CAPITAL BUDGETING AND PROBABILISTIC SCENARIO ANALYSIS: A STUDENT RESEARCH EXPERIENCE IN FINANCE

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ABSTRACT

Student research experiences (SREs) in the business disciplines have historically lagged behind non-business disciplines. The purpose of this study is to illustrate, using a case analysis of a finance project, how SREs can be effectively integrated into the business curriculum. We begin with a discussion of the role of SREs in higher education and describe how the study was developed to meet the joint needs of the faculty mentors and the student researchers. We then present the study and conclude with a discussion of the results and the implications for future research.

INTRODUCTION

Student research experiences (SREs) in the business disciplines have historically lagged behind non-business disciplines. [2] This is unfortunate as SREs are viewed by many to provide numerous benefits to students, faculty, the university, and society as a whole (e.g., [3], [5], [9]. [11], [13]). Schneider (2004), for example, has argued that SREs can: "result in more successful and competitive alumni, serve as a selling point for recruiting freshman, provide positive publicity, lead to greater overall productivity, and impart a more mature learning atmosphere." (p. 90, [11]) Elgren and Hensel (2006) have noted that: "Inviting students to invest intellectually in a project gives them the opportunity to help shape its direction, exert some of their own creativity, and experience the joy of intellectual 'ownership' of the products resulting from the effort" (p. 6, [3]). In an empirical study of the benefits of student research experiences, Starke (1985) found that students participating in research reported improved organizational and statistical skills. [12]

The purpose of this paper is to further discussion of the benefits of SREs by presenting the results of a collaborative research project in finance that was conducted in a school of business at a large land-grant university.

THE CAPITAL BUDGETING PROJECT

The capital budgeting process has historically relied on single-point estimates such as the Net Present Value or the Internal Rate of Return. Because each of these estimates has a certain degree of risk associated with it, analysts most often adjust the discount (or hurdle) rate to account for *business* and *market* uncertainty. Additionally, analysts often augment the process by employing scenario analysis in order to account for *analyst* uncertainty; that is, the input data is varied to account for perceived best, most likely, and worst case scenarios. In doing so, the risk associated with the analyst's uncertainty can be better evaluated.

While the use of each method is sound, this study argues that advances in information technology make the practice of conducting discrete scenario analysis both outdated and suboptimal. By incorporating probabilistic scenario analysis, we argue that the analyst can calculate the expected probability for a continuous series of scenarios.

Problem Statement

Although probabilistic scenario analysis is well-grounded in the literature, there is little guidance from the literature on how to apply it to capital projects in the hospitality sector, in general, and lodging investments, in particular. Our review of the literature reviewed only three such studies. First, Sheel (1995) used probability analysis to determine the economic feasibility of adding 75 rooms to a hypothetical 700-room hotel property. [10] Atkinson, Kelliher and LeBruto (1997) used of probability analysis to help determine what type of point-of-purchase system would provide the best return for a hypothetical food and beverage operation. [1] Finally, Field, McKnew, and Kiessler (1997) used probability analysis to identify problem areas in the operation of buffet restaurants. [4] None of these studies applied the use of probability to the analysis of an overall hotel investment.

If we are to further our understanding of how probability analysis can lead to better decision-making in the hospitality sector, additional research is needed. The purpose of this research is to help address the gap in the literature.

MODEL DEVELOPMENT

At the most fundamental level, probabilistic scenario analysis can be defined as the process of creating a series of events based on *a priori* estimates of the probability of occurrence. Once this process has been completed, a probability distribution for an outcome variable can be developed.

The @RISK software program developed by the *Palisade Corporation* was used to test the model using Monte Carlo simulations and *pro forma* income statements estimated for the hypothetical lodging investment. To simplify the process, we assumed that the investment cost was known and that relational variables such as food & beverage and utilities were a stabilized percentage of their respective revenue or cost stream. This procedure is consistent with industry practice (e.g., [6], [8], [9]).

