**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: *μ* = 45 minutes,

*σ* = 8 minutes

let x be the amount of time it takes to complete the repair on a customer’s car. To finish in one hour we require X<=50, so th question is to find p(X>50).

P(x>50)=1-p(x X<=50)

Z=(X-45)/8.0

Normal table can give the answer 73.4%

Probability that the service manager will not meet his demand will be

100-73.4%=26.6%

Means 0.26

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: μ = 38

σ = 6

N = 400

# using stats.norm.cdf(x, loc = mean, scale= std )

1. A training program for employees under the age of 30 at the center would be expected to attract about 36 employees.
2. 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: X1∼N(μ,σ^2) ,   X2∼N(μ,σ^2)   then X1+X2∼N(μ,σ^2)

2X1 = 2N(μ,σ^2)

The distribution function for both will result the same

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 x=0.99 ,

loc=100,

scale=20

# using stats.norm.interval(0.99,loc,scale)

stats.norm.interval(0.99, loc=100, scale=20)

So, 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: # Mean profits from two different divisions of a company = Mean1 + Mean2

= 5+7

= 12

Given: 1 dollar = Rs. 45

Mean\_in\_dollar = Mean\*45

=12\*45

=540

Variance of profits= SD1^2 + SD2^2

SD= np.sqrt((9)+(16))

SD = 5

SD\_in\_dollar= SD\*45 =5\*45

=225

stats.norm.interval(0.95,540,225)

Range is Rs (99.00810347848784, 980.9918965215122) in Millions

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

Ans: 5th percentile of profit (in Million Rupees) is 170.0

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

Ans: Probability of division 1 making a loss P(X<0)

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

Output: 0.0477903522728147

Probability of division 2 making a loss P(X<0)

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

Output: 0.040059156863817086

Probability of Division 1 making a loss in a given year is more than Division 2.