**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

**from scipy import stats**

**from scipy.stats import norm**

**stats.norm.cdf(60,55,8)**

**0.7340144709512995**

**1-stats.norm.cdf(60,55,8)**

**0.26598552904870054**

**So probability that the service manager cannot meet his commitment is 26%**

**Ans- 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. **Ans- false**

**#employees older than 44 are**

**1-stats.norm.cdf(44,38,6)= 0.15865525393145707**

**That is 15%**

**#employees between 38 to 44is**

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

**0.3413447460685429**

**That is 34 % which is greater than 15% hence FALSE**

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

**#employees under age 30**

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

**0.0912**

**Total employees are 400 hence 400\* 0.0912= 0.364**

**We can consider it as 36 employees**

**Hence 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.

**2 X1 is simply a larger scale version of the random variable *X1.* If  X1 is normally distributed then 2X1 is also normally distributed.**

***X*1 and *X*2 are  normal distributed, the associated sums and random samples are exactly (and not just approximately) normal, with the appropriate 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

**stats.norm.interval(0.99,100,20)**

**Ans - 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.
3. Specify the 5th percentile of profit (in Rupees) for the company
4. Which of the two divisions has a larger probability of making a loss in a given year?

**import** **numpy** **as** **np**

**from** **scipy** **import** stats

**from** **scipy.stats** **import** norm

#mean values in rupees

mean = 5+7

print('mean profit is rupees ',mean \*45,'million')

mean profit is rupees 540 million

#SD values in rupees

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

print('mean profit is rupees ',SD\*45 ,'million')

mean profit is rupees 225.0 million

#A. Specify a Rupee range (centered on the mean) such that it contains 95% probability for the annual profit of the company.

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

(99.00810347848784, 980.9918965215122)

**Answer for A=(99.00810347848784, 980.9918965215122)**

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

#z-value for 5 percentile = -1.645

x= (-1.645)\*225+540

x

169.875

np.round(x)

170.0

**Answer for B = 170 million rupees**

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

# Probability of Division 1 making a loss P(X<0)

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

0.0477903522728147

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

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

0.040059156863817086

**Answer for C = division 1 has higher probability of making loss.**