

Write your name on the cover of the test booklet and nowhere else. Enclose this sheet with the booklet. Failure to follow these directions will cost you 1 point. The test has 100 points (to be scaled up to 170 points) and is scheduled to take 50 minutes. Therefore, expect to spend 1 minute for every 2 points. For example, a 12-point question should take 6 minutes. I can give extra time but not much.

**Show all work on all questions.**

1) (10 points each) Use the following matrices to do FOUR of the following operations.

- A) Trace( $E^T D^T$ )
- B) Trace( $B+C$ )
- C)  $A-2B$
- D)  $A^T + 2B$
- E)  $AC$
- F)  $D^T B$

$$A = \begin{bmatrix} 3 & 1 \\ 2 & 5 \end{bmatrix}, B = \begin{bmatrix} -2 & -5 \\ 0 & 10 \end{bmatrix}, C = \begin{bmatrix} -3 & 6 \\ -1 & -4 \end{bmatrix}, D = \begin{bmatrix} 20 \\ -10 \end{bmatrix}, E = \begin{bmatrix} 7 & 8 \end{bmatrix}$$

2) (14 points) Answer EITHER Part A OR Part B.

- A) Solve the system of equations  $Q^D = 10 - \frac{1}{2}P$  and  $Q^S = P - 4$  using the graphing method.
- B) Solve the following system of equations using substitution and elimination method. (This is the IS/LM model which you will be getting in ECON 302.) LM:  $r - .02Y = 1$  IS:  $r + .01Y = 4$

3) (14 points) Answer EITHER Part A OR Part B.

- A) Suppose \$1 worth of energy uses \$.10 worth of energy and \$.20 worth of food to feed the employees. \$1 worth of food uses \$.25 units of energy and \$.15 worth of food. Set up the Leontief Input-Output Matrix. Use that matrix and matrix multiplication to determine how much food and energy would be used in the process of making \$1000 worth of food and \$400 worth of energy.
- B) Suppose 60% of Bethanians stay in Bethany while the rest move to NYC. 90% of New Yorkers stay and the rest move to Bethany. Write the population matrix P. Suppose 1000 people start in NYC and 100 start in Bethany. Multiply your matrix by an appropriate matrix to find how many people will be in both locations in a year.

4) (14 points) Answer EITHER Part A OR Part B.

- A) Find the value for X which makes the matrix to the right idempotent. (Hint: use the definition of idempotent to find equations involving X. Solve any of those equations to get the answer.)

$$\begin{bmatrix} 2 & X \\ 1/2 & -1 \end{bmatrix}$$

- B) When we calculated  $\Pi = p^T q - w^T z$ , why did we transpose  $p$  and  $w$ ? Use the price, quantity, factor cost, and factor vectors in the box to tell me what the 3, 30, 12, and 10 represent? State how you reached your conclusion. You do not need to calculate the profit matrix.

$$p = \begin{bmatrix} 3 \\ 2 \\ 5 \end{bmatrix}, q = \begin{bmatrix} 40 \\ 20 \\ 30 \end{bmatrix}, w = \begin{bmatrix} 12 \\ 24 \end{bmatrix}, z = \begin{bmatrix} 5 \\ 10 \end{bmatrix}$$

5) (18 points) Answer EITHER Part A OR Part B. You can either set it up as a partitioned matrix and use row operations or you can to row operations on the equations. Find all solutions.

- A)  $3X - Y + Z = 0$        $X + Z = 0$        $Y + 2Z = 0$
- B)  $2X + 3Y + Z = 10$        $-X + Y = 7$        $5Y + Z = 17$