Project Name: SimulPro

**Sample Only**

This document was submitted by students in a previous class. Their requirements were different from yours. We offer it only as a sample of what a project was for that class. Copying this document, in whole or in part, and submitting the result as your own work, would be a violation of the honor code.

Document Title: Reference Guide

Revision Number: 1.0

SimulPro Team:

**1. How the calculation works**

The Info and Inputs worksheet do not contain any calculations.

*Demand Worksheet.*

The Popularity Schedule assigns the popularity to models obtained by the Store from the Seller in each particular month during the year. The formula is: =IF(RandomNumbers<=ProbabilityPopularModel,1,0). So, we have a stream of random numbers from 0 to 1 generated in advance. The formula compares the stream values with the probability that a model is popular, it returns 1 if the random stream value is less or equal to ProbabilityPopularModel, and zero otherwise.

The Demand Schedule calculates the demand for models bought in different month according to their current age (in months). The formulas in the table look if this particular model was popular or not and then they choose the corresponding values from the Demand Analysis. To do that the formula refers to PopTrans column which simply contains a Transpose of the Popularity Schdule. Unlike all other tables in the model the Demand Schedule is given for 2 years period. Only the first year will be used in further calculations, except one. To calculate the Expected Average Demand we can’t use only the values of the first year. We have to combine values for the entire period while the models are sold to calculate the true average. The Average Demand is especially interesting when comparing different possible suppliers of the product.

*Prices Worksheet.*

The Popularity Schedule does exactly the same as it did in the Demand Worksheet.

The Price Schedule calculates the prices for models bought in different month according to their current age (in months). The formulas in the table look if this particular model was popular or not and then they choose the corresponding values from the Model’s Prices Table. To do that the formula refers to PopTrans column which simply contains a Transpose of the Popularity Schdule and CostsTrans column which simply contains a Transpose of the Model’s Prices Table. In the contrast to the Demand Schedule on the worksheet Demand, the total monthly prices and average price have no substantial meaning and are not calculated.

*SmallOrder, MediumOrder, BigOrder Worksheets*.

Consider these three worksheets to be sub-scenarios. They are identical to each other, with exception of the value of the Order Size. Each worksheet refers to one particular order size – Small, Medium or Big. All the calculations are the same.

First the Popularity Schedule and the Demand Schedule are given using references to the Demand Worksheet. The Popularity Schedule is not used in calculation and just given for reference. The Demand Schedule is used in the following calculations.

Inventory Schedule. This table calculates the current number of units of each model in each particular month. In the month a model is purchased its inventory equals the Order size. Then the formula compares if the demand for this model in this month was higher than the inventory level. If so, then the inventory becomes zero, otherwise the different between the previous inventory level and the demand is given. The Total Inventory for each month is calculated, and then multiplying it by holding costs we receive the monthly holding costs, the Sum of which is the Annual Holding Costs.

Sales Schedule. This table shows the sales of each particular model in each month. The formula chooses the minimum of either Inventory level or Demand.

Cost of Goods Sold. This table gives costs of the units of each model sold each. To do that the formula takes the price at which particular model was obtained from the seller and multiply it by sales of this model in the current month. The total monthly COGS sum up to the Annual COGS.

Price Schedule is just a reference table to the Price worksheet.

Revenue Schedule. This table calculates revenues generated by each model in each particular month. It is done by multiplying Sales Schedule and Price Schedule. The total monthly Revenues sum up to the Annual Revenue.

The Total Profit row and the Annual Profit cell take the values or revenue and subtract holding costs and COGS from it.

*Outputs worksheet*. The only calculation on this worksheet is the column Total Costs in the Annual Values table. It sums up the values of Holding Costs and COGS.

**2. How to locate all inputs, outputs, and intermediate results**

The model’s workbook contains 8 worksheets: Info, Inputs, Demand, Prices, SmallOrder, MediumOrder, BigOrder, Outputs.

