Embellished problems on Maximizing Expected Payoffs via Decision Trees

(How to make decisions given that alternatives have more than one stage?).

1. The University of Mighty Mouse has the options now of either rebuilding Damcen Hall (i.e. tearing it down completely first and build it into one thrice its current size) or renovating it mildly without increasing its size (cosmetic renovation). The decision depends primarily on future demands for building spaces and facilities. The rebuilding can be justified economically if the level of demand is high. Otherwise, the administrators prefer to just pay for cosmetic renovations and then decide in two years whether it (Damcen Hall) should be expanded into a building thrice its size.

A faculty, staff and student survey indicates that the probabilities of having high and low demands for space and facilities in Damcen Hall over the next 10 years are .8 and .2 respectively. The immediate (meaning now) rebuilding of Damcen Hall will cost $6 million and a cosmetic renovation will cost only $1 million. The expansion of cosmetically renovated building into one three times its size, 2 years from now is estimated to cost $4.2 million.

We all know that indirectly, building space and facilities generate income, hence, the estimates of annual income for each of the alternatives are given as follows.

(a) Rebuilding and high (low) demand will yield $1,000,000 ($300,000) annually.
(b) Cosmetic renovation and low demand will yield $200,000 annually.
(c) Cosmetic renovation and high demand will yield $250,000 for each of the 10 years.
(d) Expanded renovation - a real building three times its size - with high (low) demand will yield $900,000 ($200,000) annually.
(e) Cosmetic renovation with no expansion and high demand in the first two years followed by low demand will yield $200,000 in each of the remaining 8 years.

Draw the decision tree and based upon maximizing expected profit over the next ten years, propose a decision to the Resource and Planning Committee of the University of Mighty Mouse.

2. (Embellishment of the UMM's Damcen Hall debacle.)

Suppose a third alternative is added which will allow the university to expand the cosmetically renovated Damcen Hall into a building twice its size. This option can be exercised regardless of whether the demand is high or low during the first 2 years. Thus, if the 2-year demand is high, the University of Mighty Mouse has 3 options or alternatives: (i) expand Damcen Hall into a building three times its size (cost = $4,200,000), (ii) expand it into one twice its size (cost = $1,200,000), or (iii) do not expand it at all. On the other hand, if the demand is low, the university can expand the building into one twice its size or elect NOT to expand it at all.

Estimates of annual income for the different alternatives are given as follows:

(a) High demand in the first two years and twice-its-size expansion will yield $700,000 (or $250,000) for each of the remaining 8 years if the demand is high (or low).
(b) Low demand in the first two years and twice-its-size expansion will yield $600,000 (or $300,000) for each of the remaining 8 years if the demand is high (or low).
(c) Low demand in the first two years and no expansion will yield $400,000 (or $300,000) for each of the remaining 8 years if the demand is high (or low).

Draw the decision tree and based upon maximizing expected profit over the next ten years, propose a decision to the Resource and Planning Committee of the University of Mighty Mouse.

3. (For your thoughts.) Refer to the Food-R-Us problem in Assignment 2. Now, suppose the owner of Food-R-Us wishes to consider his decision problem over a 2-day period instead of one. If the demand in day 1 is equal to the amount stocked, he will continue to order the same quantity on the second day. Otherwise, if the demand exceeds the amount stocked, he will have the options to order higher levels of stock on the second day. Finally, if day 1’s demand is less than the amount stocked, he will have the options to order any of the lower levels of stock for the second day. Express the problem as a decision tree and find the optimum solution using the cost data given above.