**Practice Problem on Quick Response Supply Chain**

**Berkeley Goose (Q1-5)**

Berkeley Goose (BG) sources a parka from an Asian supplier for $10 each and sells them to customers for $22 each. Leftover parkas at the end of the season have no salvage value. The demand forecast is normally distributed with mean 2,100 and standard deviation 1,200. Now suppose BG found a reliable local vendor in Oakland that can produce parkas very quickly but at a higher price than BG’s Asian supplier. Hence, in addition to parkas from Asia, BG can buy an unlimited quantity of additional parkas from this Oakland vendor at $15 each after demand is known.

**Q1.** Suppose BG orders 1,500 parkas from the Asian supplier. What is the probability that BG will order from the Oakland supplier once demand is known?

BG will order from the Oakland supplier if demand exceeds 1500 units. With for  the *z*-statistic is *z* = (1500 – 2100) / 1200 = -0.5. From the Standard Normal CDF Tablewe see that , which is the probability demand is 1500 or fewer. The probability demand exceeds 1500 is  = 69.15%.

**Q2.** Again assume that BG orders 1,500 parkas from the Asian supplier. What is the Oakland supplier’s expected demand; that is, how many parkas should the Oakland supplier expect that BG will order?

The supplier’s expected demand equals BG’s expected lost sales with an order quantity of 1,500 parkas. From the Standard Normal Loss Function Table, . Expected lost sales is 1200 × 0.6978 = 837.4.

**Q3.** Given the opportunity to order from the Oakland supplier at $15 per parka, what order quantity from its Asian supplier now maximizes BG’s expected profit?

The overage cost is =10 – 0 = 10, because leftover parkas must have been purchased in the 1st order at a cost of $10 and they have no value at the end of the season. The underage cost is =15 – 10 = 5 because there is a $5 premium on units ordered from the American vendor. The critical ratio is 5 / (10 + 5) = 0.3333. From the *Std Norm Dist Func Table* we see that 0.3300 and 0.3336, so choose *z =* -0.43. Convert to *Q* : *Q* = 2100 – 0.43 × 1200 = 1584.

**Q4.** Given the order quantity evaluated in Q3, what is BG’s’s expected profit?

First evaluate some performance measures. We already know that with *Q* = 1584 the corresponding *z* is –0.43. From Standard Normal Loss Function Table,  Expected left over inventory is 1200 x I(z) = 264.4. Expected sales = Q – expected leftover inventory = 1584 – 264.4 = 1319.6. Expected lost sales is then 2100 – 1319.6 = 780.4. Now evaluate expected profit with the Oakland vendor option available. Expected revenue is 2100 × 22 = $46,200. The cost of the 1st order is 1584 × 10 = $15,840. Salvage revenue from left over inventory is 264.4 × 0 = 0. Finally, the cost of the 2nd order is 780.4 × 15 = $11,706. Thus, profit is 46200 – 15840 – 11706 = $18,654.

**Q5.**  If BG didn’t order any parkas from the Asian supplier, then what would BG’s expected profit be?

If BG only sources from the Oakland supplier, then expected profit would be ($22 - $15) × 2100 = $14,700, because expected sales would be 2100 units and the gross margin on each unit is $7 = $22 - $15.

**Practice Problem on Buy-Back Contract**

Consider a simple example with a supplier and a retailer. The unit production cost is $35, and the supplier’s wholesale price to the retailer is $80. The retailer selling price is $125, while salvage price is $20. The retailer faces demand distributed as normal with mean 200 and standard deviation 100

Q4. Without buy-back contract, what is the retailer’s optimal order quantity? What is the retailer’s expected profit under this order quantity?

G = 125 – 80 = 45

L = 80 – 20 = 60

Critical ratio = G/(G+L) = 45/105 = 0.4286

Z = -0.18

Q = 200 – 100\*0.18 = 200 – 18 = 182

Expected leftover inventory = 100\*0.3154 = 32

Expected profit = 45 \* (182-32) – 60 \*32 = 4830

Q5. Suppose the supplier offers to buy unsold units from the retailer at the price of $65. But the retailer also needs to pay for $10 shipping cost per unit. What is the retailer’s optimal order quantity? What is the retailer’s expected profit under this order quantity?

G = 125 – 80 = 45

L = 80 – (65-10) = 25

Critical ratio = G/(G+L) = 45/70 = 0.6423

Z = 0.36

Q = 200 + 0.36\*100 = 236

Expected leftover inventory = 100 \* 0.6045 = 60

Expected profit = 45 \* (236 – 60) – 25 \*60 = 6420

Q6. Suppose the supplier offers to buy unsold units from the retailer at certain price. But the retailer also needs to pay for $10 shipping cost per unit. What is the best buy-back price to maximize the total profit of the supply chain?

10 + 125 – (125 – 80)\*((125 – 20)/(125 – 35)) = 82.5