WPR 1

Lesson 12 (55 minutes) – In Lab

Version 1 SOLUTION

Login Name: .\secadet
Password: G0Systems2015!@
First Window: type EM384
Second Window: Section_LastName_FirstName
Open Excel Document

DOCUMENTATION. This WPR is an individual assignment – CLOSED BOOK and CLOSED NOTES. You may not use your computers or any digital media which is on your computer. No collaboration, e-mail, or internet use is authorized. You may ask questions of your instructor while doing the WPR. You may not depart the lab with these materials.

WPR Instructions

- Use this WPR Handout to formulate the problem and answer any questions. Fill-in your answer on this handout in the space provided and complete the digital work in Excel.
- This WPR consists of four separate problems.
- You are authorized to use a pencil, straight edge, issued calculator, and Excel.

Turn in requirements:

- Turn in the hard copy of your answer sheet prior to your departure. Make sure your name is on each page of the answer sheet.
- Submit your digital Excel file by saving the Excel file to the desktop and dragging the Excel file to the turn-in folder (on your lab computer desktop). **Confirm your instructor has received your Excel file before logging off of the computer.**

- Do not turn the page or begin work in Excel until told to do so by your instructor.
- Do not share any portion of this exam with another student.
- Save your Excel file early and often. Do not save this file to anywhere other than the Desktop of your workstation.
- You may not discuss any aspects of this WPR with anyone except an EM384 instructor until the Course Director has issued the 'all clear'.

I acknowledge that I have read and will comply with all instructions given above.

Cadet Signature: _____

Grading Summary

Problem / Part	Points Available	Points Received
1. Linear Program Formulation by Hand	40	
2. LP Graphical Solution Method	30	
3. Excel Model Formulation	50	
4. Data Exploration and Analysis	30	
Total:	150	

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1. Formulation by Hand (40 points)

The Black Rifle Ammo Company (BRAC), operates an ammunition factory in Northern New Jersey. For greater efficiency, the chief operating officer (COO) has always devoted the factory to producing one caliber of ammunition at a time: 9mm NATO. The chief financial officer (CFO) has advised him to diversify the production line to hedge against unstable market conditions. The COO is now considering producing the .45 ACP caliber as well. Each caliber round requires different amounts of brass, lead, and gunpowder and returns a different profit as seen in the table below.

	Brass (lbs/pallet)	**Lead** (lbs/pallet)	**Labor** (hours/pallet)	**Profit** ($/pallet)
9mm NATO	1400	50	3	600
.45 ACP	1580	80	5	550

The CEO has only purchased 10,000 lbs of brass for next month. He has also stored up 600 lbs of lead. He also has a limited number of workers, so he can only commit 300 hours to working in the production facility. In addition, his customers require **at least twice as many** pallets of .45ACP as pallets of 9mm NATO produced, and **no more than five** pallets of .45 ACP produced. He would like to maximize the profit of the company and has asked you to help him figure out how to do that.

1.1 Formulate a linear program algebraically for this problem using DOC in the space below. (**40pts**)

Decision variables:

x_1: Pallets of 9mm produced x_2: pallets of .45 ACP produced

Objective Function:

$$Max \quad Z = 600x_1 + 550x_2$$

Constraints:

$$1400x_1 + 1580x_2 \leq 10000$$

$$50x_1 + 80x_2 \leq 600$$

$$3x_1 + 5x_2 \leq 300$$

$$x_2 \geq 2x_1$$

$$x_2 \leq 5$$

$$x_1, x_2 \geq 0$$

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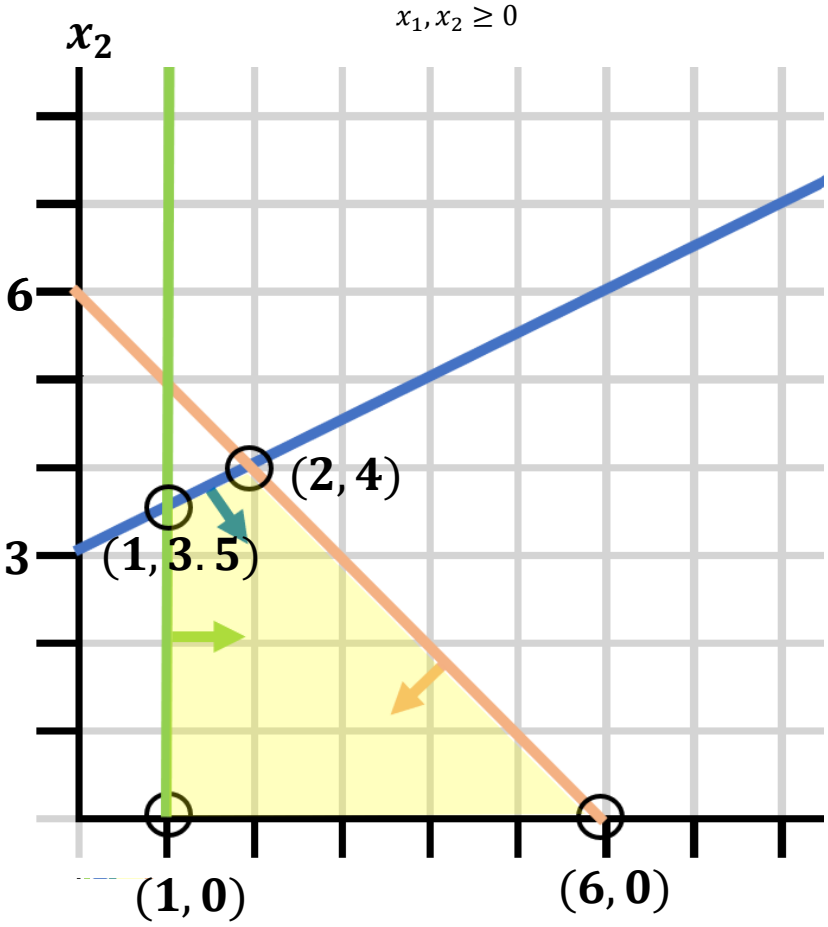
2. Graphical Method (30 points)

