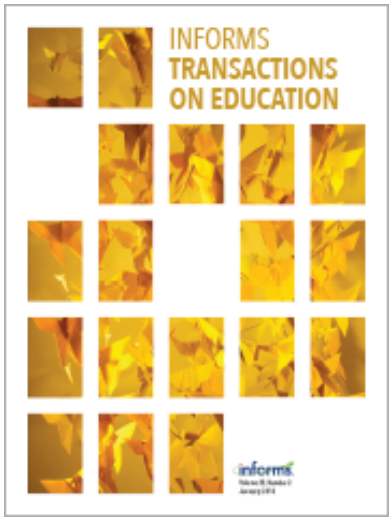

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Case Article

Tactical Decisions at Vastrapur Car Rental Services

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Abstract. Vastrapur Car Rental Services operating in Ahmedabad, Gujarat State, India offers five different options to its rental customers. Each option has a usage agreement (limits on mileage and duration) and rental rate and some customers exceed these limits. The central theme of the case is to compute the average profitability in the context of limited fleet size, uncertainty related to number and type of customer requests, and variability in the utilization of vehicles. In addition, the case provides an opportunity to discuss situations like negotiating wages, outsourcing vehicles on a need basis, and subscribing capacity to an integrator (an online platform linking the supply and the demand sides).

The case was given to MBA students in a core probability course and a core decision sciences course. The discussion can span over one or two classes depending on the students' background and nature of the course. The case helps students apply different concepts in probability (including random variables and expected value) to analyze a real-life managerial situation. When resolved appropriately, it demonstrates the power of simple probabilistic tools in addressing managerial challenges. The case is amenable for a simulation based analysis to study the interplay between demand variability (quantity and mix) and economic consequences in multiple scenarios.

Supplemental Material: The teaching note is available at https://www.informs.org/Publications/Subscribe/Access-Restricted-Materials.

Keywords: probability • random numbers • expected value • sensitivity • simulation

1. Introduction

Vastrapur Car Rental Services (VCRS) is a sole proprietary company[1] operating in Ahmedabad, Gujarat State, India. The city's incredible growth in the last decade coupled with inadequate public transportation infrastructure has created a favorable environment for the rental car business. VCRS took advantage of this opportunity. VCRS offered five (different) options,[2] each having its own usage agreement (limits on mileage and duration) and price. Some customers exceed the option limits and hence there is some uncertainty over the actual usage of rental vehicles. The daily number of customer requests is also random. Faced with these uncertainties the founder wants to know how successful and sustainable the present business model is. Historical call records are available from which the usage pattern and the call requests pattern could be obtained.

2. Pedagogical Objectives

- Help students analyze a real life situation in totality, from a business perspective.
- Enable students to apply basic concepts of probability, distribution, expected value, and breakeven analysis in a context.
- Motivate students to formulate and resolve tactical decisions in a commercial context by appropriate probabilistic modeling.

3. Literature Review

There has been prior work on effective classroom approaches to teach probability and statistics. Dinov et al. (2008) discuss how technology, including interactive interfaces and simulation applets, could be effectively used in teaching statistics and probability concepts. McLaren and McLaren (2014) discuss a learning activity for students beginning to learn statistics and probability. Cochran (2010) uses an article to guide students in reading and interpreting articles that involve statistical reports. Bailey and Fry (2010) discuss problem decomposition methods for ill-structured problems in business and engineering.

The case methodology approach has also been widely employed. Tilson (2012) uses a case exercise related to medical tests that helps in understanding conditional probability and involves spreadsheet modeling. Keller and Kros (2004) use a case dealing with credit cards to jumpstart basic quantitative skills including probability and optimality.

Games have also been used to teach probability concepts. Chow (2011) use the television game Deal or No Deal to explain expected value calculations and enhance critical thinking skills. Gorman (2012) describes the Pass the Pigs game and also gives a nice summary on the games available in the literature. Cochran (2005) uses a board game to teach basic probability concepts. There are also spreadsheet based games (Chan 2013). We hope to contribute to this growing body of literature.

4. Case Details

The case provides two discrete probability distributions, one for the distribution on the type of option chosen by the customer and the other for the distribution on the number of customer requests per day. In addition, the case provides the actual usage pattern of customers. The case also gives a detailed profile of fixed costs incurred by VCRS.

The central theme of the case is to compute the average contribution per day and hence the average profitability. The analysis takes into account a limited fleet size (5 cars), uncertainty related to number of customer requests and option chosen by various customers, and variability in the utilization of vehicles. Based on this computation it is then possible to compute the return on investment of the business to critically examine the owner's continued interest in the business. The case provides an opportunity to discuss the following situations.

