In [3]:

**import** pandas **as** pd

**import** numpy **as** np

**import** matplotlib.pyplot **as** plt

**import** scipy.stats **as** stats

**import** seaborn **as** sns

**import** statsmodels.api **as** smf

**import** warnings

warnings**.**filterwarnings('ignore')

In [ ]:

In [ ]:

"""the serving work will began 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 porbbaility that it will take more than 1 hour to complete""" mew **=** 55

std **=** 8

q1 **=** stats**.**norm**.**sf(60, loc **=** mew, scale **=** std)

print("""The probability that the service manager cannot meet his commitment is""",np**.**round(q1,5))

# **SET 2**

**Question 1**

# **Question 2**

In [8]:

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

# **QUESTION 3**

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 Difference between 2X1 and (X1 + X2) is the magnitude they hold of two different sample subsets (X1 and X2) from the same source(population). 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 ).

## **Question 4**

**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.**

A.90.5, 105.9

B.80.2, 119.8

C.22, 78

D.48.5, 151.5

E.90.1, 109.9

In [13]:

*# 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

## **Question 5**

### 5.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 USD Million. Answer the following questions about the total profit of the company in Rupees. Assume that 1USD = Rs. 45

In [15]:

*# Combine Mean Profit of both division for Company= mean1 + mean2*

mean1 **=** 5

mean2 **=** 7

Mean **=** (mean1**+**mean2) *# 1 USD = 45 rupees*

print('The Mean Profit of both division:',Mean, 'Million$')

print('The Mean Profit of both division:',(Mean**\***45)**/**10, 'Crore Rupees')

*# Combine standard Deviation = (Std1^2 + Std2^2)^1/2*

std1 **=** 3**\*\***2 std2 **=** 4**\*\***2

Std **=** np**.**sqrt(std1 **+** std2)

print('The Standard Deviation of both division:', Std, 'Million$')

print('The Standard Deviation of both division:', (Std**\***45)**/**10, 'Crore Rupees')

The Mean Profit of both division: 12 Million$

The Mean Profit of both division: 54.0 Crore Rupees

The Standard Deviation of both division: 5.0 Million$

The Standard Deviation of both division: 22.5 Crore Rupees

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

In [16]:

r1, r2 **=** np**.**round(stats**.**norm**.**interval(0.95, Mean, Std),2)

print('Rupee Ranges from',r1,'to',r2,'Million$ in Annual profit of the Company 95% of the time')

print('Rupee Ranges from',np**.**divide(np**.**multiply(r1,45),10),'to',np**.**divide(np**.**multiply(r2,45),10),'Crore Rupees in Annual profit

Rupee Ranges from 2.2 to 21.8 Million$ in Annual profit of the Company 95% of the time

Rupee Ranges from 9.900000000000002 to 98.1 Crore Rupees in Annual profit of the Company 95% of the time

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

In [18]:

*# Z value = X\_bar - Mew / Std pop*

*# for percentile, X\_percentile = (Zvalue \* Std pop) + Mew*

Z\_05\_ **=** stats**.**norm**.**ppf(0.05)

Fifth\_percentile **=** (Z\_05\_ **\*** Std) **+** Mean

print('The 5th percentile of Profit for the company is',np**.**round(Fifth\_percentile,2),'Million$')

print('The 5th percentile of Profit for the company is',np**.**round((Fifth\_percentile**\***45)**/**10,),'Crore Rupees')

The 5th percentile of Profit for the company is 3.78 Million$

The 5th percentile of Profit for the company is 17.0 Crore Rupees

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

In [19]:

*# The probability of Division #1 making a loss*

print('The Probability of Division #1 making a loss is',np**.**round((stats**.**norm**.**cdf(0,5,3))**\***100,2),'%')

*# The probability of Division #2 making a loss*

print('The Probability of Division #2 making a loss is',np**.**round((stats**.**norm**.**cdf(0,7,4))**\***100,2),'%')

Division\_1 **=** (stats**.**norm**.**cdf(0,5,3))**\***100 Division\_2 **=** (stats**.**norm**.**cdf(0,7,4))**\***100

**if** Division\_1**>**Division\_2:

print('The Division 1 has a larger Probability of making a loss')

**else**:

print('The Division 2 has a larger Porbability of making a loss')

The Probability of Division #1 making a loss is 4.78 % The Probability of Division #2 making a loss is 4.01 %

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| --- | --- | --- | --- |
|  | | | The Division 1 has a larger Probability of making a loss |
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