

Foundations of Data Analysis for Business
PROBLEM SET 2

A company manufactures and sells two models of lamps, the Allister (A) and the Zainab (Z). To manufacture each lamp, the manual work involved is 20 minutes for the Allister and 30 minutes for the Zainab. The mechanical (machine) work involved is 20 minutes for the Allister and 10 minutes for the Zainab. The manual work available per week is 100 hours and the machine is limited to only 80 hours per week. Knowing that the profit per unit is \$15 for the Allister and \$10 for the Zainab, respectively, determine the quantities of each lamp that should be manufactured each week to obtain the maximum profit. *You may ignore integrality requirements for this problem.*

1. Write an expression for the objective function of this problem, using the specified variable names. (5 pts)
2. Write a mathematical expression for the constraint on available manual work. (5 pts)
3. Write a mathematical expression for the constraint on available machine work. (5 pts)

Suppose you solved the lamp production linear program in Excel and obtained an optimal production mix of 210 Allister lamps and 60 Zainab lamps. Answer the following questions based on the Sensitivity Report shown below.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$C\$6	# Manufactured Allister	210	0	15	5	8.333333333
\$D\$6	# Manufactured Zainab	60	0	10	12.5	2.5

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$E\$9	Manual work	100	7.5	100	140	20
\$E\$10	Machine work	80	37.5	80	20	46.66666667

4. What is the optimal profit per week for this company? (5 pts)
5. Suppose the company wants to hire an additional full-time employee to work 40 hours per week on lamp production. What is the maximum amount this employee could be paid per week without reducing the company's profits? (5 pts)

6. The company expects available manual labor to be 10 hours lower than usual next week, due to scheduled vacation time. What will be the new optimal profit level? (5 pts)
7. Suppose the company is considering purchasing an additional machine, which would double the available machine time per week. What can you say about the optimal profit with an additional machine? (5 pts)
8. If the margin on the Allister lamp drops to \$12 due to higher material costs, what can you say about the new optimal production mix? (5 pts)

Refer to the following description for Q9-10:

A client of an investment management firm wishes to invest \$750,000 in the bonds shown in the table below. No more than 25% of the client's money can be invested in any given company, and at least 50% should be invested in long-term bonds (maturing in 10+ years). No more than 35% can be invested in DynaStar, Eagle Vision, and OptiPro combined.

Company	Return	Years to Maturity	Rating
Acme Chemical	8.65%	11	1 - Excellent
DynaStar	9.50%	10	3 - Good
EagleVision	10.00%	6	4 - Fair
Micro Modeling	8.75%	10	1 - Excellent
OptiPro	9.25%	7	3 - Good
Sabre Systems	9.00%	13	2 - Very Good

9. Formulate the linear program for the investment problem, i.e., state the decision variables and write mathematical expressions for the objective function and constraints. (15 pts)
10. Solve the linear program using Excel or R. Submit your spreadsheet or code along with this assignment and report the optimal values of the decision variables and the objective function on your write-up. (15 pts)

WRITE YOUR OWN LP. (30 pts)

11. Write your own linear programming problem with at least three decision variables and at least three constraints, at least one of which is binding. Submit the text of your problem description and an Excel spreadsheet in which you set up and solve the LP. *The more creative and realistic your problem is, the better!*

