13 Total Questions
→ 11 MC
2 F.R.

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Review Test 2

Math 1313
Test 2 Review
Sections 1.4, 1.5, Chapter 2 and Chapter 3

**Example 1:** Pull Company installed a new machine in one of its factories at a cost of $150,000. The machine is depreciated linearly over 10 years with no scrap value. Find an expression for the machine's book value in the t-th year of use ( $0 \le t \le 10$)

→ $0

(0, 150000)
(10, 0)

$m = \frac{0-150,000}{10-0} = -15,000$

$y = mx + b$

$V(t) = mt + b$ ← Initial

$V(t) = -15000t + 150000$

**Example 2:** A piece of equipment was purchased by a company for $10,000 and is assumed to have a scrap value of $3,000 in 5 years. If its value is depreciated linearly, find the value of the equipment after 3 years ($0 \le t \le 5$).

(0, 10000) ; (5, 3000)

$m = \frac{3000 - 10000}{5}$

$= -1400$

$V(t) = mt + \text{Initial}$

$V(t) = -1400t + 10,000$

$V(3) = -1400(3) + 10000$

$= 5,800$

**Example 3:** A bicycle manufacturer experiences fixed monthly costs of $75,000 and fix costs of $75 per standard model bicycle produced. The bicycles sell for $125 each.

a. What is the cost, revenue and profit functions?

$C(x) = 75x + 75000$

$R(x) = 125x$

$P(x) = R(x) - C(x) = (125 - 75)x - 75000$

$= 50x - 75000$

b. What is the break-even point? → (BE Quantity, BE Revenue)

$R(x) = C(x)$

$125x = 75x + 75000$

$50x = 75000$

$x = 1500$

Break Even Quantity

$R(BEQ) = 125(1500)$

$= 187,500$

Break Even Revenue

BEP: (1500, 187500)

Review Test 2

**Example 4:** Solve using Gauss-Jordon.

$$\left[\begin{array}{ccc|c} \mathbf{1} & \mathbf{3} & \mathbf{1} & \mathbf{3} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{2} \\ \mathbf{1} & \mathbf{-6} & \mathbf{0} & \mathbf{-13} \end{array}\right]$$

$-1R_1 + R_3 \to R_3$

$$\begin{array}{cccc} -1 & -3 & -1 & -3 \\ 1 & -6 & 0 & -13 \\ \hline 0 & -9 & -1 & -16 \end{array}$$

$$\left(\begin{array}{ccc|c} 1 & 3 & 1 & 3 \\ 0 & 1 & 0 & 2 \\ 0 & -9 & -1 & -16 \end{array}\right)$$

$-3R_2 + R_1 \to R_1$

$$\begin{array}{cccc} 0 & -3 & 0 & -6 \\ 1 & 3 & 1 & 3 \\ \hline 1 & 0 & 1 & -3 \end{array}$$

$$\left(\begin{array}{ccc|c} 1 & 0 & 1 & -3 \\ 0 & 1 & 0 & 2 \\ 0 & -9 & -1 & -16 \end{array}\right)$$

$9R_2 + R_3 \to R_3$

$$\left(\begin{array}{ccc|c} 1 & 0 & 1 & -3 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & -1 & 2 \end{array}\right)$$

$-1 \cdot R_3 \to R_3$

$$\left(\begin{array}{ccc|c} 1 & 0 & 1 & -3 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & -2 \end{array}\right)$$

$-1R_3 + R_1 \to R_1$

$$\left(\begin{array}{ccc|c} 1 & 0 & 0 & -1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & -2 \end{array}\right)$$

$x = -1$
$y = 2$
$z = -2$

or $(-1, 2, -2)$
x y z

**Example 5:** Determine which of the following matrices are in row-reduced form. If a matrix is not in row-reduced form, state why.

a. $\left[\begin{array}{cc|c} 1 & 0 & -3 \\ 0 & 1 & -2 \\ 0 & 0 & 0 \end{array}\right]$ Yes

b. $\left[\begin{array}{cc|c} 0 & 1 & -2 \\ 1 & 0 & 3 \end{array}\right]$ No

c. $\left[\begin{array}{ccc|c} 1 & 9 & 0 & 2 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{array}\right]$ Yes

