C&O 370 Deterministic OR Models – Winter 2011

Assignment 3 Due date: Friday Mar. 4, 2011

Assignments are due at the start (9:30-ϵAM) of class on the due date.
Write your name and ID# clearly, and underline your last name.

1 Stochastic/Robust Optimization: Student Study Planning —— 10+15+10+15=50 Marks

A common problem for students is to plan their study time for the final exam. Consider the following information for an exam. Suppose that there are 4 possible scenarios from the possibilities of long (not long) and hard (not hard), with a probability of 1/4 for each scenario. The test will cover four topics: **sensitivity analysis (SA), stochastic optimization (SO), integer programming (IP), dynamic programming (DP)**. From previous exams we get Table 1.

Scenario	(worth, difficulty)				Available time at Exam
	Sensit. Anal.(SA)	Stoch.(SO)	Integer(IP)	Dynamic(DP)	
Long, Hard	(30,3)	(20,3)	(25,2)	(25,2)	50
Long, Easy	(35,3)	(20,1)	(20,1)	(25,2)	60
Short, Hard	(40,2)	(30,2)	(15,2)	(15,3)	70
Short, Easy	(20,1)	(20,1)	(30,1)	(30,1)	80

Table 1: Exam Scenarios

The minimum amount of study-time (in minutes) required to answer a question of difficulty level D in order to get full marks is estimated to be:

$$120D \text{ for } (SA); \quad 100D \text{ for } (SO); \quad 180D \text{ for } (IP): \quad 140D \text{ for } (DP)$$

Thus, given an (SA) question of difficulty-level D that is worth M marks, in order to earn $0 \leq x \leq M$ marks, one needs to devote at least $\frac{x}{M} \times 120D$ minutes of study-time to (SA). The study-time comes from both preparation-time before the midterm, and thinking-time spent during the midterm (i.e., after a scenario materializes). Each minute of preparation-time

spent beforehand counts as one minute of study-time, however each minute of thinking-time spent on the midterm counts only as 0.2 minutes of study-time. Due to various time constraints and other factors, we will assume that only 820 minutes of (beforehand) preparation-time are available.

1. (a) Formulate the students' problem of maximizing the expected total marks as a two-stage stochastic linear program. Specify clearly what are your first- and second-stage variables. (Remember to include constraints that restrict the number of marks scored on topic j in scenario s to be at most the number of marks given in Table 1 above.)

   (b) Model and solve the problem using AMPL.

   (c) What would be the optimal solution if advance knowledge of the scenario is known? Calculate the expected value of perfect information (EVPI).

2. (a) Suppose that we used the following expected values for the exam given in Table 2.

	(worth, difficulty)				Available time
	Sensit. Anal.(SA)	Stoch.(SO)	Integer(IP)	Dynamic(DP)	at Exam
Med., Med.	(30±5,2±1)	(25±5,2±1)	(20±5,2±1)	(25±5,2±1)	65±15

Table 2: Exam Expected Scenario

Formulate and solve a robust optimal solution using AMPL. (You can use the Soyster and/or Bertsimas-Sims models.)