Business Decision Analytics under Uncertainty
Fall 2017, Professor Eckstein
Homework 2

Due Wednesday, September 27

Q1: Game Show Strategy

Problem 16(a) on page 67 of the textbook. Please keep in mind that the rules of this game are a bit different from the example covered in class, since you get to keep the amount of the highest card you have received so far, unless you draw the "STOP" card. Show your work, including a completed decision tree. State the optimal policy and its EMV. You do not have to hand in part (b), although you may find it instructive to think about. Hint: to keep the tree from getting too large, you may make the assumption that if you draw the $1,000,000 card you will always quit the game immediately, because there will never be any remaining possible actions that could increase your profits.

Q2: Returned Equipment Testing

You lease construction equipment. Whenever a piece of equipment is returned by a customer, you must run it through three quality tests, named X, Y, and Z. The costs and failure probability of each test is as follows:

Test	Cost	Failure Probability
X	$ 17.50	12.5%
Y	$ 20.00	7.5%
Z	$ 24.00	14.0%

You can run the tests in any sequence you like, but you cannot run more than one test simultaneously. As soon as a piece of equipment fails any test, you immediately send it for a complete overhaul, and you do not need to run any of the other tests. In your experience, the results of the tests are independent from one another. Create a decision tree that will allow you determine which order you should run the tests in order to minimize your average testing cost per piece of equipment. State the optimal policy and its average cost. Hint: you can reduce the size of the tree slightly by realizing that once a piece of equipment has passed two tests, you must incur the cost of the remaining test, but you do not necessarily need to know its outcome (which has no bearing on testing costs).

Q3: Product Rollout Strategy

Niikawa Electronics, a Japanese firm, has nearly finished developing a new personal electronic product aimed at the Japanese and Chinese markets (in this problem, all amounts of money are shown in US $ for simplicity). Niikawa uses two different strategies for rolling out its products. One is to introduce a product simultaneously in both the Japanese and Chinese markets, while the second is to first roll out the product in the Japanese market, and then, possibly depending on the success of the product in Japan, either not introduce a Chinese version or roll out the Chinese version one year later. Niikawa is trying to decide between these two options, and the additional possibility of simply abandoning the product. Assume that for domestic political reasons Niikawa never first introduces a product in China and then later rolls it out in Japan.

In each market, Niikawa has identified two possible scenarios for the success or the product, each called “good” and “bad”. In Japan, the good scenario has an NPV of $185 million from sales of the product, and in the bad scenario the NPV of sales would be $75 million. In China, the good scenario has a sales NPV of $470 million, while the bad scenario involves a sales NPV of $105 million. However, if Niikawa waits an additional year to introduce the product in China, these amounts would fall to $410 and $65 million, respectively.

Niikawa’s analysts estimate the following joint probabilities for the good and bad sales scenario in each country:

	China Good (C)	**China Bad ($\bar{C}$)**
Japan Good (J)	0.60	0.10
Japan Bad ($\bar{J}$)	0.05	0.25

That is, they estimate a 60% chance sales will be good in both countries, a 10% chance sales will be good in Japan but bad in China, and so forth. If the firm follows the “Japan first” strategy, it will become apparent whether the “good” or “bad” Japan scenario is happening in sufficient time to make a decision whether to launch the product in China the following year.

The remaining costs to finish development and roll the product out in Japan are estimated to be $100 million, and the cost to introduce the product in China the year after the Japanese rollout is estimated to be $330 million. There would be some savings if both rollouts were simultaneous: to finish development and roll out the product simultaneously in both markets is estimated to cost $400 million.

In the following, show your work:

(a) Calculate:
- The probability of good sales in China
- The probability of good sales in Japan
- The probability of good sales in China, given that good sales are observed in Japan
- The probability of good sales in China, given that bad sales are observed in Japan.

(b) Use a decision tree to determine the best rollout strategy for the product from the standpoint of EMV. State the optimal policy and its EMV.