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

**Assignment 2**

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 serving work will begin after 10 min of drop off so 45+10 which will now take more than the usual time so new mew is 55 minutes and the probability that it will take more than 1 hour to complete. Now mew = 55 std = 8 q1 = 1- stats.norm.cdf(60, loc = mew, scale = std) q1 = 0.2659 The probability that the service manager cannot meet his commitment is 0.2659 which is approximately equal to option 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:- 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) Answer: False**

**False. Because the probability for employees at the processing center are more between 38 and 44 than older than 44.**

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

**Ans:-** **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 *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:- As we know that if X ∼ N(µ1, σ1^2 ), and Y ∼ N(µ2, σ2^2 ) are two independent random variables then X + Y ∼ N(µ1 + µ2, σ1^2 + σ2^2 ) , and X − Y ∼ N(µ1 − µ2, σ1^2 + σ2^2 ) .**

**Similarly if Z = aX + bY , where X and Y are as defined above, i.e Z is linear combination of X and Y , then Z ∼ N(aµ1 + bµ2, a^2σ1^2 + b^2σ2^2 ).**

**Therefore in the question**

**2X1~ N(2 u,4 σ^2) and**

**X1+X2 ~ N(µ + µ, σ^2 + σ^2 ) ~ N(2 u, 2σ^2 )**

**2X1-(X1+X2) = N( 4µ,6 σ^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:-** **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]**

**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.

**Ans:- : Rupee ranges in between [9.9 to 98.1] Crore Rupees, 95% of the time 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 169.90 Million 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**