California State University – East Bay

MS in Business Analytics
BAN 602 Case 2 Solution
Group 5

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Introduction:

Specialty Toys sells a variety of children's toys. Management learnt that preholiday season is the best time to introduce toys. In order to get toys in its store by October, they place orders with the manufacturer in June or July of each year. Specialty Toys plan to introduce a new toy called Weather Teddy. Members of the management team have suggested order quantities of 15000, 18000, 24000 or 28000. The company expects to sell the toy for $24 based on a cost of $16 per unit. If inventory remains after the holiday season, company will sell the rest of the inventory for $5 per unit. As reviewing the sales history, senior sales forecaster has predicted an expected demand of 20000 units with a 0.95 probability that demand would be between 10000 and 30000 units.

Objective:

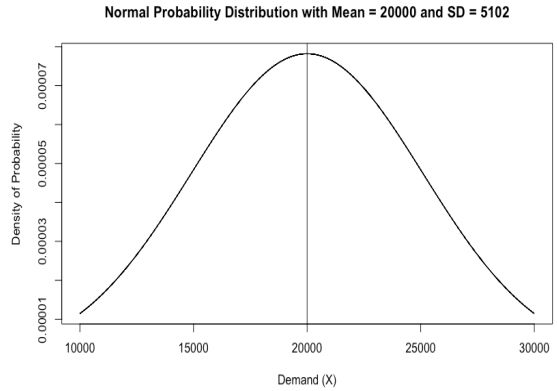
Our objective is to analyze stock out probabilities for various order quantities, provide an estimate of profit potential and to recommend an order quantity.

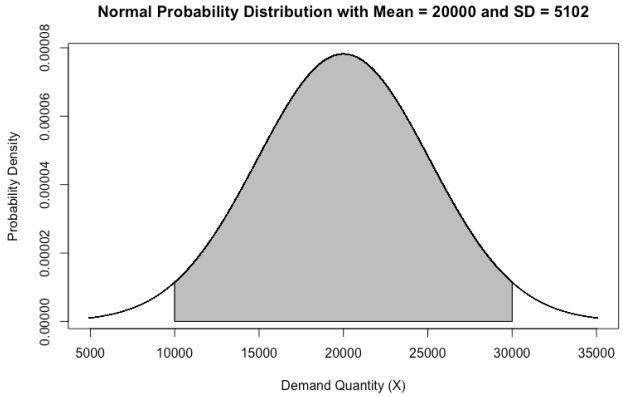
Solution1:
Sales Forecaster has predicted an expected demand of 20000 units with a 0.95 probability that demand would be between 10000 and 30000 units: P [10,000 <= X <=30,000] = 0.95
Let X be a random variable which denotes the demand for Weather Teddy. The demand distribution follows a normal probability distribution with Mean (μ) = 20,000.

Z score calculation:
Since it's a normal probability distribution, P (10000< X< 20000) = P (20000< X< 30000) = 0.475 (By symmetry)
To calculate Z score, we will consider area under the curve to the left of X = 30000 which is:
0.95 + (0.5 – 0.475) = 0.975
The standard normal probability table gives the area under the curve to the left of a particular z value. We know that the area under the curve to the left of the unknown z value must be equal to 0.975. By checking the table, we find that the corresponding z value is 1.96

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767

Standard Deviation (σ) calculation:
X=30,000, Mean (μ) = 20,000 and Z score (z) = 1.96:
$z= (x – \mu)/ \sigma$
(30,000 − 20,000)/1.96= 5,102
Standard Deviation = 5,102.
Hence using Sales forecaster's prediction, we can infer that there is a 0.95 probability that demand would be between 10000 units to 30000 units with a mean of 20000, standard deviation of 5102 and z score of 1.96.



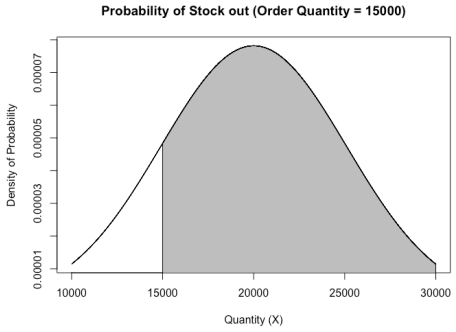


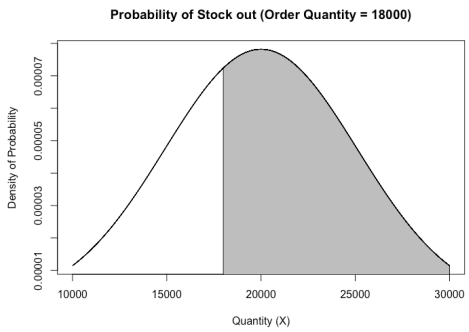
Solution2:

