

Mathematics 235
Robert Gross
Homework 4
Due February 25, 2011

Note: For this week's assignment, you will need to solve linear programming problems using *Excel*. Please put all of your solutions on separate sheets on one file, which you should name `HW2.xls`. Please put your name in cell A1 of each sheet, and in cell A2 please put the words "MT235: Homework 2" and the problem number. *If you do not follow these instructions, you will have points deducted.*

You should e-mail, as an attachment, the single *Excel* file containing all of the spreadsheet solutions to `gross@bc.edu` by 2 PM on Friday, February 25. You should bring to class and submit printed versions of each spreadsheet, stapled together. You should print two versions of your solution to each problem. **Both should be formatted so that grid lines and row and column labels print.** One version should print the numerical contents of the cells. The other version should print the formulas that are in each cell.

In addition, you must write by hand the solution to the problem in words, *e.g.*, "Buy 12 regular gloves and 13 catcher's mitts."

Fractional answers are permissible in all of these problems.

1. **Sunjuice** sells bags of orange and orange juice to wholesale companies. The oranges are graded on a scale of 1 (bad) to 10 (excellent). At present, Sunjuice has in stock 200,000 pounds of grade 9 oranges and 120,000 pounds of grade 6 oranges. The average quality of oranges sold in bags must be at least 7, and the average quality of oranges used for juice must be at least 8. Each pound of bagged oranges yields a revenue of \$1.50, while a pound of oranges can be used to make juice that sells for \$2.00. A pound of oranges used for juice has a marginal cost of \$1.05, while a pound of oranges sold in a bag has a marginal cost of \$0.70. (Both of these costs are independent of the cost of the oranges, which have already been purchased.) All of the oranges need not be used.

- (a) Formulate a linear program to help Sunjuice maximize profit.
- (b) Use *Excel* and *Solver* to find the optimal solution. Be sure to state your solution in full sentences, including the maximum profit.

Using the sensitivity report produced by *Solver*, answer the following two independent questions, as best as possible. It is conceivable that they cannot be answered.

- (c) Suppose that 10,000 pounds of grade 6 oranges were found to be rotten and unusable. What happens to the optimal solution and maximum profit?
- (d) Suppose that an additional 10,000 pounds of grade 9 oranges were found in the warehouse, at no additional cost. What happens to the optimal solution and maximum profit?

2. **Bremer Agricultural Products** blends a silicon compound and a nitrogen compound to create two different types of fertilizer. *Mir-Gro* must be composed of at least 40% of the nitrogen compound, and sells for \$70/lb. *Super-Green* must be composed of at least 70% of the silicon compound, and sells for \$40/lb. Bremer can purchase up to 8,000 pounds of the nitrogen compound at \$15/lb, and up to 10,000 pounds of the silicon compound at \$10/lb. Bremer is confident that it can sell as much of each compound as it can produce.

- (a) Formulate a linear program to help Bremer maximize profit.

(b) Use *Excel* and *Solver* to find the optimal solution. Be sure to state your solution in full sentences, including the maximum profit.

3. **Time-Rite** manufactures clocks by hand. At present, they sell two models, with the following requirements:

Task	Time required		Available
	Grandfather Clock	Wall Clock	
Assembly (hrs)	6	4	40
Carving (hrs)	8	4	40
Packing/Shipping (hrs)	3	3	20
Material cost/clock	\$100	\$50	
Revenue/clock	\$500	\$300	
Maximum demand	15	20	

Time-Rite can also purchase clocks from an outside supplier. The cost of a purchased grandfather clock is \$400, and the cost of a purchased wall clock is \$150. Time-Rite can purchase a maximum of 5 clocks from the outside supplier.

(a) Formulate a linear program to help Time-Rite maximize profit.

(b) Use *Excel* and *Solver* to find the optimal solution. Be sure to state your solution in full sentences, including the maximum profit.

4. As part of the settlement for a class action suit involving the sale of rotten food, **Leon's Deli Meats** must provide sufficient cash to make the following annual payments (in thousands of dollars):

Year	1	2	3	4	5	6
Payment	110	125	430	385	215	110

The annual payments must be made at the *beginning* of each year. The judge will approve an amount that, along with earnings on its investments, will cover the annual payments. Investment of the funds will be limited to savings (at 2% annually) and government securities. Both types securities have a par value (face value) of \$1000, and have the following terms:

Security	Current Price	Rate (%)	Years to Maturity
1	\$1025	5.250	2
2	\$1015	4.525	3

Each security can be bought at the same terms at the start of each of the next 6 years. Funds not invested in these securities will be placed in savings. Assume that interest is paid annually at the *end* of each year. The plan will be submitted to the judge and, if approved, Leon's will be required to pay a trustee the amount that will be required to fund the plan.

Use linear programming to find the minimum cash settlement and bond purchase schedule necessary to fund the annual payments.