Untitled

knitr::opts\_chunk$set(echo = TRUE)

# Comparison between Exponential Distribution and Central Limit Theorem (CLT)

### David Pellon

### June 2017

## Overview:

### The objective of this study is comparing the exponential distribution and the Central Limit Theorem. We will use rexp(n, lambda) R function with lambda as the rate value = 0.2, a distribution of averages of 40 exponentials using a thousand simulations.

## Simulations:

### Definitions of the constants used: lambda, number of exponentials, number of simulations. Using a seed for reproducibility.

lambda <- 0.2  
seed <- 12321  
n\_exp <- 40  
n\_sim <- 1000  
  
set.seed(seed)

### Processing the 1000 averages of the 40 random exponentials

means = NULL  
for (i in 1: n\_sim) means = c(means, mean(rexp(n\_exp,lambda)))

## 1/ Comparing Sample Mean to the Theoretical Mean of the Distribution

### Sample mean:

mean(means)

## [1] 5.041272

### Theoretical Mean of the distribution (lambda^-1):

lambda^-1

## [1] 5

### Comparison

100\*abs((lambda^-1) - mean(means))/mean(means)

## [1] 0.8186841

The percentual difference is below 1%.

## 2/ Comparing Sample Variance and the Theoretical Variance of the Distribution

### Sample Variance:

var(means)

## [1] 0.6368595

### Theoretical Variance of the Distribution (lambda \* sqrt(n\_exp))^-2:

(lambda \* sqrt(n\_exp))^-2

## [1] 0.625

### Comparison:

100\*abs(var(means)-(lambda \* sqrt(n\_exp))^-2)/var(means)

## [1] 1.862183

The percentual difference is below 2%.

## 3/ Verifying if the difference between a large number of random exponentials and large number of averages of 40 exponentials is a normal distribution

### Displaying a plot, comparing the theoretical mean of the distribution with the theoretical normal distribution for the 1000 simulations.

library(ggplot2)  
ggplot(data.frame(x=means),aes(x=means))+  
 geom\_histogram(binwidth=0.25,color='red',fill='white',aes(y=..density..)) +  
 stat\_function(fun=dnorm,args=list(mean=lambda^-1,sd=(lambda\*sqrt(n\_exp))^-1),size=2)+ labs(title="Verifying if the distribution is normal")+xlab("Sample Mean")+ylab("Density")

