**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:**

from scipy import stats

1-stats.norm.cdf(50,loc=45,scale=8)

0.26598552904870054

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

**ANS:**

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

0.15865525393145707

More employees at the processing center are older than 44 than between 38 and 44 is **False** as the percentage is only 15.86%.

1. 1-stats.norm.cdf(36,loc=38,scale=6)

0.6305586598182363

A training program for employees under the age of 30 at the center would be to expected attract about 36 employees is **True** as the percentage is high i.e. 63.05%.

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:**

X1+X2 are both independent normal random variable and 2X1 is just scale the normal distribution 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:**

stats.norm.ppf(0.995,loc=100,scale=20)

151.516586070978

stats.norm.ppf(0.005,loc=100,scale=20)

48.483413929021985

**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?

**ANS:**

1. Mean = 5+7

print('Mean Profit is', Mean\*45)

Mean Profit is 540

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

print('Standard Deviation is', SD\*45)

Standard Deviation is 225.0

μ±2σ = 540±2\*225

(540-450,540+450)

(90,990)

1. Fifth percentile is calculated as:

μ-1.5σ = 540-(1.5\*225)

` 202.5 million rupees

5th percentile of profit is Rs. 202.5 million rupees.

1. Probability of division 1 making loss is

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

0.0477903522728147

Probability of division 1 making loss is

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

0.040059156863817086