OPTIMUM CAPACITY EXPANSION -- INTRODUCING UNCERTAINTY (Part 2)

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GOALS:

1. To experiment with dynamic policies under uncertainty
2. To practice simulation tools and their use in decision making

GENERAL PROBLEM DESCRIPTION:
In the previous exercise you experienced how the distribution of costs moves by using different plant sizes. Based on the knowledge you have gained so far on the capacity expansion problem in this exercise you will investigate the effect of flexibility under uncertainty and will value its use in decision making.

PROBLEM OUTLINE:
In this exercise you are going to experiment with another "simulation model (2)" (optimal capacity expansion simulation 2.xls), built upon "simulation model (1)". With this model you will try a strategy that provides the following flexibilities:

1) to vary the size of initial investment
2) to vary the size of future investments.

Assume you have a choice of only three possible plant sizes. You will choose an initial plant size based on average growth forecast to start with and then you will increase or decrease this size depending on how the demand grows. The size of the initial investment is the optimum size suggested by the base case model with average demand growth. If the demand growth rate is smaller than the one predicted then you choose the smallest size and vice versa if the demand growth rate is larger than the forecasted. The model finds forecasted and actual demand growth rates using historical information since the first investment.

In this exercise you are also going to find what is the effect of starting with a small initial investment, smaller than the one predicted by the base case model for average forecasts.

ACTIONS:
Open the simulation model (2) by clicking here and in the flexible policy worksheet enter your assumptions in the green cells according to the following plan.

1. Start with growth rates 2 and 8 units/year/year and equal probabilities. Use a large plant size of 70 units/year and a small plant size of 20 units/year. Use initial investment of 35 units/year which is the optimum size as predicted by the base case model for average growth 5 units/year/year. Run the model and observe the distribution of NPVs and the average NPV at the given graphs.
2. Try an initial investment of 20 units/year, a small plant size of 20 units/year/year and a large plant size of 40 units/year/year and again discuss any changes on your distributions.
3. Change the probability of small growth rate to 80% while trying plant sizes of action 1 and 2. Discuss the distribution of costs. Then reverse probabilities for the small and large growth rates and try again the plant sizes of action 1 and 2 to observe and discuss any changes in the distributions.

DISCUSSION QUESTIONS:

1. What is the effect of a flexible strategy on the distribution of costs with the assumptions of action 1?
2. What is the effect of starting as well as continuing with smaller plant sizes?

3. What is the effect of probability changes according to action 3 on the distributions and how do these changes affect your strategy

TAKE AWAYS:

1. A flexible compared with a fixed plant size strategy does not have significant effect in average costs when growth rates probabilities are equal. In this case it is also riskier since it creates “upper tails”.
2. When the probability of lower growth rate is bigger then the smaller size can be a lot more beneficial since it reduces significantly average costs, increases probabilities of these costs to occur and introduces probabilities of extremely low or extremely high costs to occur.
3. When the probability of higher growth rate is bigger then the smaller plant size policy has a small disadvantage compared with the larger plant policy. The distribution of costs spreads out slightly and the average moves to the right.
4. By comparing all different strategies we could say that overall it is preferable to build a smaller plant to benefit substantially from possible low growth rates while in case of bigger growth rates you will suffer only small losses compared to the larger plant size policy.