For illustrative purposes, we limit the analysis to the primary variables of price and occupancy. Although it might make sense to include other variables in the full analysis, we limit our examination to these as they are central to the determination of revenue. The hypothetical probability distributions for these two variables are as follows:

1. Average Daily Price -> Low = $64, Expected (mean) = $68, High = $72
2. Average Daily Occupancy -> Low = 62%, Expected (mean) = 69%, High = 74%
3. Elasticity coefficient for probabilistic model= -.60

The elasticity coefficient is negative indicating that if the model sampled a higher price, it would sample a lower occupancy (and vice versa) based on this correlation. It is an estimate, but conforms to the notion that higher prices lead to lower quantity demanded (and vice-versa). The ranges for price and occupancy are based on the type of worst-case/best-case scenarios used in traditional capital budgeting models.

RESULTS

Figure 1 illustrates the results for a single point estimate; that is, one where only the mean variables are used for the calculation of net present value. In the present case, the net present value is estimated at a little under $200,000.

FIGURE 1
SINGLE-POINT MODEL

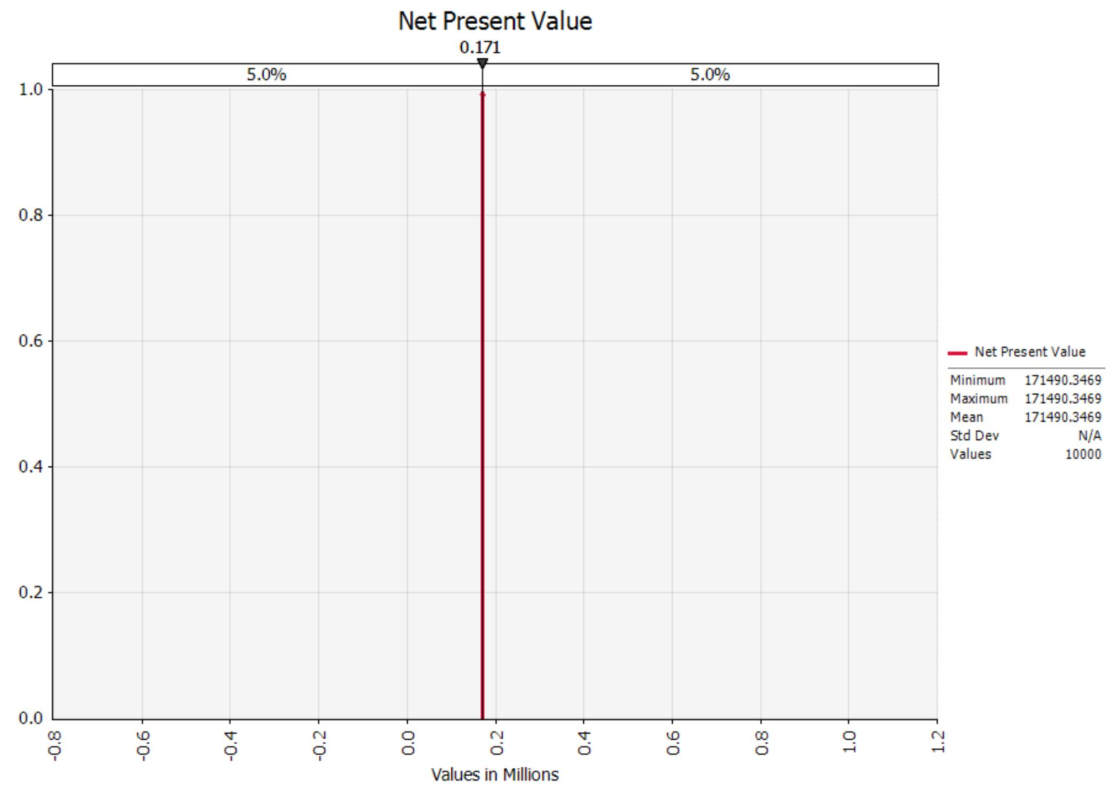


Figure 2 illustrates best/expected/worst-case scenarios. As the illustration shows, the addition of the best-case and worst-case scenarios adds value to the analysis beyond the single point estimate. It is important to note, however, that this model also relies on "best-guess" assumptions; in this case, that the best/worst-case scenarios have an estimated 20 percent probability of occurrence. Had the assumption for best-worst-case scenarios used alternative values (e.g., 10%), the calculated probability of a positive net present value would have been different.

