Question 1

Consider the example we were discussing in the class today. Consider the (r, Q) policy with $Q = 120$ and $r = \lambda l = 10 \times 2 = 20$. The daily demand can take values 9,10,11 with $\lambda = 10$ as the mean. Assume customer orders to be of unit size. Is it possible that there is unplanned shortage, which cannot happen in the deterministic case? Answer the same question if we follow the (T, S) policy with $T =$ 12 days and $S = \lambda(T + l) = 140$.

Now, consider the daily demand takes values 5,6, ... ,15 with $\lambda = 10$ as the mean. How does the possibility of unplanned shortage change in both the policies due to this increased demand variability? Which policy would you prefer if we are concerned with shortages?

Question 2

Consider the (r, Q) policy optimization that we were carrying out in the class. Implement an iterative search for finding the optimal Q and s for fulfilling a fill rate requirement of 90%. You would need to find $\Psi^{-1}(l)$ for some $l > 0$. Create a database of $\Psi(z)$ for many z using the formula $\Psi(z) = \phi(z) - z\{1 - \Phi(z)\}$. Then you can find $\Psi^{-1}(l)$ by searching in the data base.

Question 3

Consider the data used in the previous homework, i.e., $K = 1500$ per order, h = 4 per unit per week, $\lambda = 30$ unit per week with the weekly demand following $N(30,8^2)$ distribution. Consider a constant lead time $l = 3$ weeks. Then the lead time demand $D_l \sim N(90,13.86^2)$. Obtain the optimal r and Q so that service level is at least 90%.

Now, consider lead time to be stochastic: L takes values 2,3,4 with equal probabilities. Note that $E[L] = 3$ weeks, same as the previous constant lead time. What can you say about the lead time demand D_L? What is the service level if we operate with the previously obtained values of r and Q? Obtain new values of r and Q so that service level is at least 90%.

Question 4

Consider the data used in the previous homework with the constant lead time $l = 3$ weeks. A (T, S) policy is followed with T same as that of the equivalent EOQ model. Determine the optimal value of S when (i) a penalty of 1000 rupee is applicable whenever there is a stock- out (irrespective of the quantity and duration of the stock-out), (ii) a penalty of 50 rupee is applicable for each unit short, (iii) a penalty of 10 rupee per week is applicable for each unit short, (iv) there is a service level requirement of 90%, and (v) there is a fill rate requirement of 99%. What do you think will happen if T is increased, S is increased accordingly, i.e., by $\lambda \times$ (increase in T), but the safety stock is not changed?

Question 5

Billy's Bakery bakes fresh bagels each morning. The daily demand for bagels is a random variable with a distribution estimated from prior experience given by

Number of bagels	0	5	10	15	20	25	30	35
Sold in one day probability	0.05	0.10	0.10	0.20	0.25	0.15	0.10	0.05

The bagels cost Billy's 8 cents to make, and they are sold for 35 cents each. Bagels unsold at the end of the day are purchased by a nearby charity soup kitchen for 3 cents each.

1. a) How many bagels should Billy's bake at the start of each day?
2. b) Find the optimal number of bagels to bake each day using a normal approximation.