**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. **B**

The service manager plans to begin work on the transmission of the car after 10 minutes the car is dropped. so Time remaining to complete the work = 60 minutes - 10 minutes = 50 minutes.

The time required for servicing transmissions is normally distributed. so by using the CDF function in python we can calculate the probability that the manager meets his commitment.

Notebook link = [Statistics\_Level\_2\_Set\_2.ipynb](https://colab.research.google.com/drive/10R59mPFBMgQblq3DIwhnFmUMOpy49BiA?usp=sharing)

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 ,** 68% of data lies between -1 to +1 standard normal distribution. Also here the mean is 38 which already states that majority or employees ages around 38 years and standard deviation is 6 years which tells the spread of data(i.e. Between 38 to 44 years)

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

Ans. **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. The Normal Distribution is linked with the Central Limit Theorem, which states that ‘Any large sum of iid random variables are approximately Normal’.

Then (X1 + X2) and (2X1) tends to have Normal distribution only If X1 and X2 are iid and n is Large.

The Difference between 2X1 and (X1 + X2) is the magnitude they hold of two different sample subsets (X1 and X2) from the same source(population). X1 and X2 can be a different subset of a sample from a similar source (population) but If X1 ~ N(μ, σ2) then, 2 X1 ~ N(2 μ, 4 σ2) If X1 ~ N(μ, σ2) and X2 ~ N(μ, σ2) are iid normal random variables then (X1 + X2)N(μ+ μ, σ2+ σ2)(2 μ, 2 σ2)

Hence, 2X1 – (X1+X2) ~(2 μ – 2 μ, 4 σ2 + 2σ2 ) The distribution remains the same for every sample subset of similar source, it tends to fall under Normal distribution and slight deviations in parameters. The Normal distribution has two parameters, the mean, µ, and the variance, σ2. µ and σ2satisfy −∞ < µ < ∞, σ2> 0. We write X ∼ Normal (µ, σ2) or X ∼ N(µ, σ2 ).

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. Here we need a range of 99% data which lies between 3rd standard deviation of mean.

Here mean = 100, std = 20

from empirical rule,

lower limit = mean - 3\*std = 100-3\*20 = 100-60 = 40

upper limit = mean + 3\*std = 100+3\*20 = 100+60 = 160

(40, 160)

**Here option D (48.5, 151.5)is symmetric about mean.**

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. A. Notebook link= [Statistics\_Level\_2\_Set\_2.ipynb](https://colab.research.google.com/drive/10R59mPFBMgQblq3DIwhnFmUMOpy49BiA?usp=sharing)

B. Notebook link= [Statistics\_Level\_2\_Set\_2.ipynb](https://colab.research.google.com/drive/10R59mPFBMgQblq3DIwhnFmUMOpy49BiA?usp=sharing)

C. 2nd division