**MATH 141 Homework Due Dec 2 Name :**

1. Solve the following linear programming problem using a ***graphical method***

A company makes two puddings, vanilla and chocolate. Each serving of vanilla pudding requires 2 teaspoons of sugar and 25 fluid ounces of water, and each serving of chocolate requires 3 teaspoons of sugar and 15 fluid ounces of water. The company has available each day 3,600 teaspoons of sugar and 22,500 fluid ounces of water. The company makes no more than 600 servings of vanilla pudding because it is all that it can sell each day. If the company makes a profit of 10 cents on each serving of vanilla pudding and 7 cents on each serving of chocolate pudding, how many servings of each pudding should it make to maximize its profit ?

***Step I*** : Set up your objective function and constraint inequalities

Maximize: *P =* **10x + 7y**Subject to **2x + 3y** $\leq $ **3600
 5x + 3y** $\leq $ **4500
 x** $\leq $ **600** $x\_{1}$$\geq 0$$y\_{1}\geq 0$

***Step II*** : Shade the feasible region, Find corner points and evaluate profit at each corner point.

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| Please complete the table below. |
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 The maximum Profit is \_\_\_\_\_\_\_\_\_\_\_.

 It occurs when the number of vanilla puddings is \_\_\_\_\_\_\_\_\_\_\_

 and the number of chocolate puddings is \_\_\_\_\_\_\_\_\_\_\_

1. Now solve the same linear programming problem in question #1 above using the **SIMPLEX**

method. **Clearly state the row operations used. For each tableau used, complete the leftmost column by providing the appropriate basic variables.**

***Step I*** : Set up your objective function and constraint inequalities

Maximize: P = +

Subject to: = $\leq $

 = $\leq $

 $X\_{1}$
 $X\_{2}$

***Step II*** : Introduce slack variables

***Step III*** : Set up the initial Simplex tableau.

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|  | **1** | 0 | 1 | 0 | 0 | 0 | 600 |
|  | 2 | 3 | 0 | 1 | 0 | 0 | 3600 |
|  | 5 | 3 | 0 | 0 | 1 | 0 | 4500 |
|  | -10 | -7 | 0 | 0 | 0 | 1 | 0 |

$R\_{2}-2R\_{1}$$\rightarrow R2$$R\_{3}-5R\_{1}$$\rightarrow R3$$R\_{4}+10R\_{1}$$\rightarrow R4$

**Now carry out successive pivoting operations to obtain an optimum solution to the linear programming problem. In each case clearly state the row operations used. For each tableau used, complete the leftmost column by providing the appropriate basic variables. You must show all work leading to the final tableau. Use the tables in the next page. At the end of your work please answer the questions below.**

 The maximum Profit is \_\_$**100**\_\_.

 It occurs when the number of vanilla puddings is **300 servings** and the number of chocolate puddings is **1000 servings**Does this result agree with your solution from question #1?

 **Show your work in the following tables. You may need less than the six tables provided for you.**

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|  | 1 | 0 | 1 | 0 | 0 | 0 | 600 |
|  | 0 | 3 | -2 | 1 | 0 | 0 | 2400 |
|  | 0 | 3 | -5 | 0 | 1 | 0 | 1500 |
|  | 0 | -7 | 10 | 0 | 0 | 1 | 6000 |

$R\_{2}-R\_{3}$$\rightarrow R2$$3R\_{4}+7R\_{3}$$\rightarrow R4$

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| S1 | 1 | 0 | 1 | 0 | 0 | 0 | 600 |
| S2 | 0 | 0 | 3 | 1 | -1 | 0 | 900 |
| S3 | 0 | 3 | -5 | 0 | 1 | 0 | 1500 |
| P | 0 | 0 | -5 | 0 | 7 | 3 | 28500 |
|  |  |  |  |  |  |  |  |
| S1 | 3 | 0 | 0 | -1 | 1 | 0 | 900 |
| S2 | 0 | 0 | 3 | 1 | -1 | 0 | 900 |
| S3 | 0 | 9 | 0 | 5 | -2 | 0 | 9000 |
| P | 0 | 0 | 0 | 5 | 16 | 9 | **90000** |

 $3R\_{1}-R\_{2}$ $\rightarrow R1$
 $3R\_{3}+5R\_{2}$ $\rightarrow R3$
 $3R\_{4}+5R\_{2}$$\rightarrow R4$

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**3.**

**Verik Engineering Company** manufactures three different types of

Calculators and classifies them as **S**cientific, **B**usiness and **G**raphing

according to their computing capabilities. The production requirements

are as follows

Each **S**cientific calculator requires five circuit components, one

assembly hour and one case.

Each **B**usiness calculator requires seven circuit components, three

assembly hours and one case.

Each **G**raphing calculator requires ten circuit components, four

assembly hours and one case.

The company has a monthly limit of 90,000 circuit components,

30,000 labor hours and 9,000 cases. The unit profits on **S**cientific,

**B**usiness, and **G**raphing calculators are $6, $13 and$20 respectively.

How many of each should be produced to yield the maximum profit?

What is the maximum profit?

 **a. Complete the production table below**

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| --- | --- | --- | --- |
|  | **S**cientific | **B**usiness | **G**raphing |
| Circuit components |  |  |  |
| Assembly Time (hours) |  |  |  |
| Cases |  |  |  |

 **b.** Construct the mathematical model for the linear programming problem.

 Include the objective equation and the constraints in standard form.

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| Let |  |
|  | = the number of  **S**cientific calculators |
|  | = the number of  **B**usiness calculators |
|  | = the number of  **G**raphing calculators |
| P | = Profit |



 **c.** Introduce slack variables to obtain the initial system.

 In order to answer questions **d** and **e** below you must first complete

 questions **f, g** and **h** below,

 **d.** How many of each calculator should Columbia Engineering Company

 produce each month to maximize profit.

 **S**cientific= \_\_\_\_\_\_ **B**usiness= \_\_\_\_\_\_ **G**raphing= \_\_\_\_\_\_

 **e.** What is the maximum profit?

 Maximum Profit = \_\_\_\_\_\_

 **f.** Are there any unused circuit components, hours, or cases?

 If there are, what are they and how many.

 **g.** Set up the initial simplex tableau. Circle the pivot element.

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 **h.**

 **Now carry out successive pivoting operations to obtain an optimum solution to**

 **the linear programming problem. In each case clearly state the row operations**

 **used. For each tableau used, complete the leftmost column by providing**

 **the appropriate basic variables.**

 **You must show all work leading to the final tableau.**

 **Show your work in the following tables. You may need less than the seven tables provided for you.**

 The initial simplex tableau for this problem is :

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