FIGURE 2
THREE-POINT MODEL

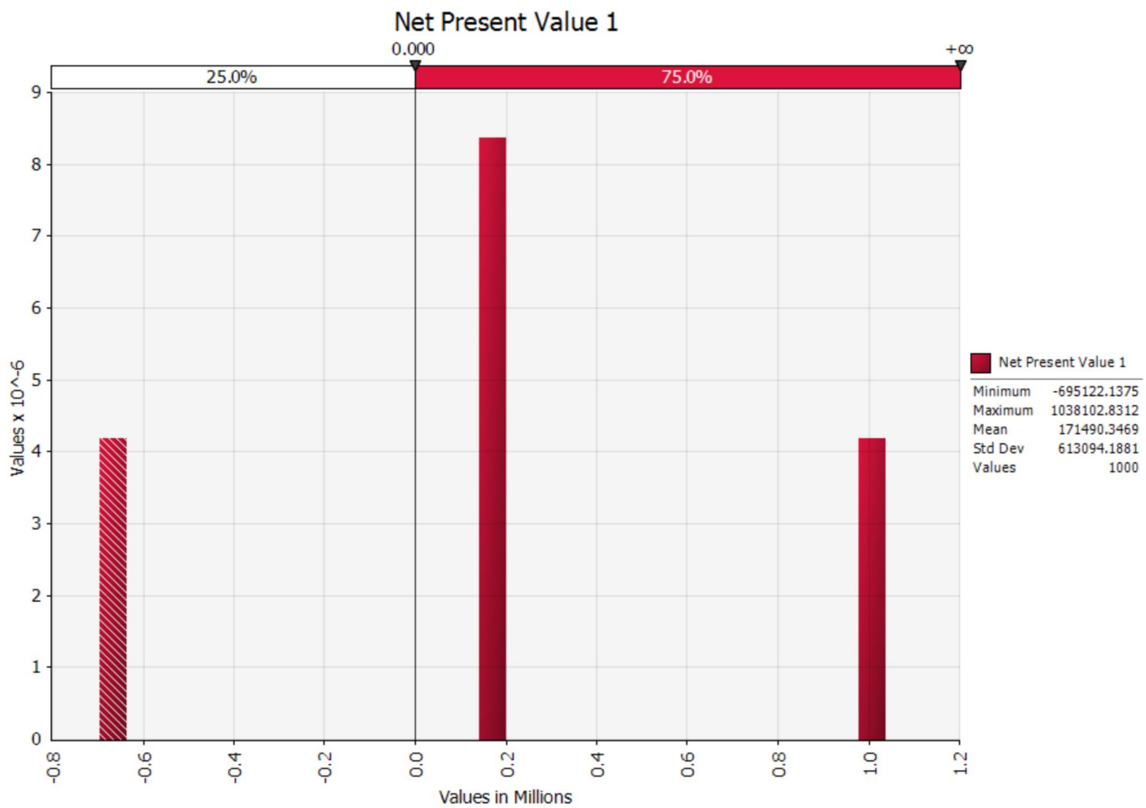
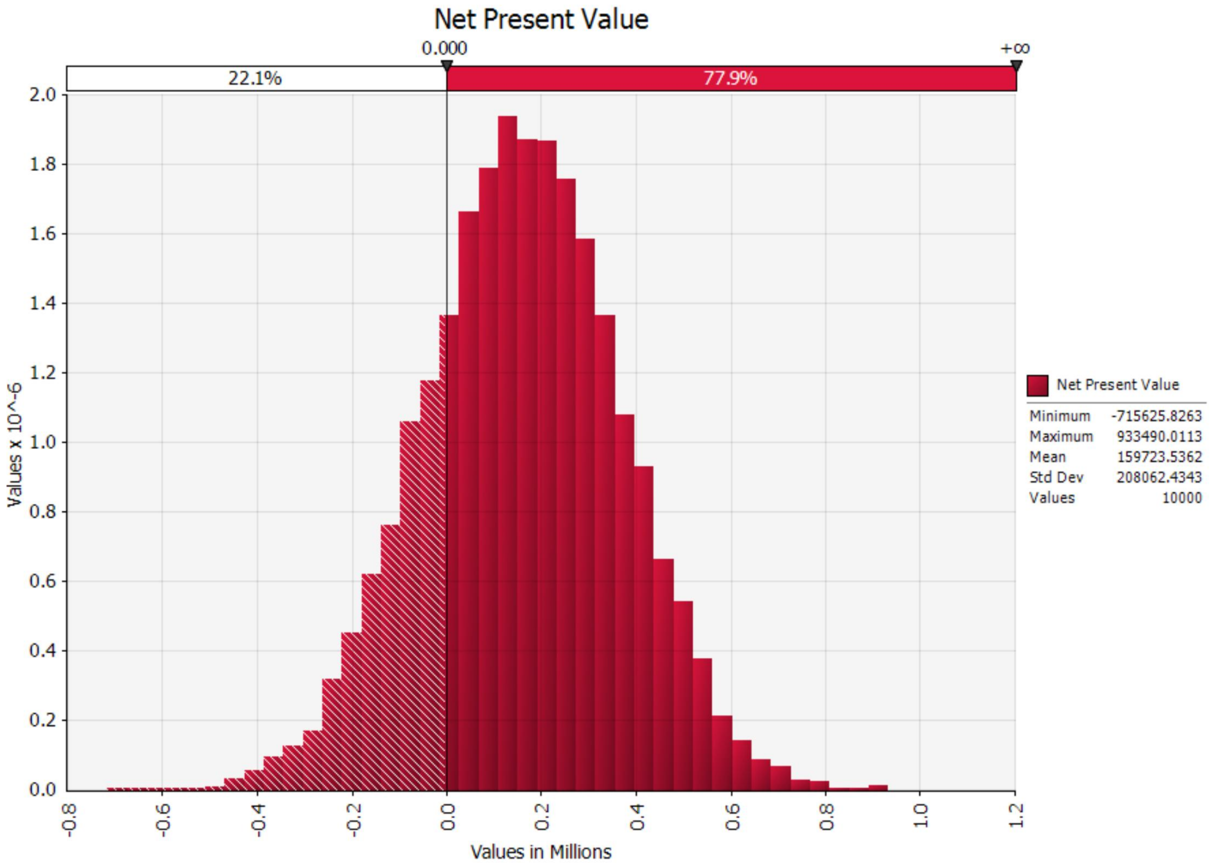


