APMA 1210 Recitation 1 Problems

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1 Questions

1.1 Rabbit Food

Your beloved pet rabbit needs a special diet. Your vet says to feed your rabbit at least 24g of fat, 4g of protein, and 36g of carbohydrates every day. However, the vet also warns you not to feed your rabbit more than 5oz of food in total each day.

On your college-student budget, you can reliably afford two brands of rabbit food: E-Z-Feed and Bargain Bunny. E-Z-Feed costs \$0.20/oz, and each ounce contains 12g of fat, 1g of protein, and 12g of carbohydrates. Bargain Bunny costs \$0.30/oz, and each ounce contains 8g of fat, 2g of protein, and 12g of carbohydrates. Your goal is to come up with a mixture of these brands that will minimize the amount you have to spend on food while meeting your pet's needs.

(a) Write a linear program representing this problem. Clearly specify your decision variables.

(b) Reformulate your program in standard and matrix form.

(c) Draw the feasible region for the problem and clearly identify all constraints.

(d) Solve the problem.

1.2 Camera Manufacturing

This is problem #9 from Chapter 1 in *Applied Mathematical Programming*. The Candid Camera Company manufactures three lines of cameras: the Cub, the Quickiematic and the VIP, whose contributions are \$3, \$9, and \$25, respectively. The distribution center requires that at least 250 Cubs, 375 Quickiematics, and 150 VIPs be produced each week.

Each camera requires a certain amount of time in order to: (1) manufacture the body parts; (2) assemble the parts (lenses are purchased from outside sources and can be ignored in the production scheduling decision); and (3) inspect, test,

	City	Trip cost*	Trip revenue	Average flying time (hours)
B707	A	$ 6,000	$ 5,000	1
	B	7,000	7,000	2
	C	8,000	10,000	5
	D	10,000	18,000	10
Electra	A	$ 1,000	$ 3,000	2
	B	2,000	4,000	4
	C	4,000	6,000	8
	D	———	———	20
DC9	A	$ 2,000	$ 4,000	1
	B	3,500	5,500	2
	C	6,000	8,000	6
	D	10,000	14,000	12

* Data is for a round trip.

Figure 1: Data for Airline Optimization Problem

and package the final product. The Cub takes 0.1 hours to manufacture, 0.2 hours to assemble, and 0.1 hours to inspect, test, and package. The Quickiematic needs 0.2 hours to manufacture, 0.35 hours to assemble, and 0.2 hours for the final set of operations. The VIP requires 0.7, 0.1, and 0.3 hours, respectively. In addition, there are 250 hours per week of manufacturing time available, 350 hours of assembly, and 150 hours total to inspect, test, and package.

Formulate this scheduling problem as a linear program that maximizes contribution.

1.3 Airline Optimization

This is problem #14 from Chapter 1 in *Applied Mathematical Programming*. An airline that flies to four different cities (A, B, C, D) from its Boston base owns 10 large jets (B707), 15 propeller-driven planes (Electra), and two small jets (DC9). The data in the table above (Figure 1) is available for the flight paths, assuming consistent flying conditions and passenger use.

(a) Can you choose decision variables that could be used in multiple linear programs based on this data set? What would a good selection of decision variables be, with no context on what the goal of the program would be?

(b) Write a constraint or set of constraints to ensure that City D is visited at least twice each day, and all the other cities are visited at least four times each day.

(c) Each plane can fly at most 18 hours in a single day. Write a constraint or set of constraints to govern the limitations on the availability of planes.

(d) Several objective functions could be pursued based on this information. Write objective functions designed to (i) minimize cost over a day, (ii) maximize profit over a day (note profit is revenue minus cost), and (iii) minimize fleet flying time over a day.