**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

**Solution: *μ* = 45 is usual time but service manager take after 10 minutes of drop off so new**

***μ* = 45+10 =55 *σ* = 8 minutes**

**Probability to finish the work within 1 hour=stats.norm.cdf(60,55,8)**

**Probability to not finish the work within commitment=1-stats.norm.cdf(60,55,8)**

**=0.2659 so Answer is “ B”**

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. **Answer False.**

**Solution: P(age>44) = 1-p(age<44) =1-stats.norm(44,38,6)**

**= 0.1586 = 15%**

**P(Age between 38 &44) =p(age<44)-p(age<38)**

**Stats.norm.cdf(44,38,6)-stats.norm.cdf(38,38,6)**

**=0.3413 = 34.13 %**

**Answer is False, because the people in the processing center with age older than 44 is only 15% as less when compare with age between 38 and 44 as 34% so above statement is false.**

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

**P(age<30) = stats.norm.cdf(30,38,6) = 0.091=9 %**

**=0.09\*400 =36**

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.

**X1 & X2 are two independent random variables then X1 + X2 ∼ N(µ1 + µ2, σ1^2 + σ2^2 ).**

**Therefore, in the question**

**2X1~ N(2 u,4 σ^2) and**

**X1+X2 ~ N(µ + µ, σ^2 + σ^2 ) ~ N(2 u, 2σ^2 )**

**In summary, both 2X1 and X1 + X2 are normal random variables. However, they have different means and variances. The mean of 2X1 is 2μ and the variance is 4σ^2, while the mean of X1 + X2 is 2μ and the variance is 2σ^2.**

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

**Answer is D**

**P(random variable taking value b/w)= stats.norm.interval(0.99,100,20)**

**=48.48 , 151.52**

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.

**Solution: Mean from two divisions is =5+7=12\*45=540 millions**

**Standard Deviation = sqr.root (9+16 )=5\*45 =225 millions**

**Rupee range = stats.norm.interval(0.95,540,225)**

**=( 99, 980.99)**

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

**5th percentile of profit = x= mean + z-score for 5th percentile\*(Standard Deviation)**

**X=540+(-1.645\*225) # z-score from table**

**= Rs 170 millions**

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

**Probability of division 1 making loss is p(x<0) = 0.047= 4.7%**

**Stats.norm.cdf(0,5,3)**

**Probability of division 2 making loss is p(x<0) = 0.04 = 4%**

**Stats.norm.cdf(0,7,4)**