**Topics: Normal distribution, Functions of Random Variables**

1. The time required for servicing transmissions is normally distributed with *μ* = 45 minutes and *σ* = 8 minutes. The service manager plans to have work begin on the transmission of a customer’s car 10 minutes after the car is dropped off and the customer is told that the car will be ready within 1 hour from drop-off. What is the probability that the service manager cannot meet his commitment?
2. 0.3875
3. 0.2676
4. 0.5
5. 0.6987

**Ans:**

**B. is the correct answer.**

The probability that the service manager cannot meet the commitment, i.e., taking more than 1 hour, is about 26.59%. This calculation is based on a normal distribution with a mean of 55 minutes (due to work starting 10 minutes after drop-off) and a standard deviation of 8 minutes.

1. The current age (in years) of 400 clerical employees at an insurance claims processing center is normally distributed with mean *μ* = 38 and Standard deviation *σ* =6. For each statement below, please specify True/False. If false, briefly explain why.
2. More employees at the processing center are older than 44 than between 38 and 44.

**Ans:**

**False.** Because the probability for employees at the processing center are more between 38 and 44 than older than 44. mean = 38 std1 = 6 q2\_lessthan\_38 = stats.norm.cdf(38, loc = mean, scale = std1) q2\_lessthan\_38 = 0.5 q2\_less\_than\_44 = stats.norm.cdf(44, loc = mean, scale = std1) q2\_less\_than\_44 = 0.841 q2\_betweeen\_38\_and\_44 = q2\_less\_than\_44 - q2\_lessthan\_38 print('The probability of employee age between 38 and 44 is',np.round(q2\_betweeen\_38\_and\_44100,2),'%') The probability of employee age between 38 and 44 is 34.13 % q2\_morethan\_44 = 1-stats.norm.cdf(44, loc = mean, scale = std1) print('The probability of employee age more than 44 is',np.round(q2\_morethan\_44100,2),'%') The probability of employee age more than 44 is 15.87 % true\_or\_false = (q2\_morethan\_44 > q2\_betweeen\_38\_and\_44) print('Answer:',true\_or\_false)

1. A training program for employees under the age of 30 at the center would be expected to attract about 36 employees.

**Ans:**

**True**. q2b = stats.norm.cdf(30, loc = mean, scale = std1)100 print('A training program for employees under the age of 30 at the center would be expected to attract about',np.round((q2b400)/100,0),'employees')

A training program for employees under the age of 30 at the center would be expected to attract about 36.0 employees

1. If X1 ~ N(μ, σ2) and X2 ~ N(μ, σ2) are iid normal random variables, then what is the difference between 2 X1 and X1 + X2? Discuss both their distributions and parameters.

**Ans:**

The Normal Distribution has its link with the Central Limit Theorem, which states that ‘Any large sum of independent identically distribution random variables are approximately Normal then (X1 + X2) and (2X1) tends to have Normal distribution only If X1 and X2 are i.i.d and n is Large.The Normal distribution has two parameters, the mean, µ, and the variance, σ2. µ and σ2satisfy −∞ < µ < ∞, σ2> 0. We write X ∼ Normal (µ, σ2) or X ∼ N(µ, σ2 ).

1. Let X ~ N(100, 202). Find two values, *a* and *b*, symmetric about the mean, such that the probability of the random variable taking a value between them is 0.99.
2. 90.5, 105.9
3. 80.2, 119.8
4. 22, 78
5. 48.5, 151.5
6. 90.1, 109.9

**Ans:**

**D. 48.5, 1515**

print("""The two values of a and b, symmetric about the mean, are such that the probability of the random variable taking a value between them is 0.99:""",np.round(stats.norm.interval(0.99, loc = 100, scale = 20),1)) The two values of a and b, symmetric about the mean, are such that the probability of the random variable taking a value between them is 0.99: [ 48.5 151.5]

1. Consider a company that has two different divisions. The annual profits from the two divisions are independent and have distributions Profit1 ~ N(5, 32) and Profit2 ~ N(7, 42) respectively. Both the profits are in $ Million. Answer the following questions about the total profit of the company in Rupees. Assume that $1 = Rs. 45
2. Specify a Rupee range (centered on the mean) such that it contains 95% probability for the annual profit of the company.

**Ans:**

Specify a Rupee range (centered on the mean) such that it contains 95% probability for the annual profit of the company.

1. Specify the 5th percentile of profit (in Rupees) for the company

**Ans:**

The 5TH Percentile of profit for the company is 17 Crore Rupees

1. Which of the two divisions has a larger probability of making a loss in a given year?

**Ans:**

The Division #2 (Profit2 ~ N(7, 42) ) has a larger probability of making a loss in a given year