**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: Option B***

*Mean =45 mins, st deviation = 8 mins , x= 50 mins (60-10)*

*P value is = 0.26598552904870054*

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. – ***FALSE***

*probability employees are older than 44 ( measuring left hand side of the graph)= 0.15865525393145707*

*probability employees are between 38 and 44= 0.3413447460685429*

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

*probability that training employees are under 30= 0.09121121972586788*

*9.1 percent of employees are 36.4 ~ 36*

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

if x (X ~ N(μ, σ^2)and Y (Y ~ N(μ, σ^2) are two independent identically distributed random variables then

*the sum of normal random variables is given by*

*X+Y = N(μ+μ , σ^2+σ^2) = N(2μ, 2σ^2)*

*X-Y = N(μ-μ , σ^2+σ^2) = N(2μ, 2σ^2)*

*2X = N(2μ, 4σ^2)*

*Applying the above*

*2X1-(X1+X2) = N(2μ, 4σ^2)-N(2μ, 2σ^2)*

*= N(2μ-2μ ,4σ^2+2σ^2)*

***= N(0, 6σ^2)***

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.*

# *Since we need to find out the values of a and b, which are symmetric about the mean, such that the probability of random variable taking a value between them is 0.99, we have to work out in reverse order.*

*The Probability of getting value between a and b should be 0.99.*

*So the Probability of going wrong, or the Probability outside the a and b area is 0.01 (ie. 1-0.99).*

*The Probability towards left from a = -0.005 (ie. 0.01/2).*

*The Probability towards right from b = +0.005 (ie. 0.01/2).*

*So since we have the probabilities of a and b, we need to calculate X, the random variable at a and b which has got these probabilities.*

*By finding the Standard Normal Variable Z (Z Value), we can calculate the X values.*

*Z=(X- μ) / σ*

*For Probability 0.005 the Z Value is -2.57 (from Z Table).*

*Z \* σ + μ = X*

*Z(-0.005)\*20+100 = -(-2.57)\*20+100 = 151.4*

*Z(+0.005)\*20+100 = (-2.57)\*20+100 = 48.6*

***Option D is correct***

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.

*The mean profit from two divisions is 540 million rupees. Standard deviation of mean profit is 225 million rupees*

*Rupee range is 99 million to 981 million.*

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

# *Fifth percentile of profit in million rupees: 168.75*

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

# *There is a probability that division 1 will make a loss than division 2.*