1. Sensitivity of daily revenue and hence the average daily profit to the demand variability, in particular, the number of calls per day.

2. Request from the drivers for an increased allowance—The drivers (employed by VCRS to drive the rented cars) request an additional allowance when they do multiple trips in a day. VCRS needs to examine how the request affects the profitability per day and if it can afford to entertain this request from its drivers.

3. Option to outsource vehicles—Faced with an increasing demand, VCRS may have to turn down customer requests if the cars would not return in time. When all the cars of VCRS are in use, VCRS wants to commercially examine outsourcing a car from a local dealer as an option. VCRS would also need to find an additional driver for the outsourced vehicle.

4. Subscribing to an online integrator—Instead of dealing with different options and individual customer requests, VCRS wants to explore subscribing to a third party online platform. Under this dispensation VCRS will contract a fixed number of vehicles to a third party online integrator and is required to pay a subscription fee per vehicle. Customers make rental reservations directly through the integrator and the payments are made by the customers to VCRS directly at the completion of service.

5. Solution and Classroom Approach

At the first level, students learn how to use information available and convert it to formulate the problem. They will then be able to compute the expected revenue from each of the five options.

Given the two discrete probability distributions (one on number of requests and another on the option preference), the expected net revenue can be easily obtained by finding the product of the expectations of these two distributions (the technical details are presented in the teaching note). Even without going into probability theory, this can be a great exercise to show how easy it is to work with expected values, if we are only looking at the averages.

The sensitivity analysis is performed by skewing the demand distribution and evaluating the resultant expected net revenue. Given the case parameters, the net revenue is quite sensitive to the demand profile. The sensitivity analysis applies probability concepts related to skewness. Discussion on how to get information on the demand distribution is possible at this stage.

The increased allowance to drivers who operate on multiple trips involves incorporating the additional allowance in the expected profit calculations. In addition to increasing the level of comfort with expected value calculations, the increased allowance scenario lets students take multiple perspectives that go beyond final numerical figures. It can be a very brief introduction to negotiation and contracting and has the potential to generate some good discussions in the class.

The outsourcing decision requires application of breakeven analysis, that is, comparing the marginal expected revenue with the marginal fixed cost of outsourcing. Besides, it can also be used to test the understanding of conditional probability by framing questions suitably. For example, students can be asked to compare the expected revenue if the type of customer request is known vis-à-vis if the type of request is unknown.

The online integrator extension can be used to cover several different concepts. Demand from each customer request through the online platform is random. At a basic level, this extension can be used to show how addition of random numbers (independent and identical) can be handled. It can also be used to show the effect of capacity pooling that reduces variation. The extension can also be used to help the students to compare the revenue distribution in the base case and the revenue distribution with the online integrator.

Utilization of fixed assets and flexibility of contracts (how many cars to subscribe to the online integrator) can also be discussed using this extension.

Students can also be asked to simulate the daily profit for a sufficiently large number of days (using Crystal Ball, Risk or other such software). This exercise will drive home the fact that expected values need not be "expected" as one of the actual outcomes but reflect the long term average. The simulation will also give students an idea of the distribution of the profit. Students will also compare the variability in profits when managing business in house (i.e., VCRS handles all the demand) with that of subscribing to an online integrator.

6. Classroom Experience and Suggestions

The case was utilized in two different settings. One was in an Indian graduate school and the other in a U.S. business school. The case was used in the course "Probability and Statistics," a required core course for students in the Indian graduate program. In the U.S. business school, the case was used in the course "Data Analysis and Decision Modeling," a fundamental course in the MBA curriculum.

While it was not a strict requirement, most students enrolled in the Indian program had an undergraduate degree in engineering and had an exposure to probability concepts. Their exposure to modeling was however limited or lacking. Students enrolled in the U.S. program had a very diverse background. While all of them had a Bachelor's degree, their specialization ranged from literature to engineering. Hence not all of them had a strong mathematical background and their exposure to probability concepts ranged from limited to none.

Students in both programs are also required to take other fundamental courses in various management disciplines along with this course but had no prerequisites for taking this course. The student profile in both settings were also completely different on other dimensions related to work experience (1/3 of the class in India had 2+ years of experience vs. more than 80% in the United States), class size (90 in India vs. 45 in the United States) and age (24 in India vs. 32 in the United States).

In India, it was given as a take-home case assignment and a debriefing was held after the submissions were evaluated. The students thoroughly enjoyed the assignment. Since the students had already involved themselves in the preparation of the assignment, the discussion was of very high quality. They were appreciative of the fact that the case was based on a real-life situation. They were willing to deal with the complexity of the analysis. Most of the students were able to structure the problem in terms of estimating the expected revenue. They were able to clearly decipher the relevant data, understand and use appropriately the various cost components to evaluate the expected value under different scenarios.

