**Title: Case Study #2 Report**

**Group 1**

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**Executive Summary**

This report analyzes the sales forecast, stockout probabilities, projected profits, and optimal order quantity for the "Weather Teddy" product. Based on the analysis, we provide recommendations for inventory management.

1. **Sale Forecast Analysis –**

As per the Sales Forecaster it is predicted to have expected sales of around 22500 with the 0.97 probability that the sales will fall anywhere between 7000 and 38000 units.

Based on the above information it can be assumed to have a mean of 22500 with lower bound as 7000 and upper bound as 38000 units.

Based on the normal probability distribution it can be said that it is 0.03 probability it is out of the bounds and with normal distribution it can be safe to say that its 0.015 probability that the sales are less than 7000 units. Based on the this, the calculation can be done with the below formula

P(x) = (x- mean)/standard deviation

x here represents the expected value. In our case its 7000.

So, the z value is **-2.17** for the probability of 0.015 and mean of 22500 we get the **standard deviation of 7142.56.**

With the standard deviation it can be calculated as the **variance is 51016158.56.**

Below figure shows the mean and variance with the graph as well.

A diagram of normal distribution

Description automatically generated

1. **Stockout Probability**

The stockouts happen when we have more sales than number of units available in the stock. Hence, to get the probability of stockout happening if we have ordered the units as per management committees’ suggestions of 13000, 17000, 26000 and 29000 can be calculated by getting the probability of sales less then suggested quantity and then subtracting from 1.

So, say P(X) is the probability of sales less than the suggested quantities. Hence, the probability of sales more than 13000 and leading to stockouts can be calculated with as 1-P (13000).

Below is the tabular representation of all the stockout probabilities.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No. of Units** | **Mean** | **Z Score Value** | **Probability of Sales Under limit P(X)** | **Stockout Probability 1-P(X)** |
| 13000 | 22500 | -1.330 | 0.092 | 0.908 |
| 17000 | 22500 | -0.770 | 0.221 | 0.779 |
| 26000 | 22500 | 0.490 | 0.688 | 0.312 |
| 29000 | 22500 | 0.910 | 0.819 | 0.181 |

As it is evident from the table above the stockout probability decreases as we increase the inventory from 13000 to 29000. With 13000 it is very high likely it will run into stockout issues.

1. **Projected Profit**

The Projected Profit based on the number of unit sales as 12000 units, most likely case 22500 and best case of 33000 units sale.

|  |  |  |
| --- | --- | --- |
| **Units ordered** | **Units Sold** | **Total Profit** |
| 13000 | **12000** | 134000 |
| 17000 | **12000** | 94000 |
| 26000 | **12000** | 4000 |
| 29000 | **12000** | **-***26000* |
|  |  |  |
| 13000 | **22500** | 156000 |
| 17000 | **22500** | 204000 |
| 26000 | **22500** | 235000 |
| 29000 | **22500** | 205000 |
|  |  |  |
| 13000 | **33000** | 156000 |
| 17000 | **33000** | 204000 |
| 26000 | **33000** | 312000 |
| 29000 | **33000** | *348000* |

**Note – It is assumed that you cannot sell more than the ordered quantity.**

From the above table it can be concluded that maximum profit is the when the ordered quantities are 29000 and sale also happens to be 33000 units (i.e., all 29000 units sold) while we have the loss of $26000 when 29000 units are ordered however sales is very low with 12000 units sold.

It is evident from the above table that when the ordered quantity and sold quantities are around the mean value, we have higher chances of no loss and making money. However, even though we highest profit estimate when order number is way higher it is still a risky proposition given that it can lead to a loss of $26000 if the as per worst estimates.

1. **Optimal Order Quantity**

In order to determine what should be the order quantity to have only 8% chances of stockout and 92% chances of no inventory stockouts, we can use the below formula –

X = mean + (std \* z value)

Here std 🡺 Standard Deviation is **7142.56** (refer section 1)

Z value for 92% probability is 🡪 1.405

With the above formula and values provided it can be calculated that expected value is 32535.81 which can be rounded up to **32536** units.

