**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:-**

**The work begins after 10 min, so the average time increases from 45 min to 55min.**

**#Find Z-Scores at X=50; Z = (X - µ) / σ**

**Z=(50-45)/8**

**Z = 0.625**

**As we want to find the probability that the service manager cannot meet his commitment.**

**1-stats.norm.cdf(abs(0.625))**

**Answer is -> B. 0.2676**

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:-**

**The probability of employee age between 38 and 44 is 34.13 %**

**The Probability of employee age older than 44 is 15.87 %**

**More employees at the processing center are older than 44 than between 38 and 44 is : 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**

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.

**ANS:-**

**The Normal Distribution has its link with the Central Limit Theorem, which states that ‘Any large sum of independent identically distributed 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.**

**Two different sample subsets (X1 and X2) from the same source (population) are different in magnitude from 2X1. X1 and X2 can be a different subset of a sample from a similar source (population) but If X1 ~ N(μ, σ2) then, 2 X1 ~ N(2 μ, 4 σ2 ) If X1 ~ N(μ, σ2) and X2 ~ N(μ, σ2) are iid normal random variables then (X1 + X2)N(μ+ μ, σ2+ σ2)(2 μ, 2 σ2) Hence, 2X1 – (X1+X2) ~(2 μ – 2 μ, 4 σ2 + 2σ2 ) The distribution remains the same for every sample subset of similar source, it tends to fall under Normal distribution and slight deviations in parameters. 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:- The 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 : [ 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:-**

**Rupee range from 2.2 and 21.8 Million dollar in Annual profit of the Company 95% of the time**

**Rupee Range from 9.9 to 98.1 Crore Rupees in Annual profit of the company 95% of the time**

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

**ANS:-**

**Step 1: Calculate the z-score corresponding to the 5th percentile.**

**The z-score is calculated as: z = invNorm(0.05)**

**The z-score corresponding to the cumulative probability of 0.05 (5th percentile): z ≈ -1.64485**

**Step 2: Calculate the value at the 5th percentile using the z-score.**

**The value at the 5th percentile is given by: Value = μ\_total + z \* σ\_total**

**Substituting the values:**

**Value = 12 + (-1.64485) \* 52.79**

**Value ≈ 3.777 million dollars**

**Step 3: Convert the value to rupees using the conversion rate.**

**Value in Rupees = 3.777 million dollars \* 45 Rs./$**

**Value in Rupees ≈ 169.965 million rupees ≈ 170 million rupees (rounded)**

**Therefore, the 5th percentile of profit for the company is approximately 170 million rupees.**

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

**ANS:-**

**The probability of Division 1 Making Loss is 4.78 %**

**The probability of Division 2 Making Loss is 4.01 %**

**The Division 2 has larger probability of making loss**