Figure 3 illustrates the probabilistic model. Using Monte Carlo simulation, the model was allowed to run until the distribution stabilized. Note that this model differs from the previous model only to the extent that it provides additional scenarios so as to create a continuous distribution of outcomes rather than set of discrete outcomes. In doing so, it allows us to estimate the probability of any individual outcome.

FIGURE 3
THE PROBABILISTIC MODEL



The analysis reveals that while the project has a positive expected net present value, it also has an estimated 22.1 percent probability of a negative net present value. It also shows that there is an approximate ten percent probability of losing $100,000. At the same time, there is approximately a ten percent probability that the net present value will be greater than $400,000. Given with this information, decision makers can then refer to their own risk utilities before deciding whether or not to proceed with the project. In essence, they will need to evaluate whether or not the estimated tradeoff between upside-gain and down-side loss is consistent with their risk preferences. This analysis, therefore, requires a commitment to action based on the uncertainty observed among the probabilistic outcomes, not merely on the discrete point estimates.

With that said, it would be an omission of fact to deny that probabilistic analysis does not rely on analyst estimates in much the same manner as either the single-point or three-point models. What the probabilistic model does do is add additional analytical rigor to the analysis. In this way, it makes an incremental improvement in much the same way that the three-point model is an improvement over the single-point model. Nonetheless, the outcomes from these models are only as good as the estimates provided. We maintain, however, that the probabilistic model forces the evaluator to confront the assumptions inherent in the analysis.

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