

**Rutgers University, Business School/Undergraduate New Brunswick**  
**Operations Management (33:623:386:03)**  
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:

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Section No:

03
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DO NOT WRITE BELOW

<b>Q1</b>	
<b>Q2</b>	
<b>TOTAL</b>	

**Q1: Grading** (50 points). **Grading On The Curve (GOTC)**, Inc. administers Operations Management tests to job candidates who are applying for CEO positions in leading Fortune 500 Companies. For this purpose, GOTC employs eight senior graders and ten junior graders (called **in-house graders**)

Each test consists of three parts: **written**, **computer**, and **video-recorded**. The time, in minutes, required by each kind of grader to grade each type of test is as follows:

Grader	Test Type		
	Written	Computer	Recorded
Senior	20	15	15
Junior	30	20	18

Each grader can work up to 40 hours in the coming week. 800 candidates have just taken the test, and the results have to be announced after a week. For quality control purposes, senior graders must grade at least 10% of all tests graded in-house in each category.

Work can also be assigned to outside part-time graders, who charge \$25 for each written test, \$15 for each computer test, and \$20 for each recorded test, and can do any number of tests in a week. However, each test done by an outside grader requires a check by an in-house grader. A check by a senior grader takes 10 minutes, while a check by a junior grader takes 15 minutes.

Formulate an algebraic linear programming model to minimize the wages paid to outside graders, while still meeting the deadline for grading all the tests. Clearly define the decision variables, and explain the 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.

- (a) What is the target cell? What are the changing cells? (5 points)
  
- (b) Write the formula in cell B23 (raw material used), that when copied to cells B24, B25, B26 gives the correct results. (5 points)
  
- (c) 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	<b>Problem 2</b>						
2							
3	<b>Data on drugs</b>	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	<b>Selling price/ounce</b>			<b>Cost</b>			
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	<b>Data for processes (running one hour)</b>	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	<b>Hours to run processes</b>	Process 1	Process 2				
20		<b>24.00</b>	<b>24.00</b>				
21							
22	<b>Results from processes</b>			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	<b>Blending (ounces of chemicals in drugs)</b>	Drug 1	Drug 2	in drugs		Produced	Sold separately
29	Chemical 1	<b>115.20</b>	<b>28.80</b>	144.00	<=	144.00	0.00
30	Chemical 2	<b>38.40</b>	<b>57.60</b>	96.00	<=	96.00	0.00
31	Filler	<b>230.40</b>	<b>201.60</b>	432.00			
32	Total produced	384.00	288.00				
33							
34	<b>Minimum of chemicals in drugs</b>	Drug 1	Drug 2				
35	Chemical 1	115.2	28.8				
36	Chemical 2	38.4	57.6				
37							
38	<b>Revenue from:</b>			<b>Profit</b>		<b>\$9,552.00</b>	
39	Selling drugs	18,432.00					
40	Selling chemicals	0.00					
41	<b>Cost of:</b>						
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)

