Project Name: SimulPro

**Sample Only**

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Document Title: Final Report

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SimulPro Team:

**1. Problem statement and approach**

*Problem Statement.*Many products and services have seasonal selling trends, and, as a result, periodic pricing. This dynamic pricing and uncertainty of the demand make decision-making of retailers of seasonal products or providers of seasonal services very complicated. The purpose of my model is to evaluate profitability of a seasonal product Store.

The Store sells one Product, a new Model of which it buys each month from a Supplier. When a Model is new it has the highest price, but each consequent month the Demand on the Model falls and the Store reduces price of the Model. In other words, in any particular month the Store sells several Models of different ages and asks different prices for them, computed as percentages of the Product costs. The Product costs are different on Models of different seasons. There is a cost to hold one unit of product for one month. The model assumes that even if a unit was sold at some point during the month the holding expense for this unit is as if for the entire month. If some model wasn’t completely sold at the point when demand on it reaches zero, the remainder units are kept till the end of the year.

Some Models happen to be popular and some not. The Unpopular Models have lower initial Demand, which then falls with higher rate each month than the Demand on Popular Models. There is fixed probability for the Model to be Popular or Unpopular. The Supplier is able to provide 3 Order Sizes: Small, Medium, and Big. The Orders Size has to be defined in advance for an entire year.

The question the Store wants to answer is: what Order Size to choose to maximize the profit? The model answer it by assigning randomly popularity to the models, and then calculating demand, costs, revenues and profits for each month, as well as the annual values.

*Approach.*Initially, I intended to create a simulation to model the uncertainty of the demand. However, as there is no capacity to grade such model, the uncertainty was introduced by using simple stream of random numbers, which have a uniform distribution [min=0, max=1], to assign popularity to the models and then choosing appropriate Demand scheme.

When the popularity is assigned to each Model of the Product, all following calculations are done in a series of convolution tables. It is important to notice here, that the Convolve function could not be used instead of those convolution tables. The case is that not the total monthly values were important for the calculations performed, but the values corresponding to each particular model in each particular month. In some cases, like in the case of prices of the models of different ages, the total monthly values would be absolutely meaningless.

The calculation for each order size formed sort of sub-scenarios. Those sub-scenarios were performed each on its own worksheet. The only difference between those sub-scenarios is the size of the order used. There is a cell of the top of those worksheet, where the reference should be changed, then all other calculation are performed automatically. As I describe in the Reference guide, the model can be changed to accommodate other number of order sizes.

**2. Description of scenarios**

*First Scenario.* In the first scenario the Store management wants to choose between 3 different order size options the Seller offers. The possible order sizes are: Small Order – 4000 units, Medium Order - 4500 units, Big Order - 5000 units. The probability that each particular model from this supplier will be popular is 0.6.

*Second Scenario.* In the Second Scenario the Store consider an offer of a New Supplier. The New Supplier is known to have more popular models, in other words the probability for model to become popular is higher in this scenario – 0.75, but all 3 Order Sizes are bigger as well: Small Order – 5000 units, Medium Order - 6000 units, Big Order - 7000 units. The costs, prices asked and the highest demand stay the same in both scenarios; I assume that they are defined by the Store’s price niche and its size (or maximum number of customers per month). It’s assumed also that the Store has capacity to store all the possible order sizes and the holding cost per unit doesn’t increase with the number of units stored. First of all, this scenario is used to choose between the Suppliers. If the New Supplier is chosen, then it allows choosing the most profitable Order Size for this New Supplier. Taking into account the uncertainty of the demand those questions cannot be easily answered without the model.

**3. Conclusion of the study**

*First Scenario.* In the first scenario the annual profit values for the three possible order sizes are the following: Small Order – $1,973,475, Medium Order - $2,023,225, Big Order - $2,072,975. That means that the Big Order size of 7,000 units should be chosen. The average monthly demand for the model of this Supplier is expected to be about 5,683 units per month.

*Second Scenario.* In the second scenario the annual profit values for the three possible order sizes are the following: Small Order – $2,614,350, Medium Order - $2,694,425, Big Order - $2,670,850. All three values are bigger than any value in the scenario one, also the average monthly demand for the model of the New Supplier is expected to be about 6,933 units per month, which is greater than in the scenario one. That means that the contract offered by the New Supplier is more profitable for the Store than the one they already have. If they finally sign the contract with the new supplier, they should choose the Medium Order size of 6,000 units as the most profitable.

**4. Budget and schedule performance**

As to the point of creation of the budget schedule I had already created several documents – Requirements for Word Document, Requirements for Excel Documents, Course Project Proposal, and the Midpoint Status Report – I was able to estimate pretty accurately how much time the remain documents will take. Thus the difference between projected and the actual budget schedule is very minor. Only some parts of Excel modeling took slightly different amount of time. My outputs representation is pretty simple and thus took less time to create than I initially expected. On the other hand, after discovering some mistakes in my initial modeling I spent more time on creating the calculations worksheets. The proposed and the actual budgets are given below.

