(071) Math 131:Finite MathematicsQuizTest(7.4,7.8): Dec.10, 2007

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Contents

Marks: 20; Time: 30 Minutes

NAME:..

I.D.#:

SERIAL# SECTION #: (check one)

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NOTE: SHOW ALL STEPS OF THE SOLUTION.

NO CREDIT FOR ANSWERS WITHOUT COMPLETE SOLUTION.

The questions are not in any order of difficulty at all.

Only the nonprogramable calculators are allowed.

Write the simplified answer of each question at the end of each question.

Q.1. $(Marks: 4)$. (**Crop** Planning). A farmer has at most 200 acres of farmland suitable for cultivationg crops A, B, and C.

The costs for cultivating crops A, B, *and* C, are \$ 40, \$ 50, and \$ 30 per acre, respectively.

The farmer has a maximum of \$ 18000 avaiable for land cultivation.

Crops A, B, and C require 20, 30, and 15 hours per acre of labor, respectively,

and there is a maximum of 4200 hours of labor avaiable.

If the farmer expects to make a rofit \$ 70, \$ 90, and \$ 50 per acre on crops A, B, and C, respectively,

how many acres of each crop should he plant in order to maximize his profit?

Set up the Standard Linear Programming Problem without Solution.

Let x = Number of acres of land for cultivation crop A.

Let y = Number of acres of land for cultivation crop B.

Let z = Number of acres of land for cultivation crop C.

OBJECTIVE FUNCTION: (Complete it).
MAXIMIZE Profit $P =$ ______ x +_______ y
subject to the constraints:

$$\begin{cases} 40x + 50y + 30z \leq 4200 \\ 20x - 6y + z = 22 \\ 2x - 5y + 2z = 18 \end{cases}$$

Solution. The augmented matrix for this system is

$$\left[\begin{array}{ccc|c} x & y & z & const. \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \end{array}\right]$$

ROW OPERATIONS:

$$\left[\begin{array}{ccc|c} x & y & z & const. \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \end{array}\right]$$

ROW OPERATIONS:

$$\left[\begin{array}{ccc|c} x & y & z & const. \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \end{array}\right]$$

ROW OPERATIONS:

$$\begin{bmatrix} x & y & z & : & const. \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \end{bmatrix}$$

ROW OPERATIONS:

$$\begin{bmatrix} x & y & z & : & const. \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \end{bmatrix}$$

ROW OPERATIONS:

$$\begin{bmatrix} x & y & z & : & const. \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \\ & & & : & \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & : & \ldots\ldots \end{bmatrix}$$

$x = \ldots\ldots\ldots\ldots$, $y = \ldots\ldots\ldots\ldots$, $z = \ldots\ldots\ldots\ldots$

Q.2.$(Marks: 8)\,.\,(516BZ23)$. **Use the SIMPLEX METHOD to solve the following problem.**

MAXIMIZE $P = 4x_1 + 3x_2 + 2x_3$

$$\textbf{subject to} \begin{cases} 3x_1 + 2x_2 + 5x_3 \leq 23 \\ 2x_1 + x_2 + x_3 \leq 8 \\ x_1 + x_2 + 2x_3 \leq 7 \\ x_1 \geq 0 \\ x_2 \geq 0 \\ x_3 \geq 0 \end{cases}$$

Solution.

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ - & - & - & - & - & - & - & : & - \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \end{bmatrix}$$

ROW OPERATIONS:

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ - & - & - & - & - & - & - & : & - \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \end{bmatrix}$$

ROW OPERATIONS:

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ - & - & - & - & - & - & - & : & - \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \end{bmatrix}$$

ROW OPERATIONS:

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ & & & & & & & : & \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \\ - & - & - & - & - & - & - & : & - \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & : & \ldots \end{bmatrix}$$

ROW OPERATIONS:

$$\left[\begin{array}{cccccccc:c} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ & & & & & & & : & \\ .... & .... & .... & ... & ... & ... & ... & : & .... \\ & & & & & & & : & \\ .... & .... & .... & ... & ... & ... & ... & : & .... \\ & & & & & & & : & \\ .... & .... & .... & ... & ... & ... & ... & : & .... \\ - & - & - & - & - & - & - & : & - \\ .... & .... & .... & ... & ... & ... & ... & : & .... \end{array}\right]$$

ROW OPERATIONS:

$$\left[\begin{array}{cccccccc:c} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ & & & & & & & : & \\ .... & .... & .... & ... & ... & ... & ... & : & .... \\ & & & & & & & : & \\ .... & .... & .... & ... & ... & ... & ... & : & .... \\ & & & & & & & : & \\ .... & .... & .... & ... & ... & ... & ... & : & .... \\ - & - & - & - & - & - & - & : & - \\ .... & .... & .... & ... & ... & ... & ... & : & .... \end{array}\right]$$

Max $P = ..., x_1 = ..., x_2 = ..., x_3 = ...$

Q.3. $(Marks : 4)\,.\,(334BZ33)\,.$ **Write (Set up but do not solve) the DUAL Problem associated with the following problem:**

[Rewrite the given linear programming problem as a maximization problem with constraints involving inequalities of the form $\leq$ (with the exception of the inequalities $y_1 \geq 0, y_2 \geq 0,$ and $y_3 \geq 0$)]

MINIMIZE $C = 16x_1 + 8x_2 + 4x_3$

subject to
$$\begin{cases} 3x_1 + 2x_2 + 2x_3 \geq 16 \\ 4x_1 + 3x_2 + x_3 \geq 14 \\ 5x_1 + 3x_2 + x_3 \geq 12 \\ x_1 \geq 0 \\ x_2 \geq 0 \\ x_3 \geq 0 \end{cases}$$

The Dual Form is the following Standard Maximum Problem:

MAXIMIZE $G =$ .....

subject to
$$\begin{cases} ..... \leq ..... \\ ..... \leq ..... \\ ..... \leq ..... \\ y_1 \geq 0 \\ y_2 \geq 0 \\ y_3 \geq 0 \end{cases}$$