Data Analytics
Mini Project - 1

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September 11, 2016

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0.1 Overview for simulating the experment

Given:

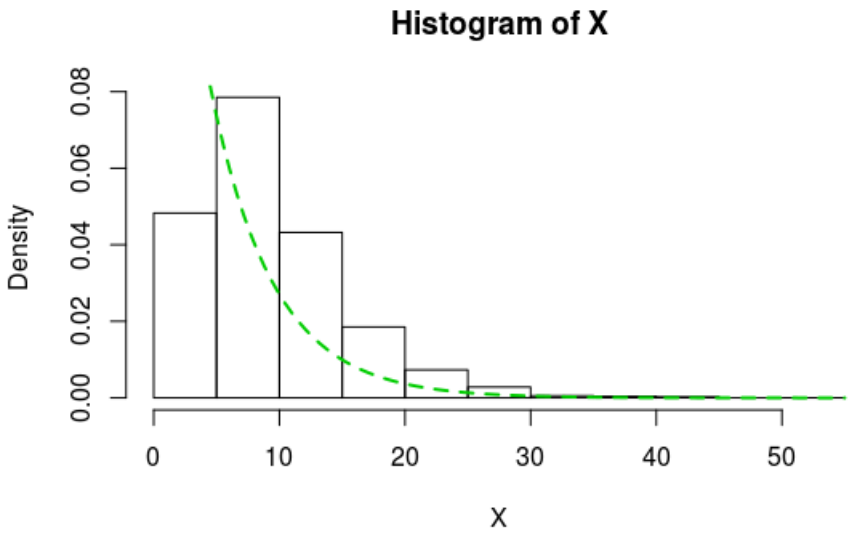
- A program is divided into 3 blocks & each block runs in parallel manner.
- Average time taken by each block = 5 minutes (independent of other blocks).
- Each block takes an exponential amount of time.
- Program completes, when all blocks get completed.

Algorithm

- From above given conditions, it is evident that time required for program to get competely compiled = Execution time of slowest thread.
- Therefore, **X**(time taken by program for compilation) = Maximum(value of x_1, x_2, x_3, name of each thread as denoted in below R code).
- Finally, E[X] = average of all values of X.

0.2 Section 2

Part A & B



The image represents the histogram generated from simulated values and the green dotted line shows the density function for exponential distribution.

Part C

Using, the fact that:

E[X] = $1/\lambda = 5$, Var[X] = $1/\lambda^2 = 25$

& Var[X] = $E[X^2] - E[X]^2$

Therefore, $E[X^2]$(theoritical) = 50

But, $E[X^2]$(experimental) = 116.66

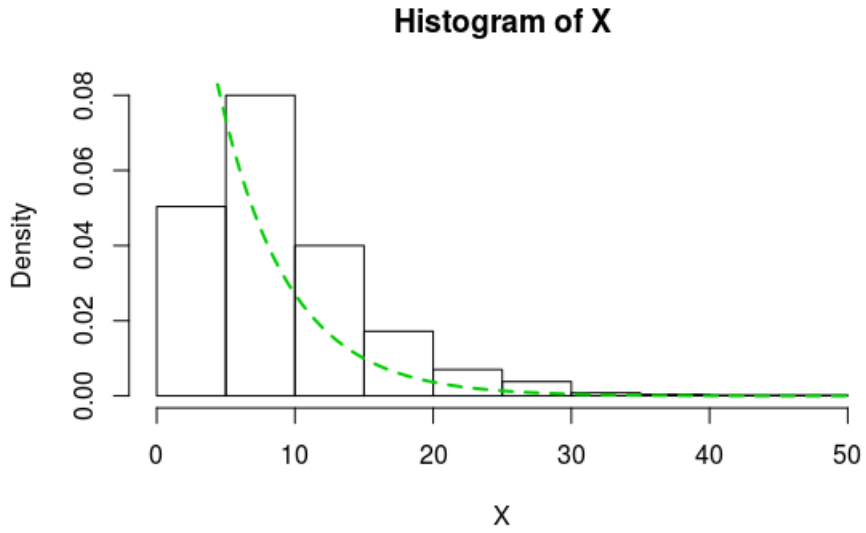
Difference = 66.66

Part D

$E[X^2]_1$(experimental) = 117.12 & Difference = 67.12
$E[X^2]_2$(experimental) = 116.15 & Difference = 66.15
$E[X^2]_3$(experimental) = 117.14 & Difference = 67.14
$E[X^2]_4$(experimental) = 118.64 & Difference = 68.64
$E[X^2]_5$(experimental) = 120.29 & Difference = 70.29

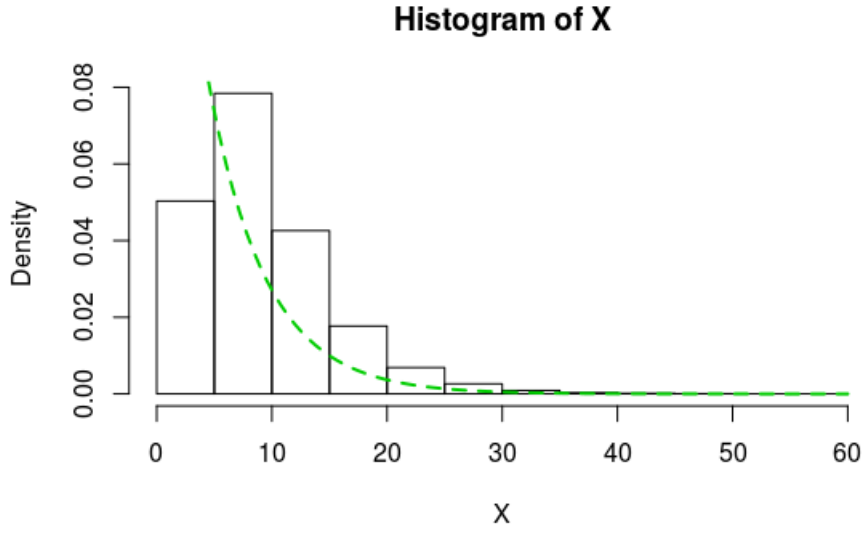
Part E

For 1,000 replications:



E[X] = 9.27
E[X^2] = 123.47

For 1,00,000 replications:



E[X] = 9.19
E[X^2] = 118.74

Inference:

Between 1,000 and 1,00,000 simulations, there is a slight difference in E[X] and a significant difference is observed in E[X^2]. This is because as number of simulations increases E[X] & E[X^2] gets more closer to the theoritical E[X] & E[X^2].

0.3 R-Code

For Part A & Part B

```
X=c() #initializing a column vector of total time for
                #complete compilation of program
X2=c()#square of total time

for (i in 1:10000) #for each i
{  x1 = rexp(1,rate=0.2) # generate random x1, x2, x3
x2 = rexp(1,rate=0.2)    # for exponential distribution,
                         #for rate = 0.2
x3 = rexp(1,rate=0.2)
m=max(x1,x2,x3)
X=c(X,m) #appending the maximum time taken by a thread
                #into compilation time vector
X2 = c(X2,m^2)
}
hist(X,prob=TRUE) #here curve in plotting is used to
                                  #superimpose two graphs
curve(dexp(x,rate=0.2), col=3, lty=2,lwd=2,add=TRUE)
mean(X) #Expectatio of X
mean(X2)#Expectation of X^2
```