

## Lab 7 – 5%

Solve the following questions. You can use Python or solve them on paper (Or you can solve some using Python and some on paper). If you are using Python to solve, please make sure to attach the output in your submissions. Like the other labs, please hand in PDF and/or Python code with output.

### 1. Generate and Visualize a Normal Distribution

Write a Python program to generate 10,000 random numbers from a normal distribution with a mean of 50 and a standard deviation of 10. Plot the histogram of the data using matplotlib.

### 2. Compute Probability Density Function (PDF)

Given a normal distribution with mean  $\mu = 30$  and standard deviation  $\sigma = 5$ , write a Python function that computes the probability density function (PDF) for a given  $x$ . Use `scipy.stats.norm.pdf` to validate your results.

### 3. Compute Cumulative Distribution Function (CDF)

For a normal distribution with  $\mu = 40$  and  $\sigma = 8$ , write a Python program to compute the cumulative probability  $P(X \leq 45)$ .

### 4. Generate and Compare PDF and CDF Plots

Write a Python script to generate the probability density function (PDF) and cumulative distribution function (CDF) for a normal distribution with  $\mu = 60$  and  $\sigma = 15$ . Plot both functions on the same graph for  $x = 0$  to 120.

### 5. Calculate Probability of an Interval

For a normal distribution with  $\mu = 70$  and  $\sigma = 12$ , calculate the probability that a random variable  $X$  falls between 55 and 85 using the cumulative distribution function (CDF).

### 6. Simulate a Standard Normal Distribution

Generate 10,000 random values from a standard normal distribution ( $\mu = 0$ ,  $\sigma = 1$ ) using numpy. Calculate the mean and standard deviation of the generated data to verify if they are close to 0 and 1.

## 7. Standardization (Z-Score Calculation)

Write a Python function to standardize a dataset by converting raw scores into z-scores using the formula:

$$Z = \frac{X - \mu}{\sigma}$$

Use the dataset:

`data = [45, 50, 55, 60, 65, 70, 75, 80, 85, 90]`

Assume  $\mu = 65$  and  $\sigma = 12$ . Compute and print the standardized values