**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:** For Code Refer – Jupyter Notebook PDF Attached

*μ* = 45

*σ* = 8

n = 50 since, 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.

P = stats.norm.cdf(*μ, n, σ*)

P = 0.2659

So, the probability that the service manager cannot meet his commitment is **Option B i.e.,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.

**Solution:** For Code Refer – Jupyter Notebook PDF Attached

The statement is **False**, P(Age<44) < P(38<Age<44)

The Probability of having between 38 & 44-year aged people is **0.341**

which is great then the probability of have 44 years old i.e., **0.158**

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

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The statement is **True**, Since, the Probability that the employees would be under the age 30 is to attract about 36 employees

* 1. **=** approx. **9.12%, = 400/9.12 = 43 employees approx.**

3. 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.

**Solution:**

* 2X1 is simply a larger scale of the random variable X1, but as X1 follow normal distribution 2X1 will continue to follow normal distribution,
* X1 + X2 also follows normal distribution as the associated sums of random samples same as X1 & X2

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

**Solution:** For Code Refer – Jupyter Notebook PDF Attached

Using stats.norm.interval() in python

*a* = **48.48**

*b =* **151.51**

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:** For Code Refer – Jupyter Notebook PDF Attached

Using stats.norm.interval() in python

(-77.38865513011706, 1157.388655130117)

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

**Solution:**

Percentile Formula = (n+1) \* (p/100)

n = 540 – Mean of both division profit

p = 5th percentile

according to percentile formula,

= (540 +1) \* (5/100)

= **27.05** million rupees

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

**Solution:** For Code Refer – Jupyter Notebook PDF Attached

Probability of making a loss in a given year is larger for Division 1 with **P = 0.047**, the Division 2 with **P = 0.040**