c$ which best fits these points.

   b. [10 points] Find the parabola $y = ax^2 + bx$ passing through the origin which best fits these points.

C. HECKMAN Final Exam MW 4:30, D	242

Name: ______________________________

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Signature

1. Let $A = \begin{bmatrix} 1 & 0 & 2 \\ -1 & 8 & -10 \\ -1 & 6 & -8 \end{bmatrix}$.

a. [15 points] Find the eigenvalues of A.

b. [10 points] One of the eigenvalues of A is 2. Find a basis for the eigenspace of this eigenvalue.

2. [30 points] For the matrix A below, find a basis for the null space of A, a basis for the row space of A, a basis for the column space of A, the rank of A, and the nullity of A.

$$A = \begin{bmatrix} -5 & -20 & -4 & -4 \\ -2 & -8 & 2 & -3 \\ -1 & -4 & -1 & 4 \\ -1 & -4 & 4 & 4 \end{bmatrix}$$

3. [10 points] Let $\vec{v}_1 = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 0 \end{bmatrix}$, $\vec{v}_2 = \begin{bmatrix} -1 \\ -2 \\ -5 \\ 2 \end{bmatrix}$, $\vec{v}_3 = \begin{bmatrix} 2 \\ 4 \\ 4 \\ 5 \end{bmatrix}$, and $\vec{v}_4 = \begin{bmatrix} -1 \\ -2 \\ -5 \\ 5 \end{bmatrix}$. The set $\{\vec{v}_1, \vec{v}_2, \vec{v}_3, \vec{v}_4\}$ is linearly dependent. Find a nontrivial linear combination of these vectors that adds up to $\vec{0}$.

4. [15 points] Find the values of x that make $AB = BA$, where $A = \begin{bmatrix} 1 & x \\ -2 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & -2 \\ x & x \end{bmatrix}$.

5. Do the following, for the following set of data points: $(-4, -48)$, $(-1, 0)$, $(3, 8)$, $(5, 96)$.

a. [10 points] Find the parabola $y = ax^2 + bx + c$ which best fits these points.

b. [10 points] Find the parabola $y = ax^2 + bx$ passing through the origin which best fits these points.

C. HECKMAN Final Exam TTh 3:00, E	242

Name: ______________________________

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Signature

1. Let $A = \begin{bmatrix} 0 & 0 & 0 \\ 8 & -6 & -4 \\ -8 & 6 & 4 \end{bmatrix}$.

a. [15 points] Find the eigenvalues of A.

b. [10 points] One of the eigenvalues of A is 0. Find a basis for the eigenspace of this eigenvalue.

2. [30 points] For the matrix A below, find a basis for the null space of A, a basis for the row space of A, a basis for the column space of A, the rank of A, and the nullity of A.

$$A = \begin{bmatrix} -2 & -3 & -7 & -13 \\ 0 & 2 & 2 & 6 \\ 3 & 2 & 8 & 12 \\ 3 & 2 & 8 & 12 \end{bmatrix}$$

3. [10 points] Let $\vec{v}_1 = \begin{bmatrix} 3 \\ 3 \\ 5 \\ 0 \end{bmatrix}$, $\vec{v}_2 = \begin{bmatrix} 4 \\ 5 \\ -4 \\ -4 \end{bmatrix}$, $\vec{v}_3 = \begin{bmatrix} -4 \\ -4 \\ 2 \\ -5 \end{bmatrix}$, and $\vec{v}_4 = \begin{bmatrix} -16 \\ -19 \\ 14 \\ 7 \end{bmatrix}$. The set $\{\vec{v}_1, \vec{v}_2, \vec{v}_3, \vec{v}_4\}$ is linearly dependent. Find a nontrivial linear combination of these vectors that adds up to $\vec{0}$.

4. [15 points] Find the values of x that make $AB = BA$, where $A = \begin{bmatrix} x & -6 \\ 0 & -7 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & x \\ 0 & x \end{bmatrix}$.

5. Do the following, for the following set of data points: $(-3, 80)$, $(0, 2)$, $(2, 0)$, $(5, -48)$.

   a. [10 points] Find the line $y = ax + b$ which best fits these points.

   b. [10 points] Find the parabola $y = ax^2 + c$ with no linear term which best fits these points.

C. HECKMAN 242

Final Exam TTh 3:00, F

Name: ___________________________________

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Signature

1. Let $A = \begin{bmatrix} 6 & 4 & 14 \\ 6 & 5 & 16 \\ -3 & -2 & -7 \end{bmatrix}$.

a. [15 points] Find the eigenvalues of A.

b. [10 points] One of the eigenvalues of A is 3. Find a basis for the eigenspace of this eigenvalue.

2. [30 points] For the matrix A below, find a basis for the null space of A, a basis for the row space of A, a basis for the column space of A, the rank of A, and the nullity of A.

$$A = \begin{bmatrix} -1 & 2 & 9 & 8 & 8 \\ -2 & 1 & 9 & 1 & 10 \\ -1 & 4 & 15 & 18 & 12 \end{bmatrix}$$

3. [10 points] Let $\vec{v}_1 = \begin{bmatrix} -4 \\ 3 \\ 3 \\ 0 \end{bmatrix}$, $\vec{v}_2 = \begin{bmatrix} -4 \\ -2 \\ 5 \\ 1 \end{bmatrix}$, $\vec{v}_3 = \begin{bmatrix} 16 \\ 3 \\ -18 \\ -3 \end{bmatrix}$, and $\vec{v}_4 = \begin{bmatrix} -3 \\ -1 \\ 4 \\ 2 \end{bmatrix}$. The set $\{\vec{v}_1, \vec{v}_2, \vec{v}_3, \vec{v}_4\}$ is linearly dependent. Find a nontrivial linear combination of these vectors that adds up to $\vec{0}$.

4. [15 points] Find the values of x that make $AB = BA$, where $A = \begin{bmatrix} 2 & 0 \\ x & 6 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 0 \\ x & x \end{bmatrix}$.

5. Do the following, for the following set of data points: $(-3, 52)$, $(-1, -4)$, $(4, 31)$, $(5, 20)$.

   a. [10 points] Find the line $y = ax + b$ which best fits these points.

   b. [10 points] Find the parabola $y = ax^2 + c$ with no linear term which best fits these points.