Statistical Inference Course Project

Author: Rajesh T Date: 11-02-2021

Part 1:

Overview:

Investigation of exponential distribution in R and comparison with CLT(Central Limit Theorem) Project involves analysing the distribution of averages of 40 exponentials over 1000 simulations

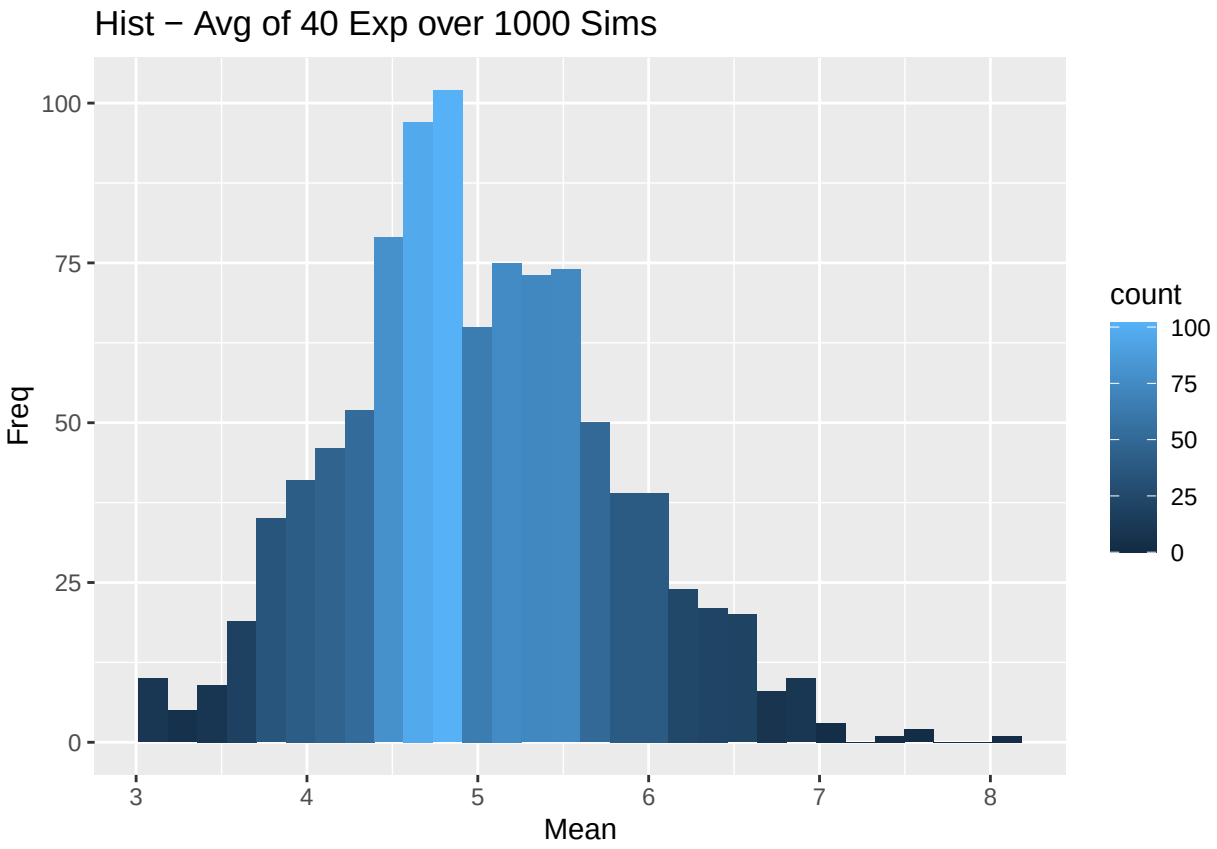
Simulation

```
lambda <- 0.2
n <- 40
simulations <- 1:1000
set.seed(100)

library(ggplot2)

pop <- data.frame(x=sapply(simulations, function(x) {mean(rexp(n, lambda))}))
head(pop)
```

```
##          x
## 1 4.137412
## 2 6.051703
## 3 4.415869
## 4 4.404714
## 5 3.210413
## 6 5.475307
```

```
hist_v1 <- ggplot(pop, aes(x=x)) +
  geom_histogram(aes(y=..count.., fill=..count..)) +
  labs(title="Hist - Avg of 40 Exp over 1000 Sims", y="Freq", x="Mean")
hist_v1
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Comparing Sample and Theoritical Mean

