**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: 0.2676

Probability= 1-P(X<=50)

from scipy import stats

prob=stats.norm.cdf(50,45,8)

print(round((1-prob),3))

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 : False

P(38<=X<=44)=P(X<=44)-0.5= 0.34 so 34 % employees having age between 38 to 44.

Hence remaining 12% employee will have age greater than 44.

Hence given statement is wrong.

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

ANS: True

from scipy import stats

prob=stats.norm.cdf(30,38,6)

print(round((prob\*400),3))

36.484

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.

2X1 ~ N(2μ, 4σ2)

*X*1 + *X*2 ~ N(2μ, 2σ2)

In first case , mean will be multiplied by 2 and std deviation will increase 4 times.

And in second case mean and standard deviation will increase by 2 times.

and 2X1-(X1+X2)=N(0,2 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: as probability is 0.99, so points should be approx. mean+-3\*std

Which is 100-(3\*20) to 100+(3\*20) = 40 to 160

So correct option is D.48.5, 151.5

from scipy import stats

prob1=stats.norm.cdf(151.5,100,20)

prob2=stats.norm.cdf(48.5,100,20)

print(round((prob1-prob2),3))

0.99

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: Range for 95% data: mean -2\*std to mean +2\*std

For division1 range= 5-6 to 5+6 = (-1 to 11)million $= (-45 to 495) million rupees

For division2 range= 7-8 to 7+8 = (-1 to 15)million $= (-45 to 675) million rupees

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

ANS:5th percentile = 0.05 probability and z value for 0.05 is -1.604 (from z score table) now, x=μ+zσ = 5-1.604\*3=3.188 million $ = 143.45 million Rs

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

loss=Profit less than 0

loss1=stats.norm.cdf(0,5,3)

loss2=stats.norm.cdf(0,7,4)

print(round(loss1,4),round(loss2,4))

0.0478 0.0401

Chances of loss for division 1 are more than division 2.