Application Portfolio Assignment – Part 5 and 6 Combined

In this application you develop a "lattice projection" for your application, value the project using it, and present the associated cumulative distribution of possible outcomes.

A) Lattice Analysis of Evolution of a major uncertainty

Develop a lattice depicting the development of a major uncertainty that applies to your case. The object of this exercise is to ensure that you understand the process of developing a lattice projection.

The lattice should cover 5 periods beyond the current best estimate at time zero. To do this, you will need to determine u, d, and p based on estimates of the

- Trend, v, that you expect over time, of the form:
  Modal forecast = (forecast at time zero) e^{rt}
  where r is the rate of growth per period (it may be zero, or even negative)
- Volatility, σ, around this mean.

Note Carefully:

Certain values of v and σ may lead you to the impossible estimate of p > 1.0. To resolve this problem, you need to calculate v and σ over a shorter time period, for example over 3 months instead of over a year.

Here's an example of how to do this. Assume that v = 5%, σ = 4% for a 1 year period, t = 1. If you scale to 3 months, or t = 1/4 of year, then you need to find v_{3M} and σ_{3M} which are the scaled versions of v and σ. To find v_{3M}, we make use of the relationship $1 + v = (1 + v_{3M})^4$. This leads to $v_{3M} = (1 + v)^{1/4} - 1 = 1.23\%$

For volatility σ_{3M}, note that the variances over each 3-month period add up to give you the variance over 1 year. [You may assume this only with memory less processes, like Brownian motion.] Thus: $4\sigma_{3M}^2 = \sigma^2$. This leads to: $\sigma_{3M} = \sigma/\sqrt{4} = 0.04/2 = 2\%$

So the scaled parameters change to t = 0.25, v_{3M} = 1.23%, and σ_{3M} = 2%

Software aids:

On the web, under "…Course Material / Spreadsheets" you will find several Excel files that can be useful:

- "binomial lattice.xls" allows you to try out various (u, d, p) combinations to see what you can get
- "best fit to data.xls" gives you a way to obtain the (v and sigma) and thus the (u, d, p) that best fit time series of data
- "binomial fitting to assumed values.xls" provides a way to get (u, d, p) to some minimal technology (or other) projection.

B) Decision Analysis Using Lattice you have already prepared.

Given the lattice of probabilities and states that you have developed, now do a decision analysis for your application.

To make this practical, assume that you have only 1 option to exercise. Once this is done, there is no further change possible in the configuration of the system. [The reason for this restriction is that it ensures that there will be 'path independence' so that you can do the analysis according to conventional lines as used in financial analyses. As emphasized in class, this assumption is not realistic for many designs.]

To do this exercise, you will need to exercise your model of performance or cost, to calculate the value of being in each node of the lattice (at a specified level of the uncertainty, at the specified time).

The object of this exercise is to make sure that you understand the process using a lattice to value a single option.

C) Cumulative Distribution of Outcomes and Multiple Criteria

Create and graph the cumulative distribution of possible outcomes associated with your project. Also, set up a table of multiple criteria for your case.

This exercise sets you up for a discussion of ways to choose preferred designs.