OPERATIONS RESEARCH I
CASE STUDY – SPRING 2015

INSTRUCTIONS: (Please read them carefully)

1. This case is worth **10%** of the course total grade.
2. **This case is to be solved individually.**
3. Students cheating solutions from each other or plagiarizing answers from any other source will be awarded a grade of zero for the case. **There is zero tolerance policy when it comes to plagiarism.**
4. The case is due on **Monday, June 1st, 2015** and it is to be submitted during class.
5. **The developed linear program shall be solved using both Excel Solver as well as LINGO software.**
6. Include a hard copy of the Excel sheet and the LINGO code with your report along with a hard copy of the output report generated by both Excel and Lingo after running the code.
7. **A soft copy of the Excel and LINGO files shall also be emailed to me at rafif@aus.edu by the above stated deadline at 11:59 p.m. the latest.**
8. There will NOT be any presentations for this case.

PRBLEM DESCRIPTION: The ACM Company

The Arabian Carpet Manufacturing (ACM) Company is one of the leading carpet producers in the region. Competition in this industry is intense and forces producers to strive for maximum efficiency and economies of scale. It also forces producers to continually evaluate investments in new technology. As such, the owner of the ACM Company is seeking your assistance in planning the production schedule for the next quarter (13 weeks). The company has orders for fifteen different types of carpets that the company can produce on two types of looms: Dobbie looms and Pantera looms. Pantera looms produce standard tufted carpeting. Dobbie looms can also produce standard tufted carpeting but also allow the incorporation of designs (such as flowers or corporate logos) into the carpeting.

The following table summarizes the orders for each type of carpet that must be produced in the coming quarter along with their production rates and costs on each type of loom, and the cost of subcontracting each order. Note that the first 4 orders involve special production requirements that can only be achieved on a Dobbie loom or via subcontracting. Assume that any portion of an order may be subcontracted.

Carpet type	Demand (Yds)	Dobbie		Pantera		Subcontract
		Yd/Hr	Cost/yd	Yd/Hr	Cost/yd	Cost/yd
1	14,000	4,510	$2.66	NA	NA	$2.77
2	52,000	4,796	2.55	NA	NA	2.73
3	44,000	4,629	2.64	NA	NA	2.85
4	20,000	4,256	2.56	NA	NA	2.73
5	77,500	5,145	1.61	5,428	$1.60	1.76
6	109,500	3,806	1.62	3,935	1.61	1.76
7	120,000	4,168	1.64	4,316	1.61	1.76
8	60,000	5,251	1.48	5,356	1.47	1.59
9	7,500	5,223	1.50	5,277	1.50	1.71
10	69,500	5,216	1.44	5,419	1.42	1.63
11	68,500	3,744	1.64	3,835	1.64	1.80
12	83,000	4,157	1.57	4,291	1.56	1.78
13	10,000	4,422	1.49	4,558	1.48	1.63
14	381,000	5,281	1.31	5,353	1.30	1.44
15	64,000	4,222	1.51	4,288	1.50	1.69

ACM currently owns and operates 15 Dobbie looms and 80 Pantera looms. In order to maximize efficiency and keep pace with demand, the company operates 24 hours a day, 7 days a week. Each machine is down for routine maintenance for approximately 2 hours per week.

Managerial Report

a) Formulate the above problem as a linear program (LP). Clearly define the decision variables and provide a verbal description of the objective function as well as each of the constraints.

b) Solve the model developed in part (a) using Excel solver.

c) Solve the model developed in part (a) using LINGO.

d) What is the optimal production plan obtained, and what is the associated optimal objective function value?

e) Is the optimal solution obtained degenerate? Why?

f) Is the optimal solution obtained unique? Why?

g) Comment on the utilization of the resources (i.e., which of the resources have been fully utilized and which haven't).

h) Discuss the range of optimality for the objective function coefficients and provide its interpretation.

i) Discuss the range of feasibility for the constraints right hand sides and provide its interpretation.

j) Present the shadow prices for the constraints along with their interpretations.

k) If ACM wanted to decrease the production of any carpet type, which one would you recommend and why? (*assume minimum production requirement could be violated*)

l) What would happen to the total cost if one of the Dobbie looms broke and could not be used at all during the quarter?

m) What would happen to the total cost if an additional Dobbie loom was purchased and made available for the quarter?

n) What would happen to the total cost if one of the Pantera looms broke and could not be used at all during the quarter?

o) What would happen to the total cost if an additional Pantera loom was purchased and made available for the quarter?

p) How much money does it cost to produce carpet order 2? How much would the total cost decrease if that order were eliminated? Explain.

q) If the carpets in orders 5 through 15 all sell for the same amount, which type of carpet should ACM encourage its salesforce to sell more of? Why?

r) If the cost of subcontracting the carpet in order 1 is increased to $2.80 per yard, would the optimal solution change? Why?

s) If the cost of subcontracting the carpet in order 15 is decreased to $1.65 per yard, would the optimal solution change? Why?

t) What is the maximum that ACM should be willing to pay in order to increase the available production hours on the Dobbie looms by one hour (*assuming such an increase is possible*)?

u) Due to quality related concerns, ACM imposes the restriction that the total quantity of carpet subcontracted should not constitute more than one third of the amount of carpet delivered to the customers? How would this restriction be formulated as a constraint? Would the amendment of this constraint to the LP developed in part (a) change the optimal solution obtained earlier? Why?