Checking CLT via exponential samples

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Overview

In this report we will validate the central limite theorem (CLT) via a huge random sample of exponential distribution. Briefly we will investighate the distribution of means of ramdom samples of an exponntial distribution and compare it to the normal distribution.

Simulation

First let us simulate 1000 simulations of exponetial samples each having 40 elements with λ equal .2. Recal that the mean of exponential distribution is $1/\lambda$ and the standard deviation is also $1/\lambda$.

I simulated 40000 values and then arranged then in a 1000x40 matrix to have 1000 sapmles each of 40 values.

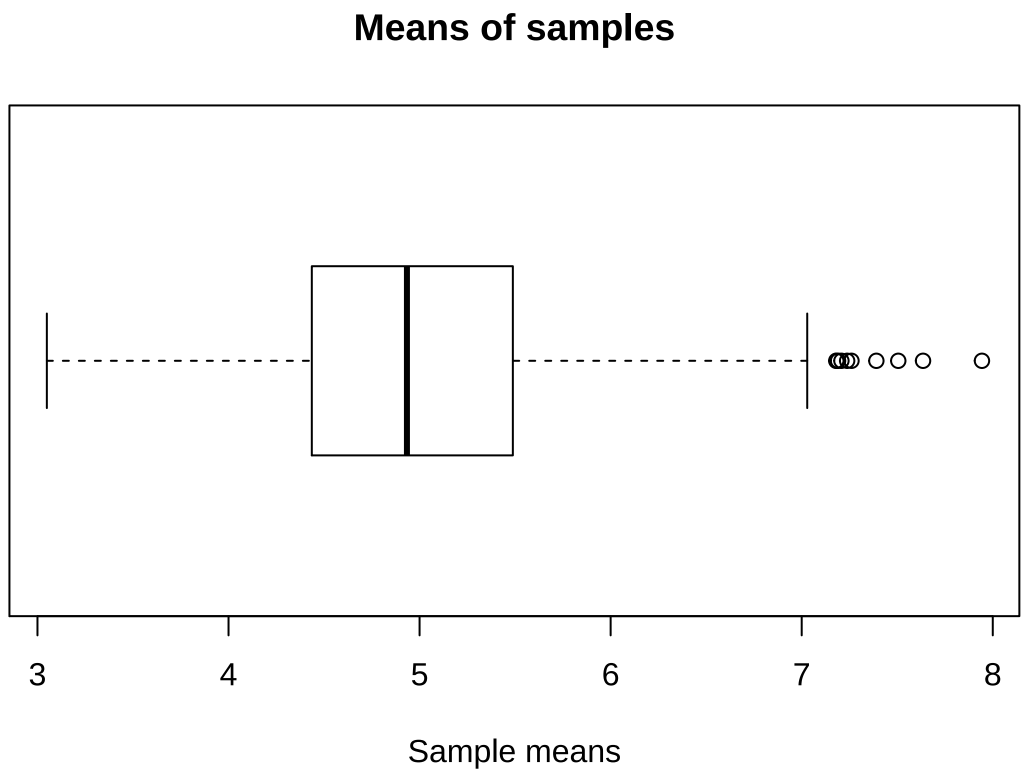
```
#simulate 40000 of exponential distributions
set.seed(200)
exp <- rexp(40000, .2)
#arranhe them in 1000 samples each of quatity 40
expmat <- matrix(exp, 1000, 40)
```

Sample mean vs. the theoretical mean

In this section we will examine if the sample mean and compare it to the distribution mean which is 5. First compute the means of samples.

```
means <- apply(expmat, 1, mean)
```

The mean of means is equal 4.984, quite close to expected mean 5. Now let's look at boxplot of means.



It is centered around 5 with half of the numbers between $4.44, 5.49$

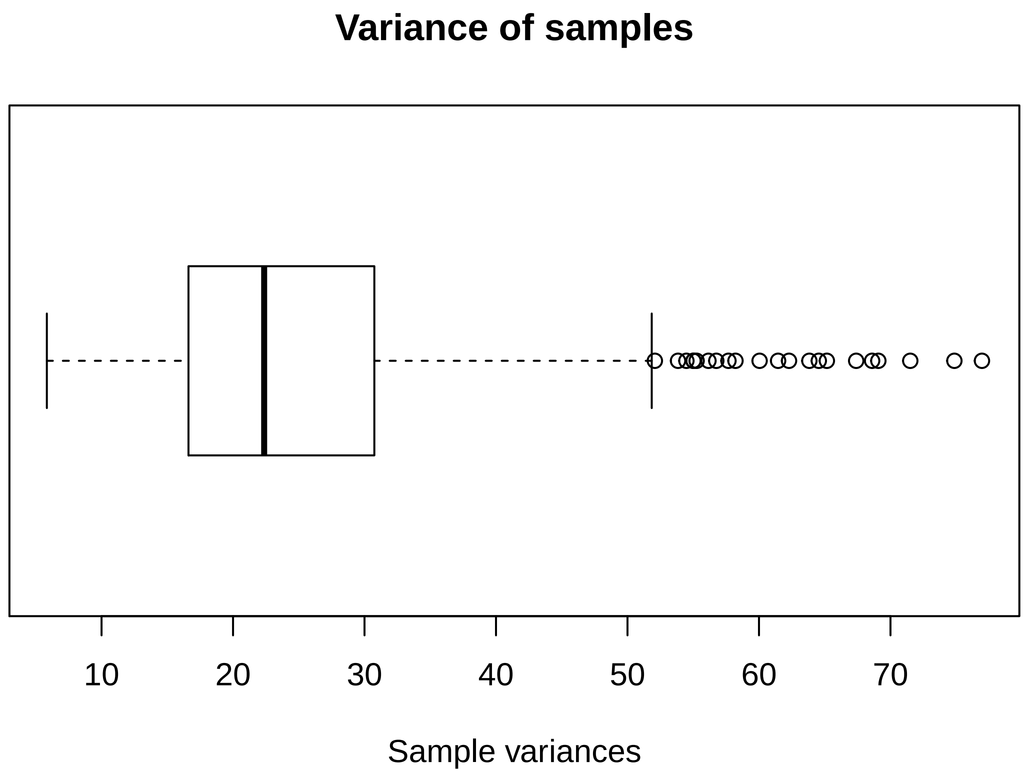
Finally runnig a t-test one can see that the 95% confidence interval is $(4.935, 5.033)$ aparently containg 5 the distribution's mean.

Sample variance vs. the theoretical variance

One can do similar test done in the last section on the variance of the samples. Note that the expected variance is 25. Fist we compute the samples variaices.

```
vars <- apply(expmat, 1, var)
```

The average variance is 24.699 quite close to 25. Now drawig a boxplot of sample variances.



It can be seen that the plot is centered at 22.37 with half of the data between $16.63, 30.75$. Not that far from the expexted value of 25.

Finally let's see the 95% t-confidence interval. It is $(24.02, 25.38)$, 25 is in it so the sample's variance is a good aproximation of the distribution variance.

Distribution