**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 :- mew = 55

Std = 8

Q1 = stats.norm.sf(60,loc = meu, scale = std)

Print(“””the probability that the service manager cannot meet his commitment is “””,np.round(q1,5))

-------🡪 B option i.e 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:- TRUE

**mean = 38**

**std1 = 6**

**q2\_lessthan\_38 = stats.norm.cdf(38, loc = mean, scale = std1)**

**q2\_less\_than\_44 = stats.norm.cdf(44, loc = mean, scale = std1)**

**q2\_betweeen\_38\_and\_44 = (q2\_less\_than\_44 - q2\_lessthan\_38)**

**print('The probability of employee age betweeen 38 and 44 is',np.round(q2\_betweeen\_38\_and\_44\*100,2),'%')**

**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\_44\*100,2),'%')**

**true\_or\_false = (q2\_morethan\_44 > q2\_betweeen\_38\_and\_44)**

**print('Answer:',true\_or\_false)**

**q2b = stats.norm.cdf(30, loc = mean, scale = std1)**

**print("""A training program for employees under the age of 30 at the center would be expected to attract about"""**

**,np.round((q2b\*400),0),'employees')**

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

**The probability of employee age more than 44 is 15.87 %**

**Answer: False**

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

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:- → As we know that if X ~ N(μ, σ2) and Y ~ N(μ2, σ2) ² are two independent random variables than X + Y ~ N(μ1 + μ2, σ12+ σ2²) and X - Y ~ N(μ1 - μ2, σ12+ σ2²)

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 a² σ1² + b² σ2² )

therefore in the question

2X1~ N(2µ,4 σ2) and

X1 +X2 ~ N(µ + µ, σ2+ σ2) ~ N(2µ , 2σ2)

2X1 – (X1 +X2) = N(4µ ,6 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:-

**# Given**

**mew = 100**

**std = 20**

***# p(a<x<b)***

***#To 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"""**

***# Solution***

**""" From the above details,we have to exclude .005% area from each**

**left and right tails. Hence, we want to find the .005th and the**

**.995th percentiles Z score values"""**

***# Z value for .005 percentiles***

**z\_005\_ = np.round(stats.norm.ppf(0.005),4)**

**z\_005\_**

***# Z value for .99 percentiles***

**z\_99\_ = np.round(stats.norm.ppf(0.995),4)**

**z\_99\_**

***#z = (x\_bar - mew) / std***

***#x\_bar = (z\*std) + mew***

**a = np.round((z\_005\_\*std) + mew,1)**

**b = np.round((z\_99\_\*std) + mew,1)**

**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:""",a,b)**

**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**

**D option i.e 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:- Mean Profit id Rs 540 Million.

Std Deviation is Rs 225 Million.

Range is Rs 99.008,980.991.

State norm interval(0.95,540,225).

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

Ans :- formula X= X=μ + Zσ; wherein from z table, 5 percentle = -1.645

X = 540(-1.645)\*225

X = 169.875C.

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

Ans:- 1) Probability od division 1 making loss (X<0)

State. norm. cdf (0,5,3)

0.0477

2) Probability od division 2 making loss (X<0)

State. Norm. cdf (0,7,4)

0.0400