**Example 6:** The reduced form for the augmented matrix of a system with 3 equations and 3 unknowns is given. Give the solution to the system, if it exists.

a. $\left[\begin{array}{ccc|c} 1 & 0 & -5 & -3 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 6 \end{array}\right]$

$0 \neq 6$

No Solution

b. (x y z) $\left[\begin{array}{ccc|c} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 3 \end{array}\right]$

$x = 0$
$y = 1$
$z = 3$

One Solution
"Unique"

c. (x y z) $\left[\begin{array}{ccc|c} 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 2 \end{array}\right]$

More Variable than Equation
(1) Infinite
(2) No solution

Infinitely Many

**Example 7:** Find the value for x and y:

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ x & -1 \end{bmatrix} - 3\begin{bmatrix} y-1 & 2 \\ 1 & 2 \\ 4 & -3 \end{bmatrix} = 2\begin{bmatrix} -4 & -2 \\ 0 & -1 \\ 4 & 4 \end{bmatrix}$$

$x - 3(4) = 2(4)$

$x - 12 = 8$

$x = 20$

$1 - 3(y-1) = 2(-4)$

$1 - 3y + 3 = -8$

$-3y + 4 = -8$

$-3y = -12$

$y = 4$

**Example 8:** Given the following matrices find the product.

$(2\times 3)\ (3\times 2) = 2\times 2$

$$\begin{bmatrix} 0 & -2 & 1 \\ 4 & -1 & 0 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ 0 & 1 \\ -2 & -1 \end{bmatrix}$$

Row times Column

$R_1 \cdot C_1$: $0 + 0 - 2$

$R_1 \cdot C_2$: $0 - 2 - 1$

$R_2 \cdot C_1$: $4 + 0 + 0$

$R_2 \cdot C_2$: $-8 - 1 + 0$

$$= \begin{pmatrix} -2 & -3 \\ 4 & -9 \end{pmatrix}$$

**Example 9:** Find the transpose of matrix A.

$2\times 3 \rightarrow$ $A = \begin{bmatrix} 1 & -4 & 3 \\ -2 & 7 & \frac{4}{3} \end{bmatrix}$

$$A^T = 3\times 2 = \begin{pmatrix} 1 & -2 \\ -4 & 7 \\ 3 & 4/3 \end{pmatrix}$$

**Example 10:** Find the inverse of matrix A.

$$\begin{bmatrix} -3 & 4 \\ 1 & -2 \end{bmatrix} \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

$D = ad - bc$

$= -3(-2) - 4(1)$

$= 6 - 4$

$= 2 \neq 0$

Inverse Exist

$$A^{-1} = \frac{1}{D}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$$

$$= \frac{1}{2}\begin{pmatrix} -2 & -4 \\ -1 & -3 \end{pmatrix}$$

$$= \boxed{\begin{pmatrix} -1 & -2 \\ -\frac{1}{2} & -\frac{3}{2} \end{pmatrix}}$$

**Example 11:** Solve the system of equations by using the inverse of the coefficient matrix.

$$x - y = -4$$
$$5x + 6y = 2$$

$A = \begin{pmatrix} 1 & -1 \\ 5 & 6 \end{pmatrix} \qquad B = \begin{pmatrix} -4 \\ 2 \end{pmatrix}$

$D = ad - bc$

$= 1(6) - (-1)(5)$

$= 6 + 5$

$= 11$

$$A^{-1} = \frac{1}{11}\begin{pmatrix} 6 & 1 \\ -5 & 1 \end{pmatrix}$$

$X = A^{-1} \cdot B$

$$X = \frac{1}{11}\begin{pmatrix} 6 & 1 \\ -5 & 1 \end{pmatrix}\begin{pmatrix} -4 \\ 2 \end{pmatrix}$$

$$= \frac{1}{11}\begin{pmatrix} -24 + 2 \\ 20 + 2 \end{pmatrix} = \frac{1}{11}\begin{pmatrix} -22 \\ 22 \end{pmatrix} = \begin{pmatrix} -2 \\ 2 \end{pmatrix}$$

$$\boxed{x = -2 \quad y = 2}$$

**Example 12:** A vineyard produces two special wines a white and a red. A bottle of the white wine requires 14 pounds of grapes and one hour of processing time. A bottle of red wine requires 25 pounds of grapes and 2 hours of processing time. The vineyard has on hand 2,198 pounds of grapes and can allot 160 hours of processing time to the production of these wines. A bottle of the white wine makes $11.00 profit, while a bottle of the red wines makes $20.00 profit. Set-up the linear programming problem so that profit can be maximized.

