# EE511 week2 homework

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**Q1. Simulate sampling uniformly (how many?) on the interval [-3,2].**
**a. Generate a histogram of the outcomes.**
**b. Compute the sample mean and sample variance for your samples. How do these values compare to the**
**theoretical values? If you repeat the experiment will you compute a different sample mean or sample variance?**
**c. Compute the bootstrap confidence interval (what width?) for the sample mean and sample standard**
**deviation**

**Code:**

```
A=5*rand(1,10000)-3;
hist(A);%Q1(a)
Mean=mean(A)%mean
Variance=var(A)%variance
disp('Q1(c)confidence interval for sample mean: ')
Confidence_mean=bootstrp(10000,@mean,A);
x=sort(Confidence_mean);
ConMeanLow=x(250)
ConMeanHigh=x(10000-250)
disp('Q1(c)confidence interval for sample standard: ')
Confidence_std=bootstrp(10000,@std,A);
x=sort(Confidence_std);
ConStdLow=x(250)
ConStdHigh=x(10000-250)
```

**Results:**

Q1(a): Figure 1 shows that the data are evenly distributed by generating from rand function.

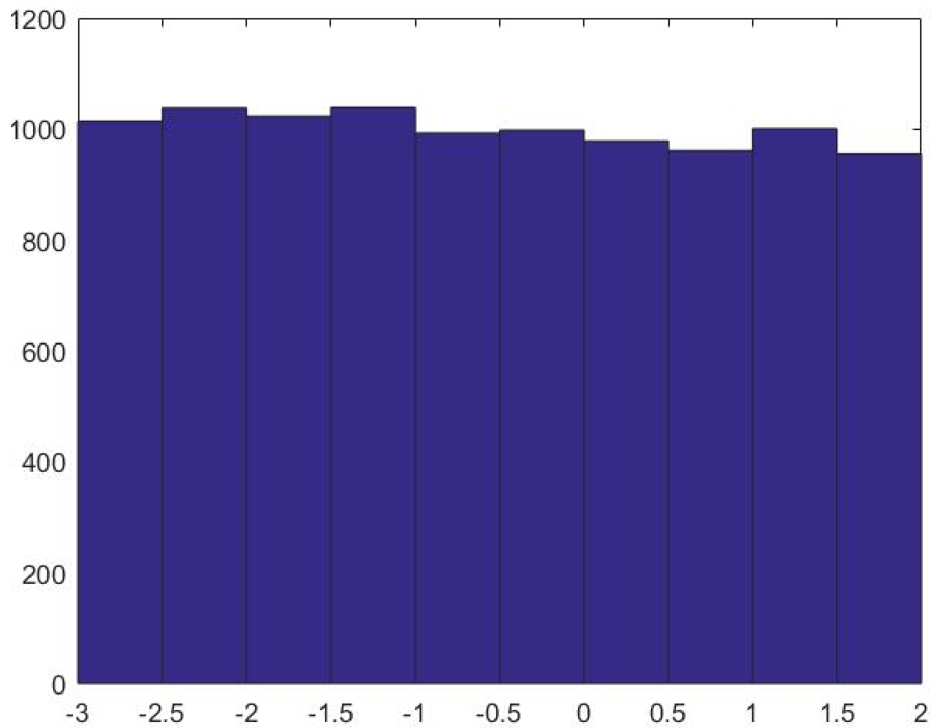


Figure 1: Generate a histogram of the outcomes [-3.2]

**Q1(b).**

**Simulation value:**

Mean =-0.5275

Variance = 2.0642

**Theory value:**

Mean: (-3+2)/5=0.2

Variance: $\sum(xi-u)^2$ =2.0833,

where xi is generated through

var(-3:0.00000001:2)

Yes, every time we have different data so that we will have different mean and variance. But they will not change a lot.

**Q1(c):confidence interval for sample mean: 95%**

ConMeanLow = -0.5556

ConMeanHigh =-0.4997

So we consider the data from [-0.5556, -0.4997] are convincing.

Q1(c)confidence interval **for sample standard**: 95%

ConStdLow =1.4237

ConStdHigh = 1.4492

So we consider the data from[1.4237,1.4492] are convincing.