```
s_mean <- mean(pop$x)
t_mean <- 1/lambda
cbind(s_mean, t_mean)
```

```
##        s_mean t_mean
## [1,] 4.999702      5
```

```
t.test(pop$x)[4]
```

```
## $conf.int
## [1] 4.949933 5.049471
## attr(,"conf.level")
## [1] 0.95
```

- At 95% confidence level, sample mean is between 4.96 and 5.06

Comparing Sample and Theoritical Variance

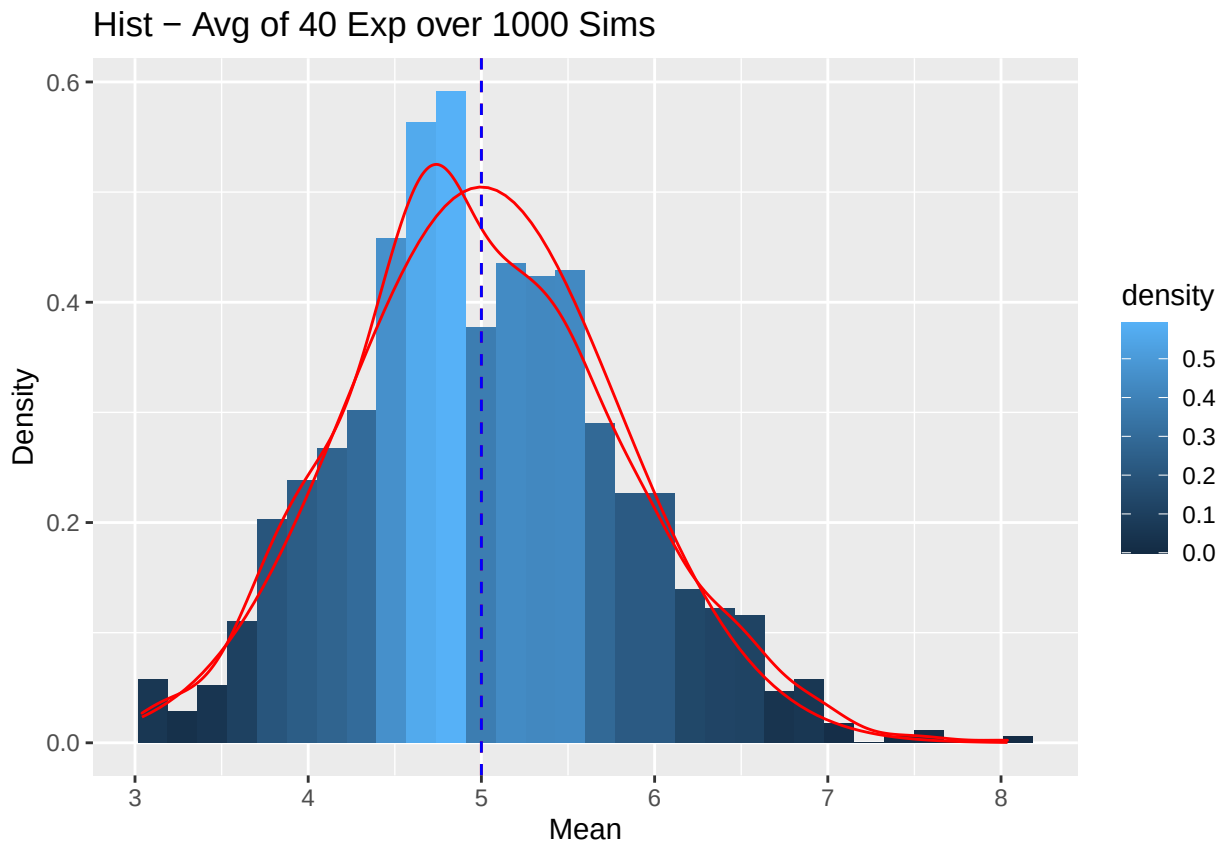
```
s_var <- var(pop$x)
t_var <- ((1/lambda)^2)/n
cbind(s_var, t_var)
```

```
##          s_var t_var
## [1,] 0.6432442 0.625
```

Distribution

```
dist_plot <- ggplot(pop, aes(x=x)) +
  geom_histogram(aes(y=..density.., fill=..density..)) +
  labs(title="Hist - Avg of 40 Exp over 1000 Sims", y="Density", x="Mean") +
  geom_density(colour="Red") +
  geom_vline(xintercept=s_mean, colour="Red", linetype="dashed") +
  stat_function(fun=dnorm,args=list( mean=1/lambda, sd=sqrt(t_var)),color = "red") +
  geom_vline(xintercept=t_mean, colour="Blue", linetype="dashed")

dist_plot
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



- The plot reveals that sample mean for 40 simulations (1000 times) is very close to the theoretical mean for a normal distribution