

Rutgers University, Business School/Undergraduate New Brunswick
Operations Management (33:623:386:10)
Spring 2008; Instructor: Adi Ben-Israel

Midterm Exam — February 20, 2008

You have 80 minutes to complete this examination. The exam has 6 pages.

Please do not read past this page until instructed to.

Allowed materials:

- A single “cram sheet” in your own handwriting (both sides allowed)
- A dictionary (if English is not your first language)
- A calculator

You may detach any page from the exam form, but you must turn in all pages at the end of the exam.

Name:

ID:

Section No:

10

DO NOT WRITE BELOW

Q1	
Q2	
TOTAL	

Q1: Manpower Planning (50 points). The **Garden State Airline (GSA)** must decide how many new cabin personnel (stewardesses & stewards) to hire and train over the next 6 months. The requirements are given in terms of flight-hours per month:

Month	Hours Needed	Month	Hours Needed
January	8,000	April	10,000
February	9,000	May	9,000
March	8,000	June	12,000

One month of training is required before a trainee becomes "experienced" (or a "regular crew member"). During the month of training, each trainee requires 100 hours of actual in-flight experience and supervision. Therefore, for each trainee, 100 less hours are available for flight service by regular personnel.

Each experienced crew member can work up to 150 hours in a month. The pay for experienced crew members is \$3000/month, even if they work less than 150 hours. Experienced crew members may be asked to work up to 20 hours overtime, at the rate of \$50/hour (in addition to their regular hours and pay.) The pay for trainees is \$2000/month.

GSA has 60 regular crew members at the beginning of January. Each month afterwards, approximately 10% of the experienced personnel quit GSA on the first of the month.

Formulate the hiring-and-training problem as an LP model, where the objective is to minimize cost.

Use X_t for the **number of new personnel beginning training in month t**, ($t = 1, \dots, 6$). Define clearly any additional variables that you need, and explain your constraints.

Q2: Drugs (50 points, Spreadsheet). Garden State Pharmaceuticals (**GSP**) produces 2 drugs, called **Drug 1** (selling for 30 \$/ounce) and **Drug 2** (24 \$/ounce). GSP can sell all its production.

The drugs are produced by blending 2 chemicals, called **Chemical 1** and **Chemical 2**, and a **Filler**. Drug 1 must have at least 30% of Chemical 1, and at least 10% of Chemical 2. Drug 2 must have at least 10% of Chemical 1, and at least 20% of Chemical 2. The amounts of Filler in both drugs are unrestricted.

Any chemicals left after blending drugs can be sold separately, Chemical 1 at 5.20 \$/ounce, and Chemical 2 at 6.30 \$/ounce.

The two chemicals are produced on two processes, called **Process 1** and **Process 2**. Each process can run for at most 24 hours.

The results of running the processes for one hour are summarized in the following table

	Process 1	Process 2
Raw material required (lbs)	3	2
Labor hours required	2	3
Yield of Chemical 1 (ozs)	3	3
Yields of Chemical 2 (ozs)	3	1

The following costs apply:

Raw material	Labor	Filler
8 \$/lb	12 \$/hour	15 \$/oz

250 lbs of raw material and 180 labor hours are available. The Filler supply is unlimited.

The spreadsheet in p. 4 gives the optimal solution (maximal profit) found by Solver.

- What is the target cell? What are the changing cells? (5 points)
- Write the formula in cell B23 (raw material used), that when copied to cells B24, B25, B26 gives the correct results. (5 points)
- Write the formula in cell B35 (minimum of Chemical 1 in Drug 1), that when copied to cells C35, B36, C36 gives the correct results. (5 points)

	A	B	C	D	E	F	G
1	Problem 2						
2							
3	Data on drugs	Drug 1	Drug 2				
4	Selling price/ounce	\$30.00	\$24.00				
5	Minimum percent of chemical 1	30%	10%				
6	Minimum percent of chemical 2	10%	20%				
7							
8	Selling price/ounce			Cost			
9	Chemical 1	\$5.20		Raw material		\$8.00	per pound
10	Chemical 2	\$6.30		Labor		\$12.00	per hour
11				Filler		\$15.00	per ounce
12	Data for processes (running one hour)	Process 1	Process 2				
13	Raw material required	3.00	2.00				
14	Labor hours required	2.00	3.00				
15	Yield of chemical 1	3.00	3.00				
16	Yield of chemical 2	3.00	1.00				
17	Maximum hours available	24	24				
18							
19	Hours to run processes	Process 1	Process 2				
20		24.00	24.00				
21							
22	Results from processes			Available			
23	Raw material used	120.00	<=	250.00			
24	Labor hours used	120.00	<=	180.00			
25	Yield of chemical 1	144.00					
26	Yield of chemical 2	96.00					
27				Total used		Total	Chemicals
28	Blending (ounces of chemicals in drugs)	Drug 1	Drug 2	in drugs		Produced	Sold separately
29	Chemical 1	115.20	28.80	144.00	<=	144.00	0.00
30	Chemical 2	38.40	57.60	96.00	<=	96.00	0.00
31	Filler	230.40	201.60	432.00			
32	Total produced	384.00	288.00				
33							
34	Minimum of chemicals in drugs	Drug 1	Drug 2				
35	Chemical 1	115.2	28.8				
36	Chemical 2	38.4	57.6				
37							
38	Revenue from:			Profit		\$9,552.00	
39	Selling drugs	18,432.00					
40	Selling chemicals	0.00					
41	Cost of:						
42	Raw material	\$960.00					
43	Labor	\$1,440.00					
44	Filler	\$6,480.00					
45							

- (d) Write the formula in cell G29 (Chemical 1 sold separately) that gives the correct result when copied to cell G30. (5 points)

- (e) Write the formula in cell B42 (Cost of raw material) that copies correctly to cell B43. (5 points)

- (f) Write the formula in cell F38 (Profit). (5 points)

- (g) Write all constraints in the Solver dialog box. (20 points)

