Linear Programming Problems

Problem 1

The University of North Central Oregon is determining how many summer classes to offer. School rules mandate that at least 40 undergraduate and 25 graduate classes be offered each term. An instructor earns $2500 per undergraduate class and $3500 for each graduate class. Additionally, the number of undergraduate classes can be no more than twice the number of graduate classes. Finally because of union rules, the school must pay at least $300,000 in salaries each term and offer at least 100 total classes. The school wants to minimize salaries in the summer term.

a) Formulate this as a linear programming problem (i.e. objective function and constraints).
b) What is the minimum total salary?
c) What is the optimal solution (i.e. how many classes of each type should be produced)?
d) If the price of a graduate class increases to $4500, what is the new solution?

Problem 2

As the COO, you must decide the daily production totals of paper shredders, the Dred and the Sawduster. The profit on each Dred is $14 per unit and the Sawduster's profit is $10. Each model goes through two phases in the production process, and there are only 80 man-hours available daily at the assembly stage and only 70 man-hours available at the packaging stage. Each Dred requires 15 minutes of assembly time and 10 minutes of packaging time. Each Sawduster requires 20 minutes of assembly time and 15 minutes of packaging time. The company has also decided that the Sawduster must comprise at least 30 percent of the production total. You need to maximize your profit.

a) Formulate this as a linear programming problem.
b) Find the solution that gives the maximum profit.
c) Given the solution from part b, how much can the profit on a Sawduster change, while keeping the solution optimal?
d) How much assembly time was used to produce the optimal solution?
e) Draw the graph to show the feasible region and the corner points.
f) How many total constraints are in this problem?

Problem 3

Tommy, the owner of Mowers, Inc. is trying to determine how many units of two types of lawn mowers to produce each day. One of these is the Lawn Master, while the other is the Sharp Cutter. The profit per unit on the Lawn Master is $70, while the profit per unit on the Sharp Cutter is $50. The Lawn Master requires 15 minutes of assembly time and 20 minutes of inspection time. The Sharp Cutter requires 30 minutes of assembly time and 15 minutes of inspection time. The company must fill a standing order for 5 Sharp Cutter models. There are 580 minutes of assembly time and 260 minutes of inspection time available each day. Tommy wants to earn as much profit as he can.

a) Formulate this as a linear programming problem.
b) How many units of each product should be manufactured to maximize profits?
c) How much assembly time is used? Inspection time?
d) How much can the profit on a Lawn Master change without changing the optimal solution?
e) How many total constraints are in this problem?

Problem 4

Sally is considering three advertising media to promote her autumn acorns. She is considering radio, television, and newspaper. Radio ads cost $250 each, television ads $600 each, and newspaper ads $850. To keep the advertising reps happy, Sally must advertise with each medium, a minimum of 14 radio ads, 10 television ads, and 4 newspaper ads. She wants to reach at least 50,000 people. Each television ad reaches 1500 people; each newspaper ad reaches 2,000 people, while each radio ad reaches 1,000 people. Sally wishes to keep her costs as low as possible. Formulate this as a linear programming problem.

Problem 5

Using the results table below, answer the following questions.

a) What is the optimal solution?
b) What is the optimal profit?
c) If one more unit of product B is produced, what will happen to profit?
d) How much should you be willing to pay for one more unit of resource1? Resource 2?
e) How much of resource 2 is used? Resource 3?
f) The boss thinks the company can charge more for each product D. How much can the profit for a unit of D increase without changing the optimal solution?
g) How many total constraints are there?

	A	B	C	D		
Maximize	12	15	23	16		RHS
1	3	5	4	7	≤	850
2	2500	2000	3600	2800	≤	86,500
3	5	2	3	4	≥	100
4		1		-2	≤	0
5	0.3		0.6		≤	223

	A	B	C	D	PROFIT
SOLUTION	25	22	16	28	1446

Variables	Solution	Reduced Cost	Value	Lower Bound	Upper Bound
A	25	0	12	10	Infinity
B	22	5	15	-Infinity	50
C	16	0	23	0	46
D	28	17	16	12	74

Constraints	Dual Value	Slack/ Surplus
1	12	0
2	0	750
3	0	3
4	10	0
5	15	0

Problem 6

You just found the solution to a linear programming problem: 42 Bangees and 65 Grungers. Each Bangee contributes $22 profit, and each Grunger contributes $15. What is the total profit for this solution?