x - White Wine    y - Red Wine

| | x | y | | |
|---|---|---|---|---|
| lbs of Grapes | 14 | 25 | ≤ | 2198 |
| Processing time | 1 | 2 | ≤ | 160 |
| Profit | 11 | 20 | | |

Max Profit = $11x + 20y$

st.

$14x + 25y \le 2198$

$x + 2y \le 160$

$x, y \ge 0$

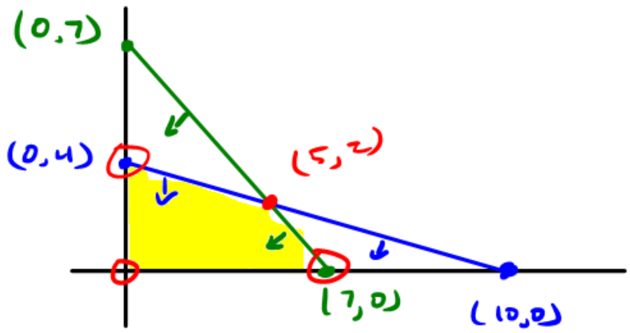
13. Solve the linear programming problem.

Max $P(x) = 3x + 7y$

St: $2x+5y \le 20$ ①

$x+y \le 7$ ②

$x, y \ge 0$




Line 1

x-int: (10,0)

y-int: (0,4)

$2x+5y \le 20$

$5y \le -2x+20$

$y \le -\frac{2}{5}x+4$

Line 2

x-int: (7,0)

y-int: (0,7)

$x+y \le 7$

$y \le -x+7$

$-\frac{2}{5}x+4 = -x+7$

$\frac{3}{5}x = 3$

$x = 5$

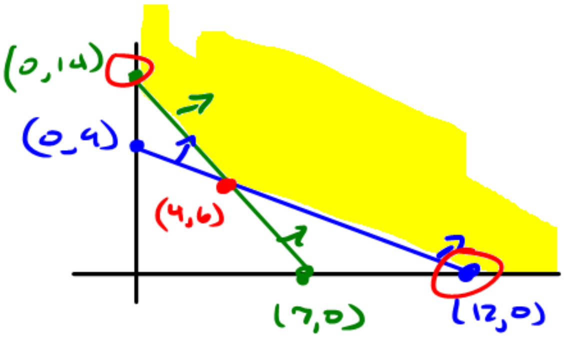
$y = 2$

| | Max $3x + 7y$ |
|---|---|
| (0,4) | 3(0)+4(7) = 28 |
| (5,2) | 3(5) +4(2) = 29 |
| (7,0) | 7(3) + 7(0) = 21 |
| (0,0) | 0 |

Optimal Solution is 29 occurred (5,2)

14. Solve the linear programming problem.

Min C(x) = x + 6y
St: $3x+4y \geq 36$ 1
$2x+y \geq 14$ 2
$x, y \geq 0$




Line 1

x-int: (12,0)
y-int: (0,9)
$3x + 4y \geq 36$
$y \geq -\frac{3}{4}x + 9$

Line 2

x-int: (7,0)
y-int: (0,14)
$2x + y \geq 14$
$y \geq -2x + 14$

$-\frac{3}{4}x + 9 = -2x + 14$
$\frac{5}{4}x = 5$
$x = 4$
$y = 6$

| | Min x+6y |
|---|---|
| (0,14) | 0+6(14) = 84 |
| (4,6) | 4+6(6) = 40 |
| (12,0) | 12+6(0) = 12 |

Optimal value is 12 occurred at (12,0)

11 MC → 64 pts Test 2

2 FR → 16 pts Test 2 FR