Sheet 1 (EOQ and Newsvendor Model)

Exercise 1:

A supermarket faces weekly demand for apples of 600 kg. The setup cost for placing an order to replenish inventory is 26 €. The order is delivered by a supplier who charges the supermarket 0.20 € per kg for the cost of transportation. This transportation cost increases the cost of apples to 1.35 € per kg. The apples lose their freshness while stored at the supermarket. To account for this, the supermarket charges an annual holding cost of 2.2 € per kg.

a) Determine how often an order should be placed by the supermarket and the optimal order quantity.

b) How are costs affected if an order quantity of 500 kg is placed instead?

c) The supermarket wants to have an optimal reorder interval based on the power-of-two policy. What is the optimal solution based on the new policy?

Exercise 2

A mining company routinely replaces a specific part on a certain type of equipment. The usage rate is forty per week, and there is no significant seasonality. The supplier of the part offers the following all-units discount structure.

Range of Q	Purchasing Cost
0<Q<300	10Q
300≤Q	9.7Q

The fixed cost of a replenishment is estimated to be 25 €, and a carrying charge of 0.26 €/€/yr is used by the company.

a) What replenishment size should be used?

b) Now, determine replenishment size by assuming that the supplier of the part offers the following incremental discount structure.

Range of Q	Purchasing Cost
0<Q<300	10Q
300≤Q	10*300 + 9.7(Q-300)

Exercise 3

A company manufactures sunshades in fashionable colours. Since sunshades are usually sold in summer, retailers have to submit their order decision by mid-May in order to have the goods delivered in June. Sales from previous years have been recorded by the Point-of-sale scanner system so that you know that demand is normally distributed with mean 2000 and standard deviation of 250. The sunshades are produced for 3 € and sold at a price of 6 € to the customer. Any sunshades that cannot be sold until August 31st will be shipped to Australia for the Australian summer season. The sunshades are sold at 3 € in Australia in order to make sure that all leftover inventories can be sold. However, shipping costs incur for the goods being transported to the Australian market which are 0.50 € per piece. It can be assumed that all sunshades shipped to Australia will also be sold.

a) Which order quantity maximizes the company's expected profit?

b) Determine the expected number of sunshades that will be shipped to Australia given your optimal order quantity in a). What is the expected profit?

Exercise 4

Krusty owns a burger restaurant. His burgers are made of a secret ingredient. Krusty is very busy with his store, so he decided to place only a single order for May. The demand is uniformly distributed on the interval [4000; 8000].

a) What is Krusty's optimal order quantity given a critical fractile of 0.75?

b) How does the result in a) change if demand is Poisson with λ=6000?

c) Now assume demand is Gamma-distributed with mean 6000 and a standard deviation being equal to the one of the uniform distributions used in a). What is the optimal order quantity?

Exercise 5

Anton is the cook of a Viennese restaurant that is famous for its delicious cakes. Every Monday morning, Anton prepares the chocolate icing and the cakes according to a special recipe. The cakes need to cool down before the chocolate icing can be applied. Anton estimates that the ingredients cost 20 € for 1 kg of chocolate cake. A cake of 1 kg can be split up into 12 pieces. Each piece of cake is sold for 3 €. Any cakes leftover at the end of the week have to be discarded at no cost. Since Anton is too busy during the week to prepare new cakes, he wants to make a careful decision on Monday to ensure that his guests are satisfied. From

previous weeks, he knows that demand for cakes is normally distributed with mean 20 and standard deviation 8.

a) If Anton is told by his boss to satisfy at least 95 % of all incoming demand, how many cakes should he prepare?

b) How many cakes should he prepare if he has to ensure that cakes are available at least on 95 % of all days?

c) Since Anton is also responsible for the recipe, he receives a bonus for every week when more than 25 cakes are sold. His boss considers this an indicator that customers like his cakes more than those of the competitors'. What is the probability that he receives a bonus with his recipe given the above demand estimates? If the bonus is 100 € and the restaurant is open 48 weeks per year, how much money will Anton probably make on his bonus in a year?

Exercise 6

The famous furniture producer IDEA introduces a new couch named "SITSGUD". The new couch is produced in a large factory together with hundreds of other products. Every time IDEA has to set up production of the new couch, many machines have to be cleaned and maintained causing costs of €10.000. As the couches are stored in efficiently packed packages that do not take up much of the available inventory space, IDEA estimates holding costs of 20% of a couch's value per unit and period. The value of one couch is listed as €120. The demand forecast for SITSGUD for the next 10 months is given in the table below.

Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
550	200	400	110	430	980	400	300	200	650

a) Solve the problem using the least unit cost heuristic.

b) Solve the problem using the Silver-Meal heuristic.

c) Solve the problem using the Wagner-Whitin model for the first 6 periods (Jun-Nov).

Exercise 7

A producer of customer gifts sells large amounts of USB sticks. It has to deal with irregular and large orders. Setting up the production of USB sticks causes costs of €180. Storing the USB sticks per 1000 units and one period causes 10% costs of the value of 1000 USB sticks, which is €35. The available machines can produce at most 25.000 USB sticks per week. The demand forecast for the next 7 weeks is given in the table below. Quantities are given in thousands of USB sticks.

week	1	2	3	4	5	6	7
Demand	12	12	1	8	15	2	7

a) Model the above problem to minimize the total costs.
(Solving the problem is not needed)