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> # STAT 100B chapter 8 simulation
> # Purpose: To understand sampling distribution and estimate standard error via
bootstrap method
>
> # define a function to compute sigma.hat^2=sum((x_i-\bar x)^2)/n
> sigma.hat.sq=function(x) mean(x^2) - mean(x)^2
> # same as sigma.hat.sq=function(x) { n=length(x); var(x)*(n-1)/(n) }
>
> # Estimated parameters from the rainfall data, p. 264
> lambda=1.674
> alpha=0.375
> n=227 # sample size
>
> # take a random sample from Gamma(alpha=0.375, lambda=1.674)
> x=rgamma(n,shape=alpha, rate=lambda)
> summary(x)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.00000 0.01737 0.09079 0.26030 0.33560 2.88600
> hist(x)
> # estimate of alpha and lambda from this sample
> mean(x)/sigma.hat.sq(x) # estimate of lambda
[1] 1.583952
> mean(x)^2/sigma.hat.sq(x) # estimate of alpha
[1] 0.4123106
>
> # do it again
> x=rgamma(n,shape=alpha, rate=lambda)
> summary(x)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.00000 0.01836 0.07693 0.24920 0.33990 5.90900
> hist(x)
> # estimate of alpha and lambda from this sample
> mean(x)/sigma.hat.sq(x) # estimate of lambda
[1] 1.048683
> mean(x)^2/sigma.hat.sq(x) # estimate of alpha
[1] 0.2613808
>
> K=1000;
> lambda.hat=alpha.hat=rep(0,K)
> for(i in 1:K){
+   x=rgamma(n,shape=alpha, rate=lambda)
+   lambda.hat[i]=mean(x)/sigma.hat.sq(x)
+   alpha.hat[i]=mean(x)^2/sigma.hat.sq(x)
+   }
>
> par(mfrow=c(1,2))
> mean(lambda.hat) # mean of lambda.hat from K simulations
[1] 1.78465
> sd(lambda.hat)  # empirical standard error of lambda.hat from K simulations
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[1] 0.3409541
> # examine the distribution of lambda.hat.
> hist(lambda.hat, main=paste("Histogram of lambda.hat")) # Figure 8.4 (a)
>
> mean(alpha.hat) # mean of alpha.hat from K simulations
[1] 0.393149
> sd(alpha.hat)  # empirical standard error of alpha.hat from K simulations
[1] 0.06319928
> # examine the distribution of alpha.hat.
> hist(alpha.hat, main=paste("Histogram of alpha.hat")) # Figure 8.4 (b)
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