Use a graphical method seen in class to solve the following linear program (LP). You must show your work. Ensure you draw your graph neatly and clearly with labeled axes, circle the extreme points, and shade in the feasible region. (**20pts**)

Decision Variables:

Maximize $Z = 3x_1 + x_2$

Subject to:
$$-3x_1 + 6x_2 \leq 18$$
$$x_1 + x_2 \leq 6$$
$$2x_1 \geq 2$$
$$x_1, x_2 \geq 0$$



Write the name of the method you used to solve this LP: **(2pts)**

Enumeration of extreme points OR Method of level curves

Write your optimal solution below: **(8pts)**

Optimal decision variable values:

$x_1 = 6 \qquad x_2 = 0$

Optimal objective function value:

$Z(6,0) = 18$

$Z(1,0) = 3$

$Z(6,0) = 18$

x_1 $Z(1,3.5) = 6.5$

$Z(2,4) = 10$

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3. Excel Model Formulation (50 points)

You are modeling the daily revenue and costs of the Black and Gold (B&G) T-shirt company in order to determine its daily profit. The B&G company makes two types of T-shirts: short-sleeve (SS) and long-sleeve (LS). SS shirts cost $2.50 to produce and LS shirts cost $3.50 to produce. The factory has a daily fixed cost of $500. Due to the machine layout and workers available, you produce 300 SS shirts and 400 LS shirts each day. SS shirts sell at wholesale for $5 and LS shirts sell at wholesale for $6. Finally, you estimate that the demand for SS shirts is 500 per day and the demand for LS shirts is **always 100 more** than the demand for SS shirts, per day. Assume that if demand exceeds production, then you will only sell the amount produced. Otherwise, you will sell an amount equal to demand.

3.1 In an Excel sheet named **3.1**, model the base case to determine your total daily profit from selling both SS and LS shirts. Fill in the total profit from your model in the space below. (**35pts**)

Base case total daily profit from selling SS and LS shirts: **$1250**

3.2 To the right of your Excel model in sheet **3.1**, create a two-way data table to analyze the **total daily profit** by changing the total SS-shirt production (between 100 and 600, every 100) and the SS shirt demand (between 100 and 500, every 100). Conditionally format the **profit values** in this table to show high values in green and low values in red. (**10pts**)

3.3 Copy sheet 3.1 (containing your base case and two-way table) to a new sheet named **3.3**. If B&G can change the amount it charges for SS shirts without changing its demand, what should the new price for SS shirts be to **break even**? Specify the excel tool or function you used for this analysis and give the break-even price for SS shirts in the spaces below. Save this result in your Excel model in sheet **3.3**. (**5pts**)

Excel tool/function used for this analysis: ***Goal Seek***

SS selling price needed to break even each day: **$0.83**

It is possible to get the right profit value for 3.1, but have errors in your model. The errors come to light when the two-way data table contains incorrect profit values.

The most common errors for the model in 3.1 were as follows:

- Incorrectly writing profit formula as total revenue – total cost. Some students attempted to sum a profit per shirt, however that does not factor in the loss from excess shirts produced.
- Ignoring the demand constraint on the amount of shirts sold (which required using a “min” or “if” formula) – doing this only results in the correct profit value for the base case because *produced is less than demand*. This model error comes to light in the two-way data table.
- Hard coding values in your formulas – again leading to errors in the two-way data table.
- not conditionally formatting the two-way table, or formatting the parameter values as well as the profit values.

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4. Data Exploration and Analysis (30 points)

You are a junior analyst for Gotham Insurance Co. which is one of the largest home insurers in the Metropolitan New York area. Your boss wants to analyze trends in the insurance data. For this problem, you will use the sheet entitled **insurance_data** to create pivot tables and answer the questions below.

4.1 In tab named **4.1**, insert a pivot table that shows the sum of Insured Value **by** Region. Using this pivot table, provide your answers in the spaces below. (**10pts**)

4.1.1 Which Region has the highest total value of Insured Policies? ***East***

4.1.2 Which Region has the lowest total value of Insured Policies? ***Central***

4.2 In a tab named **4.2**, insert a pivot table that shows the number of Policies by State and Construction, **for Rural locations**. Using this pivot table, provide your answers in the spaces below. (**10pts**)

4.2.1 How many Frame construction type policies exist Rural locations in VT? **6**

4.2.2 How many Metal-Clad construction type policies exist Rural locations in NY? **10**

4.3 In a tab named **4.3**, insert a pivot table that shows the number of Policies whose **Insured Value** is **$100,000 or below** for each Earthquake and Flood type. Using this pivot table, provide your answers in the spaces below. (**10pts**)

4.3.1 How many Earthquake-Y and Flood-Y such policies exist? **3**

4.3.2 How many Earthquake-N and Flood-N such policies exist? **1**