Exponential Distribution and CLT

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Overview

This project will show a comparission between the Exponential Distribution and CLT (Central Limit Theorem). I will calculate and compare the mean, the variance, and I will show how the distribution looks approximately normal.

Simulations

First, I need to create 1000 simulations of the mean from 40 exponential values using lambda = 0.2. I will use the rexp function to get those values. Over that function I will use the replicate function to get the 1000 simulations.

```
# Seed for reproducibility
SEED <- 1505;
set.seed(SEED);

# Lambda value
lambda <- 0.2;
# Number of values
n <- 40;
# Number of simulations
sim <- 1000;

# Creating the simulated values
simulated_values <- replicate(sim, mean(rexp(n, lambda)));

# Looking the firsts values in the vector
head(simulated_values);
```

```
## [1] 6.394458 4.291683 4.576943 4.410136 6.198644 3.798142
```

Sample Mean vs Theorical Mean

We know that we can calculate the theorical mean with this equation: $E(x) = 1/\lambda = \beta$

```
# Calculating theorical mean.
theorical_mean <- 1 / lambda;

# Looking the value
theorical_mean;
```

```
## [1] 5
```

Now, I will calculate the mean from my 1000 simulations.

```
# Calculating simulations' mean
simulation_mean <- mean(simulated_values);
```

```r
# Looking the value
simulation_mean;
```

```
## [1] 5.013908
```

We can check that both are approximately similar, the theorical mean is equal 5, and the simulations' mean is equal 5.01.

Sample Variance vs Theorical Variance

We know that we can calculate the theorical standard deviation with this equation: $\sigma_x = \sigma/\sqrt{n}$ We also know that $\sigma = \beta$ for exponential distribution. So, we can calculate standard deviation with $\sigma_x = (1/\lambda)/\sqrt{n}$

```r
# Calculating theorical standard deviation.
theorical_standard_deviation <- (1 / lambda) / sqrt(n);

# Looking the value
theorical_standard_deviation;
```

```
## [1] 0.7905694
```

Now, I will calculate the standard deviation from my 1000 simulations.

```r
# Calculating simulations' standard deviation
simulation_standard_deviation <- sd(simulated_values);

# Looking the value
simulation_standard_deviation;
```

```
## [1] 0.8062289
```

With those values, we can calculate both variances.

```r
# Calculating  theorical variance
theorical_variance <- theorical_standard_deviation ^ 2;
theorical_variance;
```

```
## [1] 0.625
```

```r
# Calculating  simulations' variance
simulation_variance <- simulation_standard_deviation ^ 2;
simulation_variance;
```

```
## [1] 0.650005
```