**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:** Time=60mins

Servicing begin after =10mins

Available time =60-10=50

P(s)= 1-stats.norm.cdf(50,45,8)= 0.26598552904870054

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:** X=44

            MEAN=38

            STANDARD DEVIATION=6

             Z score = (Value - Mean)/SD

            Z score for 44  = (44 - 38)/6  = 1  =>  84.13 %

            => People above 44 age = 100 - 84.13 =  15.87%  ≈  63    out of 400

             Z score for 38  = (38 - 38)/6 = 0 => 50%

            Hence People between 38 & 44  age = 84.13 - 50 = 34.13 % ≈  137 out of 400

            Hence More employees at the processing center are older than 44 than between 38 and 44. is F**ALSE**

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

**ANS:** Z score for 30  = (30 - 38)/6 =  -1.33  =  9.15  %   ≈ 36 out of 400

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

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:** stats.norm.cdf(0.99,100,20)

     A=48.48341

          B=151.5165

          Option:D

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=5+7=12

            Mean of two profits=12\*45=540millions

            Standard deviation=sqrt(9+16)=5

            Sum of two profits of sd=sqrt((5)2\*(45)2=225millions

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

                  P(a) for 95%=(99.00810,980.9918)

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

**ANS:** Stats.norm.ppf(0.05)=-1.64485

             X=540+(-1.64\*225)

                 = 170 million rupees

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

**ANS:** stats.norm.cdf(0,5,3)=0.047790

         stats.norm cdf(0,7,4)=0.040059

         Therefore the profit1 has the larger probability of making a loss in a given year than profit2.