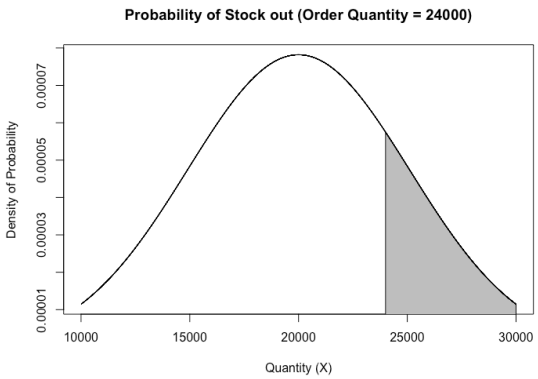
Order quantity suggested by members of the management team are: 15000, 18000, 24000 or 28000 units.

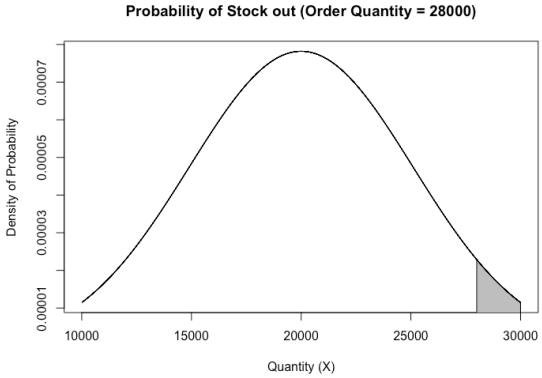
Probability of stockout with Mean 20000 and standard deviation = 5102:

- When the order quantity is 15000.
  Here x = 15000
  $z = (x - \mu)/\sigma$, z = (15000-20000)/5102 : z = -0.98
  P (z<= −0.98) = 0.1635
  P (z>= −0.98) = 1- 0.1635 = **0.836**
- When the order quantity is 18000
  X = 18000
  $z = (x - \mu)/\sigma$, z = (18000-20000)/5102 : z = -0.392
  P (z <= −0.392) = 0.3483
  P (z >= −0.392) = 1 - 0.3483 = **0.652**
- When the order quantity is 24000
  X = 24000
  $z = (x - \mu)/\sigma$, z = (24000-20000)/5102: z = 0.784
  P (z <= 0.784) = 0.7823
  P (z >= 0.784) = 1 - 0.7823 = **0.217**
- When the order quantity is 28000
  X = 28000
  $z = (x - \mu)/\sigma$, z = (28000-20000)/5102: z = 1.57
  P (z <= 1.57) = 0.9418
  P (z >= 1.57) = 1 - 0.9418 = **0.058**









Conclusion: From the above-mentioned calculations and graphs, we can infer that in all four order quantities, order quantity of 15000 has highest probability of stockout and order quantity 28000 has lowest probability of stockout.

Solution3:

Projected profit for the order quantities suggested by the management team under three scenarios is represented in the table below:

Order Quantity	Cost Price ($16)	Sales	Selling Price		Calculated Profit/Loss ($)	Profit/Loss Percentage (%)
			24$ SP	5$ Surplus SP		
15000	240000	10000	240000	25000	25000	10.42
		20000	360000	0	120000	50.00
		30000	360000	0	120000	50.00
18000	288000	10000	240000	40000	-8000	-2.78
		20000	432000	0	144000	50.00
		30000	432000	0	144000	50.00
24000	384000	10000	240000	70000	-74000	-19.27
		20000	480000	20000	116000	30.21
		30000	576000	0	192000	50.00
28000	448000	10000	240000	90000	-118000	-26.34
		20000	480000	40000	72000	16.07
		30000	672000	0	224000	50.00

Profit	Loss

Conclusion: From the above table we can infer that:

- Order quantity 28000 with a sale of 10000 will incur highest loss of 26.34%.
- Order quantity 24000 with a sale of 10000 will incur a loss of 19.27%
- Order quantity 18000 with a sale of 10000 will incur a loss of 2.78%.
- Order quantity of 15000 will incur no loss.