Based on the ordered units of 32536, the projected profit for sale of 12000, 22500 and 33000 units is mentioned in the below table.

|  |  |  |
| --- | --- | --- |
| **Units ordered** | **Units Sold** | **Total Profit** |
| 32536 | 12000 | **-61360** |
| 32536 | 22500 | 169640 |
| 32536 | 33000 | **390432** |

It can be inferred that in this case when sales are around the number or approximate to the number of units ordered of **32536,** we have the highest profit of **$390432.** However, if the sale is much less then or worst it will lead to hue inventory being sold at discounted price leading to a loss of **$61360**.

1. **Recommendations**

As a merchant our goal given the uncertain demand is to maximize profit while avoiding any losses if it came to the worst sales scenario (out of 12,000, 22,500 and 33,000 sales).

In order to minimize any losses and still make the most revenue if the sales volume favors, we recommend around order value of **26246** units. We arrived at this number as we calculated the quantities of no stockout and ran it through our profit function with the three levels of units sold. If you see the chart below, this covers our bases of not losing any money in the low sales scenario, offers comparable mid-level and max level profit for those sales volume. With *12000* sales our profit would be **1540** with *22500* sales our profit would be **232540** with *33000* sales our profit would be **314952**.

This is our recommendation to be safe. As we go further away from the mean even though our profit margins increases if we have the best sales, our profit reduces if the sale happens to be closer to the mean and less then it. Also having more than needed inventory will add cost to the operating margins which will further reduce the profits in real world.

Yes, you could certainly have higher chances of stockout scenarios, which means you may lose into certain loss of potential sales, however the tradeoff we can take if we choose a bit of defensive approach as it’s the launch of the product. However, restocking can further be reevaluated based on the sales growth and trend analysis.

Below is the table depicting the information that was used to derive to the above conclusion.

| **No Stock Out Probability** | **Units ordered** | **Units Sold** | **Total Profit** |
| --- | --- | --- | --- |
| 70% | 26246 | 12000 | 1540 |
| 70% | 26246 | 22500 | 232540 |
| 70% | 26246 | 33000 | 314952 |
| 72% | 26663 | 12000 | -2630 |
| 72% | 26663 | 22500 | 228370 |
| 72% | 26663 | 33000 | 319956 |
| 75% | 27318 | 12000 | -9180 |
| 75% | 27318 | 22500 | 221820 |
| 75% | 27318 | 33000 | 327816 |
| 77% | 27778 | 12000 | -13780 |
| 77% | 27778 | 22500 | 217220 |
| 77% | 27778 | 33000 | 333336 |
| 80% | 28512 | 12000 | -21120 |
| 80% | 28512 | 22500 | 209880 |
| 80% | 28512 | 33000 | 342144 |
| 82% | 29039 | 12000 | -26390 |
| 82% | 29039 | 22500 | 204610 |
| 82% | 29039 | 33000 | 348468 |
| 85% | 29903 | 12000 | -35030 |
| 85% | 29903 | 22500 | 195970 |
| 85% | 29903 | 33000 | 358836 |
| 87% | 30546 | 12000 | -41460 |
| 87% | 30546 | 22500 | 189540 |
| 87% | 30546 | 33000 | 366552 |
| 90% | 31654 | 12000 | -52540 |
| 90% | 31654 | 22500 | 178460 |
| 90% | 31654 | 33000 | 379848 |
| 92% | 32536 | 12000 | -61360 |
| 92% | 32536 | 22500 | 169640 |
| 92% | 32536 | 33000 | 390432 |
| 95% | 34249 | 12000 | -78490 |
| 95% | 34249 | 22500 | 152510 |
| 95% | 34249 | 33000 | 383510 |