Problem Set 3—Sensitivity Analysis and Integer Models

MSIS 504—Professor Hillier

Individual Submission due Friday, July 11, 11:59pm

Team Submission due Saturday, July 12, 11:59pm

Instructions

1. Solve each of the three problems in three tabs in a single Excel file. Label the tabs by problem number (i.e., 1, 2, and 3). It is fine (even encouraged) to discuss and/or get help from classmates. Any help provided should be via discussion only and should *not* include sending or copying of files or portions of files. Everything in your individual submission should be entered by you, based on your understanding of the material.
2. Submit your individual solution to Canvas no later than the date and time shown above.
3. Meet with your study team. Compare and discuss your various solutions. Create a single submission. At this stage (after everyone on the team has submitted their individual submissions), sharing of files is permitted. **If you copy models from one worksheet to another to create the team submission, right-click on the tab and use Move or Copy Sheet, or control-click/option-click (PC/Mac) and drag the tab to copy the whole worksheet; don't just copy and paste the cells as this does not carry over the Solver information.**
4. One member of your team should submit it to Canvas no later than the due date and time shown above.

1. Sensitivity Analysis for a Manufacturing Problem

The Trim-Look Company makes a line of hand-made shirts, dresses, and coats for women. Each product must pass through the cutting and sewing department. In addition, each product makes use of the same polyester fabric. They have formulated a linear programming spreadsheet model to determine the production levels that would maximize profit. The spreadsheet model and sensitivity report are shown below. Answer the following questions as specifically and completely as is possible without re-solving the problem with Solver. Justify your answers using the results from the sensitivity report. All problems are independent (i.e., any change made in one part does not affect the other parts). Type your answers into a single worksheet tab on your spreadsheet, clearly labeling each answer (a, b, c, etc.).

	A	B	C	D	E	F	G
1		Shirts	Dresses	Coats			
2	Profit Per Unit	$5	$30	$20			
3							
4	Resources	Resources Required per Unit Produced			Totals		Available
5	Cutting (hours)	1	4	3	200	<=	200
6	Sewing (hours)	1	6	4	280	<=	360
7	Material (yards)	1	4	2	160	<=	160
8							
9		Shirts	Dresses	Coats			Total Profit
10	Production	0	20	40			$1,400

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B10	Production Shirts	0	-2.5	5	2.5	1E+30
C10	Production Dresses	20	0	30	10	3.33
D10	Production Coats	40	0	20	2.5	5

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
E5	Cutting (hours) Totals	200	5	200	40	40
E6	Sewing (hours) Totals	280	0	360	1E+30	80
E7	Material (yards) Totals	160	2.5	160	40	26.67

a. Suppose the profit per coat decreases to $18. Will this change the optimal production quantities? What can be said about the change in total profit?

b. How much would the selling price of shirts need to be increased before it might become profitable to produce this product?

c. Suppose the profit per dress increases by $7 *and* the profit per coat decreases by $3. Will this change the optimal production quantities? What can be said about the change in total profit?

d. Suppose they discover 20 yards of extra material. How much would this affect total profit? Will this cause a change in the optimal production quantities?

e. Suppose that a part-time worker calls in sick, thus reducing the hours available in the cutting department by 4 hours *and* they obtain 30 more yards of material. How much will this affect total profit? Will this cause a change in the production quantities?

2. Locating Paramedic Stations in Pilgrim Haven

Do problem 10.12 (part *b* only) in the text. The text pages for this problem are also available electronically on Canvas. Note that the average frequency of medical emergencies per day data is only relevant for problem 10.11 and not needed for problem 10.12. You only need to assure that there is at least one station within 15 minutes of each tract. Build a linear integer programming spreadsheet model and solve it using Solver. (Be sure to set Integer Optimality in Solver Options to 0%.)

3. Computer Purchasing

Do problem 10.17 (part *b* only) in the text. The text pages for this problem are also available electronically on Canvas. Build a linear integer programming spreadsheet model and solve it using Solver. *Hint: You will need binary variables and big-number constraints to solve this in a linear way.* (Be sure to set Integer Optimality in Solver Options to 0%.)