**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 , σ = 8 , after addition of 10 min = µ+10=55**

**Z score = (x-µ/σ)  
 = (60-55/8)**

**= 0.625**

**By using 1-stats .norm.cdf(0.625) function we can find out the probability that the service manager cannot meet his commitment which is equal to 0.2659 aprrox. Equal to 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 = P(X>44) = employes older than 44**

**= 1-stats.norm.cdf(44,loc=38,scale=6)**

**= 0.15865525393145707\*100**

**= 15.58 %**

**P(38<x<44) = employes which are between 38 &44**

**= stats.norm.cdf(44,loc=38,scale=6)-stats.norm.cdf(38,loc=38,scale=6)**

**= 0.3413447460685429\*100**

**= 34.14 %**

**Hence this shows that more employees at thr processing centre are older than 44 than between 38 and 44 so this is FALSE statement**

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

**ANS = P(x<30) = employes under 30 yrs**

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

**Here, no. of employes attending training program from 400 employes is (400\*0.0912112197)= 36.484487890**

**Hence this statement is 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 both are independent normal random variables, X1 + X2 is normal with**

**N (µ1+µ2, σ12+σ22). And 2X1 will just scale the normal distribution by 2 times**

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:  p(a<x<b) = 0.99, mean =100, standardDeviation = 20**

**To Find:**

**Identify symmetric values for the standard normal distribution such that the area enclosed is .99**

**From the above details, we have to excluded area of .005 in each of the left and right tails. Hence, we want to find the 0.5th and the 99.5th percentiles Z score values**

**Using Python**

**Z value is given as stats.norm.ppf(pvalue)**

**Z value at 0.5th percentile is given as**

**Z (0.5) = stats.norm.ppf (0.005) = -2.576**

**Z value at 99.5 percentile is given as**

**Z (99.5) = stats.norm.ppf (0.995) = 2.576**

**Z = (x - 100)/20 = > x = 20z+100**

**a = -(20\*2.576) + 100= 48.5**

**b = (20\*2.576) +100= 151.5**

**Two values symmetric about mean for the given standard normal distribution are [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 = Specify a Rupee range (centered on the mean) such that it contains 95%**

**probability for the annual profit of the company.**

**Stats. Norm.ppf (0.025,45\*5,3)**

**219.12**

**Stats. Norm.ppf (0.975,45\*5,3)**

**230.87**

**Stats. Norm.ppf (0.025,45\*7,4)**

**307.16**

**Stats. Norm.ppf (0.975,45\*7,4)**

**322.83**

**So, the Rupee range with 95% probability for the annual profit of the company is given**

**by,**

**=Profit1 + Profit2**

**= [219.12, 230.87] + [307.16, 322.83]**

**= [526.28, 553.87]**

**So, Profit of the company in Rupees (in Million) is between range [526.28, 553.87]**

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

**ANS = To compute 5th Percentile, we use the formula X=μ + Zσ; wherein from z table, 5 percentile = -1.645**

**X= 540+(-1.645)\*(225)**

**X = 170**

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

**ANS = Hence, divisions 1 has a larger probability of making a loss in a given year.**