The following exam consists of 13 problems worth a total of 100 points. There are 8 multiple choice questions worth 5 points each. There are 5 work-out problems worth a total of 60 points. There is one extra-credit problem worth a maximum of 5 points.

Partial credit will be awarded on the work-out problems, according to completeness of work.

Note: You may wish to do the work out problems first, and then do the multiple-choice...

Write the answers to each problem down, in order, on the blank pages provided. Circle your answers.

You may begin the exam when the instructor indicates.
1. For what value of $k$ are the two lines $L_1 : 2y + 3x + 1 = 0$ and $L_2 : 3y + kx + 4 = 0$ parallel?
   A) $2/9$  
   B) $9/2$  
   C) $-2/9$  
   D) $-4$  
   E) none of these

2. A triangle is formed from the following three points: A(-2,-1), B(3,2), C(1,5). Which line segment has the greatest length?
   A) AB  
   B) BC  
   C) CA

3. Insurance costs per driver have followed the following trend:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>200.00</td>
</tr>
<tr>
<td>1965</td>
<td>250.00</td>
</tr>
<tr>
<td>1970</td>
<td>275.00</td>
</tr>
<tr>
<td>1975</td>
<td>325.00</td>
</tr>
<tr>
<td>1980</td>
<td>400.00</td>
</tr>
<tr>
<td>1985</td>
<td>550.00</td>
</tr>
<tr>
<td>1990</td>
<td>650.00</td>
</tr>
</tbody>
</table>

Use regression (least squares) to estimate the cost in the year 2005 (to the nearest dollar).
   A) 800.00  
   B) 823.00  
   C) 847.00  
   D) 900.00  
   E) none of these

4. If $L_1 : x + y = 1$ and $L_2 : 2x - y = 3$, then the product of the slopes is given by
   A) $-2$  
   B) $1/2$  
   C) $2$  
   D) $-1/2$  
   E) none of these

5. For what value of $k$ does the $2 \times 2$ system of equations

\[
\begin{align*}
x & + 2y = 1 \\
3x & + ky = 0
\end{align*}
\]

have no solution?
   A) 4  
   B) $8/3$  
   C) 6  
   D) $-1$  
   E) none of these

6. The system of equations

\[
\begin{align*}
x_1 & - 2x_2 + x_3 - x_4 = -1 \\
2x_1 & + x_2 + x_3 + x_4 = 5 \\
x_1 & - x_2 + x_4 = 1 \\
x_1 & + x_2 - x_3 - x_4 = 0
\end{align*}
\]

has the solution:
   A) $(1, 0, 1, 1)$  
   B) $(1, -1, 1, -1)$  
   C) $(1, 1, 0, 0)$  
   D) $(1, 2, 3, 4)$  
   E) none of these

7. For what value of $k$ are the two lines $L_1 : kx + y + 3 = 0$ and $L_2 : kx - y + 2 = 0$ perpendicular?
   A) $k = 0$  
   B) $k = 2$  
   C) $k = -1$  
   D) $k = -3$  
   E) none of these

8. Let

\[
A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}, \text{ and } C = \begin{bmatrix} 3 & 4 \\ 5 & 6 \end{bmatrix}
\]

What is the value of the coefficient in row 2, column 1, of the product $[A][B]^{-1}[C]$?
   A) 5  
   B) 10  
   C) 8  
   D) 2  
   E) none of these
9. [10 pts] Tom has a total of $40,000 invested in three mutual funds, with a rate of return given by 12%, 8% and 15% respectively. If he has twice as much money in the third fund as in the second, and if he earns $5,000, what is the amount in each of the funds?

10. [15 pts] The price of an internet stock had the following behavior in the first 12 months after its IPO (initial public offering):

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>12.85</td>
<td>20.55</td>
<td>25.80</td>
<td>15.00</td>
<td>18.77</td>
<td>25.19</td>
<td>30.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>28.10</td>
<td>30.20</td>
<td>35.22</td>
<td>40.10</td>
<td>28.00</td>
<td>35.00</td>
</tr>
</tbody>
</table>

a) plot the points
b) find the least squares line (slope and intercept)
c) predict the price 2 years after the IPO

11. [10 pts] Based on market research, a software company predicts sales of 10,000 units at a price of $29.95 If it reduces the software to $19.95, demand will increase to 20,000 units.

The minimum price the company will ship the software is $12.95. At a sales price of $25.00 it will ship 40,000 units.

What is the market equilibrium (price, quantity)?

12. [10 pts] Three lines are defined by the following: \( L_1 : y = 0.5, \ L_2 : y = x - 1, \ L_2 : y = 5 - x \)

a) graph the three lines
b) find all the intersections of the lines (vertices)
c) find the area of the triangle which is formed (Area = 1/2 base \times height)

13. [15 pts] Solve the following system of equations, using either the matrix inverse method or rref().

\[
\begin{align*}
2x_1 & -x_2 & +x_3 & -x_4 & = 5 \\
x_1 & +x_2 & -x_3 & +x_4 & = 2 \\
2x_1 & +2x_2 & & -x_4 & = 3 \\
x_1 & & & +x_4 & = 2
\end{align*}
\]

a) write down the equations in terms of matrices
b) write down the augmented matrix
c) solve the system (by inverse or rref())
d) verify that you have a solution

[EXTRA-CREDIT] [5 pts] Suppose the supply and demand curves are nonlinear, and are given by: \( S : p = 50 + 3x - 0.3x^2 \) and \( D : p = 100 + 0.2x^2 \). Using the trace and zoom features of the TI83, find the market equilibrium (approximately).