All the input streams and parameters are located on the worksheet named Inputs. The worksheet has the following Input Streams:

*Product Costs.* The stream of prices, which the Store pays to the Supplier for the product each month. As the model is intended to be used for seasonal goods, the product costs are not the same during the year. However, the user can use any prices, even the same ones during the year. All values are greater than zero. The Product Costs stream is used to calculate models’ prices (worksheet Prices) and Costs of Goods Sold (SmallOrder, MediumOrder, BigOrder).

*Model’s Prices.* Two streams of prices the Store asks for the popular and unpopular models. They are represented in percentage of the Product Costs. For example, if the cost of the model was $100 and in the first month the Store asks for it $200, then the price in this stream will be represented as 200%. The Store asks the highest percent for the newest model, then as model becomes older, the price becomes lower and lower each month till it reaches zero. In the first month, while the Store management doesn’t know yet if the model is popular or unpopular, it asks the same price for any model. However, after the first month of selling it’s possible to classify the model by popularity and choose an appropriate pricing scheme. So, the Model’s Prices streams represent the pricing policy of the user’s store. The user can create any pricing scheme he or she wishes. All values are greater than or equal to zero. The Model’s Prices stream used to calculate prices month by month (Prices) which are used to calculate Revenue later (SmallOrder, MediumOrder, BigOrder).

*Demand Analysis.*  These two streams show the fall of the demand on popular and unpopular models as the models become older. The older the model, the smaller the demand on it, and eventually it reaches zero. Obviously the unpopular models have lower demand starting from the first month, they probably also experience more rapid decrease in the demand in following months than popular models. These streams should be created by a sales management team according to historical data. The demand values are expressed in the percentages of the Highest Demand (see below) and cannot be greater than 100%. All values are greater than or equal to zero. The Demand Analysis stream is used in the model to calculate the size of monthly demand for each type of the model (Demand) which are used to calculate Sails later (SmallOrder, MediumOrder, BigOrder).

*Random Number Stream.*  This is the technical stream used in calculations. It is a stream of random numbers between zero and one. It can be changed or left as it is during creation of a new scenario. If a new scenario is supposed to be used by itself, then a new stream should be generated, if, on the other hand, 2 scenarios are intended to be compared with each other, then the same stream of random numbers should be used. The Random Number Stream is used to assign popularity for the models (Demand, Price). For more details about purposes of this stream and how it can be changed see the section “4. How to make changes” below.

The Inputs worksheet also has the following Input Parameters:

*Order Sizes.*  The model assumes that the Supplier offers three possible order sizes. Once chosen the same number of items will be ordered during the entire year. The model can be changed to accommodate fewer or more than 3 order sizes. See the section “4. How to make changes” below for the details. The Order Sizes are used to calculate the Inventory levels and Holding expenses (SmallOrder, MediumOrder, BigOrder). Each of these 3 worksheets use only one of the values of the Order Sizes.

*Highest Demand.* The highest demand possible, the values is estimated using historical data. Supposedly it is limited by the size of the store. The Highest Demand is used to calculate monthly demand values (Demand).

*Holding Cost.* The 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. The Holding Cost value is used to calculate monthly holding expenses (SmallOrder, MediumOrder, BigOrder).

*Probability that Model is Popular.* This probability is estimated according to historical data and the Supplier evaluation. The probability is always a fraction of 1. The Probability that Model is Popular value is used with the Random Numbers Stream to assign popularity to the models of the product (Demand, Prices).

All the important intermediate results located on worksheets Demand, Prices, SmallOrder, MediumOrder, BigOrder are given in bold red font (see section 3). Those are Average Demand (Demand), Annual Holding Costs, Annual COGS, Annual Revenue, Annual Profit (SmallOrder, MediumOrder, BigOrder).

All the outputs are located on the worksheet named Outputs.

