QR 26: Choice and Chance
The Mathematics of Decision Making

Unit III Exercises

References:

- [HH] Harnett and Horrell, *Data, Statistics, and Decision Models with Excel*.
- [DSS] Dorfman, Samuelson, and Solow, *Linear Programming and Economic Analysis*.
- [BHM] Bradley, Hax, and Magnanti, *Applied Mathematical Programming*.
- [R1] Rosenberg, N. UMAP Module 453: "Linear Programming in Two Dimensions: I"
- [R2] Rosenberg, N. UMAP Module 454: "Linear Programming in Two Dimensions: II"

III.A. Set up problems 1--2 of the handout, UMAP Module 453 [R1]. You need not carry out the optimization procedure, but do identify the choice variables, the constraints, and the objective function.

III.B. Exercise 3 of the hand-out, UMAP module 454 [R2], "Linear Programming in Two Dimensions, II."

III.C. [S] Your boat company makes four different kinds of boats: Large sailboats (at $1200 profit per boat), small sailboats (@ $930), motorboats (@ $1050) and sailboards (@ $750). Each boat requires some of your raw materials on hand, according to the table that follows.

		Requirements by Product			
Raw Materials	**On Hand**	**Large Sailboat**	**Small Sailboat**	**Motorboat**	**Sailboard**
Sailcloth	700	4	3	0	1
Glass Fiber	1,380	8	3	4	2
Epoxy Resin	1,280	3	3	3	2
Aluminum	1,100	4	2	2	2
Engines	120	0	0	1	0

Manufacturing what mix of products using the resources on hand will generate the highest profit? Which raw material would you most like more of and why?

III.D. Exercises 12.5--12.6 (the second continues the first) from [HH] in the sourcebook.

III.E. [BHM, Exercise 1.14]. A strategic planner for an airline that flies to four different cities from its Boston base owns 10 large jets (B707s), 15 propeller-driven planes (Electras), and two small jets (DC9s). Assuming constant flying conditions and passenger usage, the following data is available.

	City	Round Trip Cost	Round 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	0	0	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

Formulate constraints to take into account the following:

1. City D must be served twice daily; cities A, B, and C must be served four times daily;
2. Limitation on number of planes available, assuming that each plan can fly at most 18 hours per day

Formulate objective functions for:

1. Cost minimization;
2. Profit maximization
3. Fleet flying-time minimization

Indicate when a continuous linear-programming formulation is acceptable, and when an integer-programming formulation is required.

Challenge: Compute, compare and contrast solutions which optimize these objectives.