Q2:

Produce a sequence $X$ by drawing samples from a standard uniform random variable.

a. Compute $Cov[X_k, X_{k+1}]$. Are $X_k$ and $X_{k+1}$ uncorrelated? What can you conclude about the independence of $X_k$ and $X_{k+1}$?

b. Compute a new sequence $Y$ where: $Y[k] = X[k] - 2 \cdot X[k-1] + 0.5 \cdot X[k-2] - X[k-3]$. Assume $X[k] = 0$ for $k \leq 0$. Compute $Cov[X_k, Y_k]$. Are $X_k$ and $Y_k$ uncorrelated?

```
Code:
clear
disp('Q2(a)')%use
a=rand(1,1000);%
X_K=[a(1:end),0];%
X_K1=[0,a(1:end)];%
cov(X_K,X_K1,1);
coef=corrcoef(X_K,X_K1);%correlated coef

disp('Q2(b):')%use
XK=X_K;
XK1=[a(1:end),0];%
XK2=[a(2:end),0,0];%
XK3=[a(3:end),0,0,0];%
YK=XK-2*XK1+0.5*XK2-XK3;
corrcoef(YK,XK)
```

**result:**

Q2_a:

Cov[x_k,x_k+1]=[
0.0853 0.0023
0.0023 0.0853]

And their correlated coef is 0.0023 that can be approximate to 0. So x_k and x_k+1 don't correlated.

The same as above, Cov[Y[K], X[K]]= [
0.1790 -0.0800
-0.0800 0.0853 ]

the correlated corf of Y[k] and X[K] are -0.6477. So they are almost correlated.

Discussion:

- We can find that the shift of the list data will greatly influence the correlatence.
- When Y[K] has a function with a X[K], these two lists will, absolutely have relatively highly correlated.

**Q3: Let M = 10. Simulate (uniform) sampling with replacement from the outcomes 0, 1, 2, 3, …, M-1.**
**a. Generate a histogram of the outcomes.**
**b. Perform a statistical goodness-of-fit test to conclude at the 95% confidence level if your data fits samples**
**from a discrete uniform distribution 0, 1, 2, …, 9.**
**c. Repeat (b) to see if your data (the same data from b) instead fit an alternate uniform distribution 1, 2, 3,…, 10**

Code:

```
clear all;
test=floor(10*rand(1,10000));
hist(test)
test=hist(test);
test_theo = 1000*ones(1,10);
disp('Q3_1&2:')
ChisquaredTest = sum((test-test_theo).^2./test_theo);
ChisquaredThreshold_95 = chi2inv(0.95,10);%?? cdf??
sprintf('ChisquaredTest=%d\nChisquaredThreshold_95=%d\nReje
ct?%d',...
ChisquaredTest,ChisquaredThreshold_95,ChisquaredTest>Chisqu
aredThreshold_95)
disp('Q3_3:')
test=[test(2:end),0];
ChisquaredTest = sum((test-test_theo).^2./test_theo);
ChisquaredThreshold_95 = chi2inv(0.95,10);%?? cdf??
sprintf('ChisquaredTest=%d\nChisquaredThreshold_95=%d\nReje
ct?%d',...
ChisquaredTest,ChisquaredThreshold_95,ChisquaredTest>Chisqu
aredThreshold_95)
```

**Result:**

Q3_a: the figure shows that the data are evenly distributed.

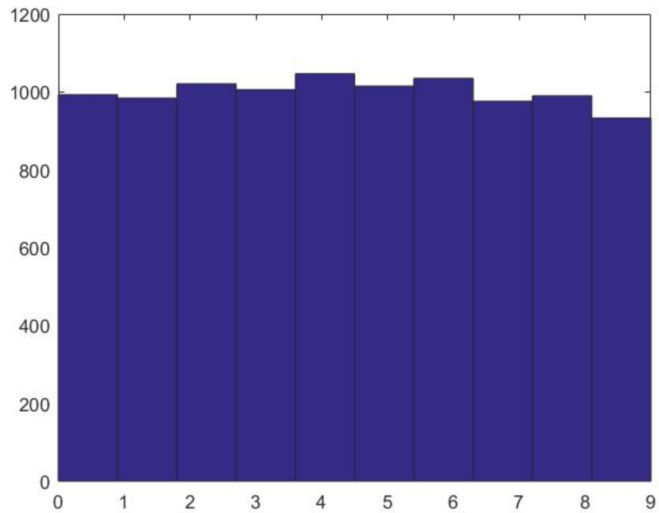


Figure 2: Generate a histogram of the outcomes of 0,1,2..9

Q3_b:
ChisquaredTest=9.606000e+00
ChisquaredThreshold_95=1.830704e+01
Reject?0

So the data fit the uniform distribution.
Q3_c:
ChisquaredTest=1.009557e+03
ChisquaredThreshold_95=1.830704e+01
Reject?1
So the data don't fit the uniform distribution.