The Outputs worksheet shows a table with all three possible order sizes and the corresponding performance values. First, there is a table of corresponding profits month by month. Then, there is a table of Annual values: Annual Profit, Annual Holding Costs, Annual COGS (Costs of Goods Sold), Total Costs (which is the sum of the previous two), and Annual Revenue. All these values allow to compare the consequences of choosing different order sizes. The Expected Average Monthly Demand is also given on this worksheet. This value may be interesting by itself and while comparing different scenarios.

The most important information on the Output sheet is the Annual Profit. The cells are colored according to the values, the lowest profit is red, the medium is yellow and the highest is green (see section 3). The Store, as any business, seeks to maximize its profit, thus the management should choose the order size which gives the best Annual Profit. The column chart visualizes the same information - the comparison of the Annual Profits given the different order sizes.

**3. Guide to visual cues and naming conventions**

The model has the following visual cues:

|  |
| --- |
| Input Streams (can be changed by user) |
| **Input Parameters (can be changed by user)** |
| Inputs Worksheet References |
| **Intermediate Results given later in Outputs**  |
| Names Definitions  |
| Smallest Annual Profit  |
| Medium Annual Profit |
| Highest Annual Profit |

The only naming convention used was to use a substantive word at the beginning of the name and all the descriptions after that. For instance, OrderSize, OrderSmall, OrderMedium and so on. It allows more effective search of names. All the names relating to orders will be close to each other. If names like SizeofOrder, MediumOrder and so on were used, they would be harder to find.

**4. How to make changes**

Random Numbers Stream

The purpose of the Random Numbers Stream is to introduce uncertainty into the model. The Store has a control of every variable in the model except the demand. The Supplier or the Store management cannot tell in advance if each particular model will be popular or not, only the probability is somehow estimated. It means that all the outputs calculated in the model are not exact numbers which will certainly occur, but some estimation of most probable outcomes. There are 3 different approaches, how the Random Numbers Stream can be used:

*Random Numbers Stream is left unchanged.*  The model can be used to compare different scenarios. If the Store management wants, for instance, to compare revenues or profits using different pricing schemes, or there are changes in the Supplier contract terms, then it is necessary to hold all other things constant, including the same Random Numbers Stream. In other words, you would consider the case, where the demand is absolutely the same, but the order sizes, or prices, or costs are different.

*Random Numbers Stream is changed.* On the other hand, if you want to create a completely different scenario for its own use and are not going to compare it with previous scenarios, then it’s always better to change you random numbers, as they can’t always be the same. To do that, you can use any random generators to create a stream of numbers which has uniform distribution from zero to one. To do it in Excel: use formula =RAND() in each cell of the Random Numbers stream, then copy the entire stream, using “paste special” paste only values into the same stream cells. You should not leave RAND function, as it will recalculate values each time the model used.

*Simulation Studies.*  As it already has been said the outputs calculated in the model are not exact numbers which will certainly occur, but some estimation of most probable outcomes. That means that this model is great candidate to be upgraded to a simulation model. In this case a mechanism of iterating random numbers and calculation average results of hundreds of iterations should be created; the calculation of the confidence intervals for all values will be also possible in this case. In each current state the model doesn’t tell the user how he or she can be confident in the results received. However, such simulation model requires more resources to be developed, and the profitability of those additional efforts should be estimated first.

Order Sizes

In its current state the model works only with 3 different Order Sizes. If, however, there is another number of order sizes available, changes are necessary. If there is only one possible order size, then there is no choice, and model is needless. If there is only 2 order choices, then you can use zero for one of the order sizes, and the model will work in the same way as before. If there are more than 3 cases, then there are several steps required to adjust the model:

*Inputs Worksheet.* Insert additional rows for additional order sizes.

*Demand and Prices Worksheets.* These worksheets don’t use order sizes and have to be left unchanged.

*Orders Worksheet.*  Create additional worksheets for new order sizes by copying one of the existing. Change the cell references of the cells B6 and C6. Press F9, all other calculations will be adjusted.

*Outputs Worksheet.* Insert new rows for new order sizes to the both tables. Adjust the chart accordingly.