

R simulation: Central Limit Theorem

```
> x<-seq(1,6) # Regular die
> A<-matrix(sample(x,90000,replace=T),ncol=9,byrow=T) # Roll 9 times; 10000 reps
> xbar<-apply(A,1,mean) # Average of n=9 rolls
> s<-apply(A,1,sd)
> head(cbind(A,xbar,s))

          xbar      s
[1,] 4 2 3 1 2 4 4 5 4 3.222222 1.3017083
[2,] 2 3 3 2 4 5 3 4 3 3.222222 0.9718253
[3,] 4 4 4 6 3 3 6 5 4 4.333333 1.1180340
[4,] 6 4 5 2 6 5 5 6 5 4.888889 1.2692955
[5,] 4 4 6 2 2 5 4 1 5 3.666667 1.6583124
[6,] 4 6 5 6 3 2 2 2 3 3.666667 1.6583124
> tail(cbind(A,xbar,s))

          xbar      s
[9996,] 5 1 4 6 4 3 5 5 2 3.888889 1.615893
[9997,] 4 6 3 6 5 4 4 3 4 4.333333 1.118034
[9998,] 4 2 2 1 3 2 4 6 5 3.222222 1.641476
[9999,] 6 4 1 1 4 3 2 3 3 3.000000 1.581139
[10000,] 4 6 1 3 5 1 1 1 1 2.555556 2.006932
> x1<-A[,1]
> barplot(table(x1)/10000,col=rgb(1,0,0,.5),ylim=c(0,.8))
> hist(xbar, col=rgb(0,0,1,.5), add=T,freq=F)
> (sum(3.5<xbar-1.96*s/sqrt(9))+sum(xbar+1.96*s/sqrt(9)<3.5))/10000
[1] 0.0913
> (sum(3.5<xbar-2.306*s/sqrt(9))+sum(xbar+2.306*s/sqrt(9)<3.5))/10000
[1] 0.055
```

