Quiz #12: Solutions

Milica Cudina

2022-03-08

Simulations

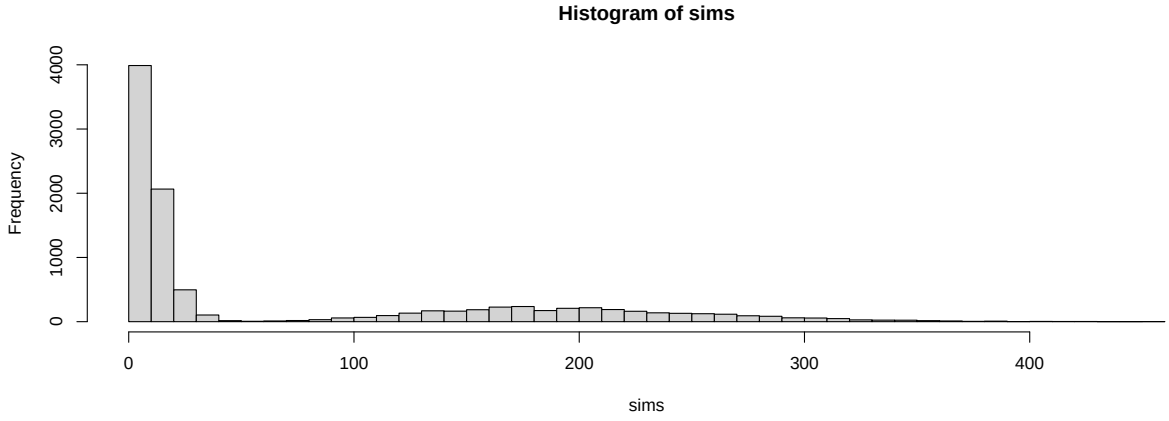
Problem 1.

Consider the following two-step experiment. First you draw a simulated value from a Bernoulli(p=1/3). If the drawn value from the Bernoulli equals 0, then you draw a simulated value from $Gamma(\alpha = 2, \theta = 5)$. On the other hand, if the drawn value from the Bernoulli equals 1, then you draw a simulated value from $Gamma(\alpha = 10, \theta = 20)$

(10 points) Repeat the above two-step experiment 10000 times and draw the histogram of the simulated values.

Solution:

```
nsim=10000
sims<-c()
for(i in 1:nsim){
  coin<-rbinom(n=1,size=1,prob=1/3)
  if(coin==0){
    new.sim<-rgamma(1,shape=2,scale=5)
  } else {
    new.sim<-rgamma(1,shape=10,scale=20)
  }
  sims<-c(sims,new.sim)
}
hist(sims,breaks=50)
```



(2 points) Find the theoretical mean of the above distribution and compare it to the mean of the simulated values.

Solution: The theoretical mean is

```
(2/3)*2*5+(1/3)*10*20
## [1] 73.33333
```

The mean of the simulated values is

```
mean(sims)
## [1] 73.20651
```

(3 points) Find the theoretical probability that the above random variable exceeds 100. It's acceptable to use the `pgamma` command. Compare it to the proportion of the simulated values exceeding 100.

Solution: This is the theoretical probability:

```
(2/3)*(1-pgamma(100, shape=2, scale=5))+(1/3)*(1-pgamma(100, shape=10, scale=20))
## [1] 0.322724
```

Here is the proportion of the simulated values exceeding 100.

```
mean(sims>100)
## [1] 0.3206
```