Several students did not appreciate the opportunity to simplify the model based on expected demand and expected revenue per call. Instead, they took a sample path approach (dynamic distribution) and found the computations to be increasing in complexity. When it was pointed out to them that the model can be simplified by using Wald's equation, it brought an "aha" moment (especially after spending hours on evaluating various sample paths) and they clearly appreciated the simplicity.

Several students had difficulty in applying simple marginal analysis to answer questions related to outsourcing and responding to the demand for increased wage allowance. Unless explicitly asked, students in general did not attempt to perform a simulation/sensitivity analysis on the decision choices by the customers, or on the demand distribution.

The discussion on marginal analysis to answer the questions related to outsourcing and responding to the demand for increased wage allowance was an eye-opener. It provided them a much needed confidence in looking at a managerial problem both from a modeling as well as commercial perspective. Needless to emphasize, when this approach was explained in the class, the learning opportunity associated with the case was quite significant.

Several students did not see the relevance, usefulness, and the need to do a sensitivity analysis on the demand distribution to analyze the revenue potential and other tactical decisions. Such a discussion added a paradigm shift in their approach to solve these problems. It changed their mindset to look at the problem context in totality and not solve the problem as an input-output situation (essentially, solving the problem for a single demand distribution amounted to do this).

In the U.S. setting, in addition to the above observations, while several students were able to get the expected revenue, some had issues in modeling and deciphering the case data (the limited exposure to quantitative and spreadsheet modeling were possibly some of the reasons). With additional inputs (and a bit of hand-holding) they were able to make progress in terms of modeling. In view of the limited background, a minority of the students felt analysis based on cost components was external to the decision making in this context. A detailed discussion with these students made them realize a managerial problem is independent of any single discipline but is actually an amalgamation of multiple disciplines.

With some additional plodding, students attempted to perform a sensitivity analysis of the problem context. On the whole the assignment was well received and appreciated for its learning value, though some felt it to be challenging. Depending on the student profile, involvement of the instructor, and the pace in which

the course is organized all the three pedagogical objectives of the case could be achieved.

Based on our experience it is important to recognize that the pedagogy of this case needs to be customized based on the student profile. We suggest three possible approaches.

A. Straight forward class room discussion.

B. A take-home case assignment.

C. Assignment in multiple stages. (Stage 1: Formulation, Stage 2: Derive expected revenue, Stage 3: Answer the managerial questions based on marginal analysis, Stage 4: Conduct an extensive sensitivity analysis on demand distribution, and Stage 5: Comprehensive reflection on the problem analysis.)

For students who have had a basic exposure and who are relatively comfortable solving problems on their own, Approach A or B is a possibility. For a student profile which is not exposed to the commercial aspect of business, Approach C may be more relevant. In our experience we accomplished all the pedagogical objectives. Approach C provides multiple intervention opportunities to meet the pedagogical objectives. Approach A would ensure the objectives are met since the discussion is driven by the instructor. In Approach B, a debriefing session is necessary to accomplish the pedagogical objectives (especially objective 3). Our experience has been overwhelmingly positive and we elaborate more on these three approaches in the teaching note.

There are three major segments related to the discussion of this case. In our teaching note we briefly present these segments in terms of what can be accomplished, technical challenges, and learning opportunities for the students. The simulation experiments and results provide deeper insights on the revenue stream and bring out the inadequacy of comparing alternatives based on average values. Since the complete profit distribution is available for both options (VCRS in-house and subscribing), it is possible to rank the options based on multiple criteria such as expected value and extreme values. This part of the discussion is technically advanced and would require some working knowledge on probability distributions.

7. Conclusion

VCRS is an elegant case that provides a range of opportunities to students to apply different concepts in probability (including random variables and expected value). It also presents the students a real-life managerial situation set in a commercial context. The different management scenarios presented in the case (negotiating wages, outsourcing vehicles on a need basis, subscribing capacity to a third party) present challenging situations for analysis. When resolved appropriately, it demonstrates the power of simple probabilistic tools in addressing managerial challenges. The case also provides an opportunity to demonstrate the sensitivity of the revenue potential to the demand distribution. The case is amenable for a simulation based analysis to bring out the interplay between the demand (quantity and mix) variability and economic consequences in multiple scenarios.

Endnotes

[1] A company run by a single person in which there is no legal distinction between the owner and the business.

[2] A car rental in the Indian context allows the customer to rent the services of a car and a driver from the rental company. Even the fuel expenses are covered in the rental charge. If the customer happens to pay for the fuel during the trip, it is adjusted when the rental payment is settled at the end of the transaction.

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