MA4240 Report

Dishank, Chirag, Mulugu, Datta

April 2022

1 Introduction

Central Limit Theorem states that normalised sum of independent and identically distributed random variables tends towards a normal distribution, irrespective of the distribution of random variables.

$$Z = \lim_{n\to\infty} \left(\frac{\bar{X}_n - \mu}{\frac{\sigma}{n}} \right) \tag{1}$$

In this project, we propose to verify the correctness of Central Limit Theorem by running simulations beginning with a variety of distributions covered in the course.

2 Central Limit Theorem and imperial approximation

While equation (1) suggests that n should be a very large number. In practice, we tend to use the theorem for $n > 30$.

2.1 proof of CLT

THE PROOF GOES HERE

3 Hypothesis

We formulate our hypothesis in the following manner

$$H_A : \text{CLT doesn't hold}$$
$$H_0 : \text{CLT holds}$$

Here, type 2 error is when CLT is actually false but we fail to reject it. It is more dangerous because several models are built on the assumption that CLT is indeed correct.

3.1 Procedure

We are generating a batch of 100 samples from the distribution, we find the sample mean of this batch, call it $\bar{X}$. From Central Limit Theorem, we know

$$\bar{X} \sim \mathcal{N}(\mu, \frac{\sigma^2}{100}) \tag{2}$$

To verify the claim, we repeat this experiment 5000 times, then perform normality tests, which can be classified into two parts

1. Graphical Methods
   - Q-Q plot
   - Histogram
2. Frequentist tests
   - Shapiro-wilk test