Sheet 3 (Inventory Control Rules)

Exercise 1:

BrightEyes is a manufacturer of eyewear. The company's best-selling item is a black frame made of acetate. The manager responsible for inventory decisions at BrightEyes has installed an (s,Q) policy with a lead time of 3 months. If the product is out-of-stock, there is a shortage penalty of 500 € per occasion. Inventory holding costs are 2 € per unit per year. Experience from previous years has shown that annual demand is normally distributed with mean 1000 and standard deviation 200. The supplier charges a fixed cost of 300 € per order.

a) Using the successive approach, determine the order quantity Q and order point s as well as the resulting costs.

b) How are costs affected if the simultaneous approach is used instead (up to 5 iterations)?

Exercise 2

A café is open every day and observes independent, normally distributed demand for Arabica coffee beans per day. Weekly demand is 700 packs of Arabica coffee beans. The café places orders of 300 packs, holding costs are 2.5 €/week. Replenishment costs are 20 € per order. The following demands (in packs) have been recorded during the past 15 days:

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Demand	83	101	105	145	179	65	79	121	81	103	75	89	61	123	85

a) Estimate mean and standard deviation per day. Assuming that each unit short incurs a cost of 3 €, determine the reorder point for coffee with one-day lead time.

b) Determine the total costs per week that will be incurred using the reorder point calculated in a).

c) The manager of the café is very satisfied with the current service level. He has measured the α-service level over several weeks and it turns out to be 95%. Determine the corresponding fill-rate which will be achieved in this case.

Exercise 3

A manufacturer of kitchenware expects annual demand to be 5000 units for a product that costs 30 € per unit. The holding cost is estimated to be 9 € per unit per year and the order cost is 75 € per order. Stockouts are assumed to cost 2 € per unit. The lead time demand is as follows:

Demand d	100	150	200	250	300
P(D=d)	0.11	0.25	0.27	0.25	0.11

Consider the following six reorder points s={100, 150, 200, 250, 300, 350}.

a) Determine the expected overage cost and the expected underage cost within the lead time for each of the six-reorder points s.

b) Calculate the optimal order quantity Q for each reorder point.

c) Which reorder point of the six mentioned above is the best solution?

Exercise 4:

A supermarket has installed an (R, S) inventory control rule. The manager places orders for chocolate-chip cookies every Monday morning before the store opens. It then takes three weeks until the order arrives. The supermarket faces normally distributed demand with a mean of 250 and a standard deviation of 30 units per week.

a) The supermarket aims to achieve an (adjusted) fill-rate of 98%. Determine the required base-stock level to fulfil this objective.

b) Which α-service level will the supermarket achieve using the base-stock level obtained in a)?

c) An employee observes that the delivery time of the cookies varies, e.g., due to delays in transportation or in the production process of the supplier. Determine the safety stock required if lead time is also normally distributed with mean 3 weeks and variance 1.44 weeks for an α-service level of 90%.

Exercise 5:

Krusty aims to improve his inventory system and revisits his assumptions made in exercise sheet 1. He decides to install a periodic-review, order-up-to level control system for one of his specialties, the Royal Spicy Burger. He now places weekly orders which take another week to arrive at the burger restaurant (R=1, L=1). The demand is gamma distributed with mean 1500 and standard deviation 750.

What is Krusty's order-up-to level given an in-stock probability of 95%?