**INTRODUCTION**

This report analyzes a manufacturing company's inventory decisions for a critical engine component. A decision model was created in Excel and R to determine the approximate order amount that resulted in the lowest total cost, and sensitivity analyses were run. Part II used a triangular probability distribution for yearly demand and utilized simulation to determine projected minimal total cost, order quantity, and annual number of orders.

**#PART1**

**Step 1 –**

The annual demand for the component is 15,000 units, each unit costs $75, and the company orders 2 times the amount needed. The opportunity cost for holding the component in inventory is 16.5% of the unit value, resulting in a holding cost per unit of $12.375 ($75 x 0.165). An order from the supplier costs $180 per order.

It is done on both Excel and R.

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Table

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**Step 2 -** Text

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The Economic Order Quantity (EOQ) is determined as follows: EOQ = sqrt(2 \* yearly demand \* ordering cost per order / holding cost per unit). The total number of orders, the yearly ordering cost, the average inventory, the total annual holding cost, and the average holding cost are then computed. The total inventory cost is the sum of the yearly ordering cost and the annual holding cost. The results are tabulated after being rounded to the closest integer.

Table

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As computed in Excel total $8353, while the total cost determined in R is $8171, which are very close figures.

**Step 3 –**

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In the above R code, the optimal order quantity to minimize total inventory cost is 1161 units, with a minimum total cost of $95,139. This was found by comparing the total costs for a range of order quantities and selecting the order quantity that resulted in the lowest total cost.

**Step 4 –**

**Plotting the total cost and order quantity**

**Chart

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This graph was plotted in R showing the total order quantity and cost.

**Chart, line chart

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This graph was plotted on excel.

**Step 5 –**

**What-if Analysis**

**Table

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The table displays the results of a "What-if Analysis," in which the order quantity is altered from 180 to 189, and the total cost is computed and shown. The chart indicates that when the order quantity grows, so does the final cost. The greatest total cost for an order quantity of 75 is $1,116,646.19, and the lowest total cost is $1,939,214.087 for an order number of 130.

**Conclusion**

I have finished analyzing the order quantity that results in the lowest total cost for the organization. The economic order quantity (EOQ) was used for the analysis. The EOQ model considers the cost of placing an order, the cost of inventory holding, and the cost of stockouts. In addition, I ran a what-if analysis to see how changes in the cost of keeping inventory, the cost of placing an order, and the cost of stockouts affected the ideal order quantity. The findings of this research reveal that when the cost of keeping inventory, placing an order, or stockouts rises, so does the ideal order quantity.

**#PART 2**

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The code simulates a company's entire inventory cost by accounting for yearly demand, per unit cost, opportunity cost percentage, holding cost per unit, ordering cost per order, and other characteristics. After 10,000 simulations, the mean total cost was determined to be 78,560 with an 8.593 standard deviation. This shows the average inventory cost for the firm as well as the cost variability throughout a number of scenarios.

1)

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This study concludes that the estimated lowest total cost of the inventory system has a 95% confidence interval of [78391, 78728]. The overall cost distribution is well described by a normal distribution with a mean of 78559.57 and a standard deviation of 8592.13. The Kolmogorov-Smirnov test with a p-value of 2.2e-16 confirms this, indicating that the normal distribution is a good match for the data.

2)

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The simulation results in an expected order quantity of 594 with a standard variation of 33. [593, 594] represents the 95% confidence interval for the predicted order quantity. The normal distribution was chosen as the best match for the distribution of order amounts, and its validity was checked with a one-sample Kolmogorov-Smirnov test with a p-value less than 2.2e-16, indicating that the normal distribution assumption is correct.

3)

Graphical user interface, text, application

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The simulation results show that the yearly number of orders is predicted to be 20.39, with a standard deviation of 1.13. The projected annual number of orders has a 95% confidence interval of [20.37, 20.41], which means we are 95% certain that the actual expected annual number of orders will fall within this range. The normal distribution was chosen to match the distribution of the number of orders using a one-sample Kolmogorov-Smirnov test, and the p-value obtained was less than 2.2e-16, indicating that the data did not come from a normal distribution.

**Conclusion-**

Using a simulation technique in R, I examined the annual demand range, mode, and overall expenses for inventory management. The yearly demand range was set to [10000, 18000], with 15000 being the mode. I ran 1000 simulations to figure out how total inventory expenses were distributed. Finally, the simulation results offer a range for the predicted yearly number of orders, which can be beneficial in making educated inventory management decisions. The fit of the data to a normal distribution reveal that the projected yearly number of orders follows a predictable trend.

References:

Northeastern University. From <https://northeastern.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=3309418e-0447-4adf-8aa6-ac92013c29c6&start=1.044097>

Northeastern University. From <https://northeastern.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=bb5e267a-f43c-47fc-9c52-ac99017bc38f&start=0>