*Budget performance*

|  |  |  |
| --- | --- | --- |
| Task | Cost (in hours) - proposed | Cost (in hours) - actual |
| Planning Total | 11 | 11 |
| Problem Definition | 10 | 10 |
| Project Schedule | 1 | 1 |
| Modeling | 14 | 16 |
| Inputs sheet | 6 | 6 |
| Main calculations modeling | 8 | 10 |
| Documents | 32 | 32 |
| Project Proposal | 6 | 6 |
| Midpoint Status Report | 2 | 2 |
| Final Report | 8 | 8 |
| User Guide | 8 | 8 |
| Reference Guide | 8 | 8 |
| Execution | 10 | 6 |
| Application to different order quantities | 1 | 1 |
| Outputs representation | 8 | 4 |
| Creation of second scenario | 1 | 1 |
| Grand Total | 67 | 65 |

My other courses workload made me change my schedule a bit. I had very high workload on some weeks and could not work with the Project, but I had one week at the end of the semester, which I could spend entirely writing the Project documentation. The comparison of the proposed and the actual schedules is given below.

*Schedule performance*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Date - proposed | Date - actual | Milestone |
| 1 | 10/5/2011 | 10/5/2011 | Project Proposal |
| 2 | 10/11/2011 | 10/11/2011 | Creation of Excel workbook template and Inputs sheet |
| 3 | 10/20/2011 | 10/20/2011 | Excel additional capabilities Request |
| 4 | 10/25/2011 | 10/25/2011 | Midpoint Status Report; New Inputs Sheet |
| 5 | 11/1/2011 | 11/1/2011 | Main Modeling |
| 6 | 11/8/2011 | 11/8/2011 | Scenarios development; Outputs Sheet |
| 7 | 11/15/2011 | 12/06/2011 | User Guide |
| 8 | 11/22/2011 | 12/07/2011 | Reference Guide |
| 9 | 11/29/2011 | 12/08/2011 | Inspection of the Model and Revision of the Guides |
| 10 | 12/6/2011 | 12/09/2011 | Final Report |
| 11 | 12/12/2011 | 12/13/2011 12/18/2011 | Entire Project review; Preparation of the package for the Projects Library, Project submission. |

**5. Lessons learned**

*Team work.* Initially, I was going to work in a team with one of the students. However, finally we separated, as I didn’t want to rely on anybody. It seemed like it would be very hard to manage our schedule differences. I was a wise decision, as that student dropped from the course lately because of the schedule conflicts. I would find myself in very uncomfortable position if I would rely on him. This situation showed me once again how it was difficult to work in a team even when there are very good attitude and relationships. On the other hand, I believe that for this particular course it’s better to work alone. In the real life situation, each person does his or her job, the job he was hired for. In the learning process, however, students want to try every possible task, if you devise the task between team members, it may be the case that some people do only modeling, and some people do only writing, and they do not learn other things.

*Model Review.* While I worked alone, I knew it was still necessary to show my model to some other people, and to explain them how it worked and what it calculated. And indeed it was very insightful; I was immediately pointed to some problems with the model and errors in the calculations. So, it is always great to have a pair of fresh eyes. Also after explaining the mechanics of the model to a real person, it was easier for me to explain it on paper. It is better to start sharing your model with somebody else as early as possible to avoid making big changes later.

*Schedule.* I think that a good schedule is really important for this course and the project. I had an experience of making all the work in last minutes before the due date. It is always very hard and stressful. This time I paid very close attention to my schedule. I planned my time taking into account that my circumstance can change and I should be still able to do everything on time. I’m very satisfied with my performance this semester, I really was able to pace myself right, and didn’t have to rush at any point. However, I also realized that making things in advance is not always wise. I spent 4 hours creating the Requirements for Word Document and the Requirements for Excel Documents, and then it was said we didn’t need them. I would create them in any case, as they are useful, but I would form them in the way it would be convenient for me to find the information. Instead, I wasted my time creating lines of no more than 25 words.

*The Wish of the Customer.* I’ve read many times in the literature for modelers, that a modeler cannot do what he or she wants or believes is absolutely necessary to do, rather it what the customer wishes. Robert Woolsey and Huntington Swanson in their famous book “Operations Research for Immediate Application” write that “the O.R. man is usually shocked that the customer would want anything less than the ‘optimum’ solution and remonstrates with him vigorously that he be allowed to continue on to 100 percent.” I also did this mistake, trying to persuade Rick that simulation studies were absolutely necessary for my Project. It didn’t work, of cause, and I learned a lot from it.