MASSACHUSETTS INSTITUTE OF TECHNOLOGY
15.053 – Optimization Methods in Management Science (Spring 2007)

Recitation 10, May 9th 2007

Problem 1: Newsvendor Type Problem
Paris Hilton has developed an ultra fashionable summer satin top for miniature dogs. Since the satin top is part of the summer line she can only sell it for the full price of $50 during the summer. At the end of the summer the dog-tops sell at a price of $5. The creation of dog-tops has a cost of $10 per top. Paris knows that the demand for these dog-tops is somewhere between 10,000 and 20,000. She also knows that if she prices them at $5 at the end of the summer they will all be sold. Use the Newsvendor problem approach to decide how many dog-tops Paris should produce in order to maximize her expected profit.

Problem 2: Gerber Baby (True story from 1998-99. <http://gbr.pepperdine.edu/993/tree.html>)
Gerber Products, Inc. needs help in deciding whether to continue using the plastic known as PVC in pacifiers and feeding products. PVC, a composite plastic, is made pliable with a softening chemical called "phthalates". Although phthalates have been used in plastic for over 30 years without any cases of health problems, Greenpeace announced that their scientific testing on the chemical has been found it to be carcinogenic in lab rats. Due to this announcement the Consumer Product Safety Commission has decided to study the matter further and issue a press release with their results. This is the point at which Gerber decides to implement a decision tree.

Gerber faces two choices: be reactive, wait for the announcement, and gauge consumer response before deciding on a course of action; or be proactive and pursue resolution regardless of the public's response to the report. The CSPC will either issue an unfavorable report recalling of all products with phthalates, or a more favorable one expressing minimal concern over the issue. The two reports have equal probability.

If Gerber chooses to be proactive, they can choose to discontinue all products with PVC. In this case if the report is favorable, there is an 80% chance that the public would react favorably causing sales to increase by $1 million, but also there is a 20% chance that sales would decline by $1 million. If the report is negative there is a 25% likelihood that Gerber could preserve current sales, but also a 75 % probability that a recall would hurt sales by $1.25 million.

In the event that Gerber waits for the CSPC report before taking action. With a favorable report and a delayed response, there is a 25% chance that sales would remain flat, along with a 75% chance that sales would decline by $2 million.

The worst-case scenario is if Gerber remains passive and there is a recall. In that case, there is still a 20 % probability that Gerber could increase sales by $.5 million. However, it was considered an 80% probability that significant volume would be lost ($10 million).

Part A: Set up the decision tree and find the optimal decision for Gerber.

Part B: CSPC agreed that in the worst case scenario they will pay Gerber for some of their losses if they act reactively. How much would the CSFP have to pay in order to make Gerber act proactively?

Problem 3: An Information Paradox

Suppose Tom Cruise is at a carnival and while there he sees a green monkey stuffed animal that he must have for his newborn baby. In order to win the stuffed monkey Tom needs to play a game that costs $1. In the game there are 5 shells and a ball that is hidden behind one of the shells. In order to win the monkey Tom needs to pick the shell that the ball is under. The monkey overall is worth $3. Assume in all parts of this problem the probability the ball is behind a give shell is .2 (e.g. 1/# of shells)

Part A: Determine using a decision tree if it is in Tom's best interest to play the game.

Part B: Before deciding weather to play the game Tom asks the carnie if the shell 3 has the ball under it. Thus since we all know carnies never try to deceive you know what he tells you will be correct. What is the greatest amount that Tom should be willing to pay for this perfect information. (If he tells you 3 is not the right shell and you decide to play you will pick shell 2).

Problem 4: Spring Break Planning

Spring break is coming up and you have the two options, go to Florida or stay in your dorm room and study.

If you go to Florida there is a 50% chance that you will celebrate spring responsibly and come back refreshed and ready to do some serious studying, in which case your probability of passing 15.053 is 0.8. There is a 1% that you will find the (wo)man of your dreams, you will fall in love and never return to MIT, in which case you will fail 15.053. Then there is 49% change that you will max out all your credit cards, and to survive the rest of the semester you will have to work 15 hours a week to be able to eat, in that case your probability of passing 15.053 drops to 0.5.

If you decide to spend all of your spring break studying, there is a 30% chance that you will become bored to death after three days in which case you can either decide to party heavily in Boston to make up for Florida, in which case your probability of passing 15.053 is 50% or you decide to read English literature to broaden your horizon in which case your probability of passing is 60%.

If you stay and you don't become bored to death after three days there is a 50% probability that you will gain great insight into optimization, you decide to get a Ph.D. in optimization and you ask professor Orlin to be your advisor. You become a total optimization wizard and you will pass 15.053. But there is a 50% chance that you will over study, become board with 15.053, gradually loose interest, and not turn in your last three problem sets. In that case your probability of passing 15.053 is 0.4.

Assuming your only objective in life is to pass 15.053, set up a decision tree to find your optimal decision.

Problem 5: Models and their utility functions.

Part A.

Suppose Heidi Klum's utility function for asset position *x* is given by $u(x) = \ln(x)$.

a. Is Heidi risk-averse, risk-neutral, or risk-seeking?

b. If Heidi has $200,000 and is considering the following two lotteries

L_1 : With probability 1, she loses $10,000.

L_2 : With probability.9, she gains $0.

With probability .1, I loses $100,000.

Determine which lottery she prefers.

Part B: Answer both a. and b. for Gisele Bundchen's utility function $u(x) = 2x + 1$.

Part C:

Answer both a. and b. for Kate Moss's utility function $u(x) = x^2$.