- Equal maximum profit for order quantity 15000 will be when sales is 20000 and 30000 respectively.
- Equal maximum profit for order quantity 18000 will be when sales is 20000 and 30000 respectively.
- Maximum profit for order quantity 24000 will be when sales is 30000.
- Maximum profit for order quantity 28000 will be when sales is 30000.

Question4:

As per Specialty's manager, order quantity should have 70% (0.7 probability) chance of meeting demand and 30% (0.3 probability) chance of stock out.

Calculating z score for 0.7 probability:

From the standard normal probability table, we see that the 0.6985 is the cumulative probability closest to 0.7. The corresponding z value is 0.52.

As per the formula, we can calculate the value of X (Order Quantity) that should be ordered to obtain a 70% chance of meeting demand.

$z = (x - \mu)/\sigma$

$0.52 = (x - 20{,}000)/5102$

X = **22653**

Note: X value as per calculations will be different than R since in calculation, we are referring to the closest probability to 0.7 which is 0.6985 for which corresponding z value is 0.52.

Quantity ordered under this policy is 22653.

Below table shows projected profit for all three scenarios for order quantity: 22653(calculation) and 22676 (R):

Order Quantity	Cost Price ($16)	Sales	Selling Price		Calculated Profit/Loss	Profit/Loss Percentage (%)
			24$ SP	5$ Surplus SP		
22653	362448	10000	240000	63265	-59183	-16.33
		20000	480000	13265	130817	36.09
		30000	543672	0	181224	50.00
22676	362816	10000	240000	63380	-59436	-16.38
		20000	480000	13380	130564	35.99
		30000	544224	0	181408	50.00

Question5:

Recommendation: Company should place the order of toys between 18000 to 20000 quantities.

Rationale for recommendation –

Analysis: Weather Teddy is a new toy in market, hence it's not possible to measure the exact customer demand. Our goal for the company is to maximize profit and minimize loss (less than 10%). If company opts for best outcome and decides to order quantities ranging 23000 to 30000 and product doesn't do well in market, company will be left with orders and would have to sell it at lower price causing huge losses. We are calculating expected profit for order quantities within 1 standard deviation from mean. Table below provides a profit/loss estimate of order values within 1 SD i.e., order quantities ranging from 15000 to 25000.For order quantity 15000 cost price will

be less than selling price for all sale scenarios, thus making profit in all the scenarios. However, Specialty's senior sales forecaster predicted an expected demand of 20,000. Order quantity 15000 would be way less considering market potential. For order quantities >=21000, if we consider worst sale scenario, losses will be more than 10%. Hence, we would not recommend company to place an order >=21000.

Conclusion: For order quantity between 18000 and 20000, company will incur a loss less than 10% for worst sale scenario.
Hence, we can conclude that Specialty toys should maintain an order quantity between 18000 to 20000. units so that company can judge the market and increase the amount of order quantity in future

Order Quantity	Cost Price($16)	Sales	Selling Price		Calculated Profit/Loss	Profit/Loss Percentage (%)
			24$ SP	5$ Surplus SP		
15000	240000	10000	240000	25000	25000	10.42
		20000	360000	0	120000	50.00
		30000	360000	0	120000	50.00
18000	288000	10000	240000	40000	-8000	-2.78
		20000	432000	0	144000	50.00
		30000	432000	0	144000	50.00
19000	304000	10000	240000	45000	-19000	-6.25
		20000	456000	0	152000	50.00
		30000	456000	0	152000	50.00
20000	320000	10000	240000	50000	-30000	-9.38
		20000	480000	0	160000	50.00
		30000	480000	0	160000	50.00
21000	336000	10000	240000	55000	-41000	-12.20
		20000	480000	5000	149000	44.35
		30000	504000	0	168000	50.00
22000	352000	10000	240000	60000	-52000	-14.77
		20000	480000	10000	138000	39.20
		30000	528000	0	176000	50.00
23000	368000	10000	240000	65000	-63000	-0.17
		20000	480000	15000	127000	34.51
		30000	552000	0	184000	50.00
24000	384000	10000	240000	70000	-74000	-19.27
		20000	480000	20000	116000	30.21
		30000	576000	0	192000	50.00
25000	400000	10000	240000	75000	-85000	-21.25
		20000	480000	25000	105000	26.25
		30000	600000	0	200000	50.00