Using Histograms and Random Number Generators

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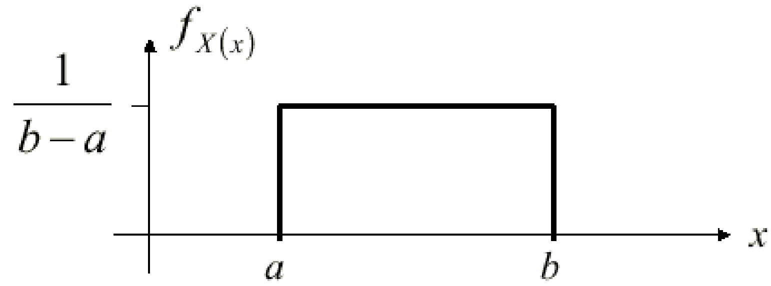
Uniform and Gaussian RV's

- ***Example:*** *Uniform Distribution*

$$E[X]=\frac{a+b}{2}$$

$$\sigma_X^2=\frac{(a-b)^2}{12}$$



- ***Example: Gaussian Distribution***

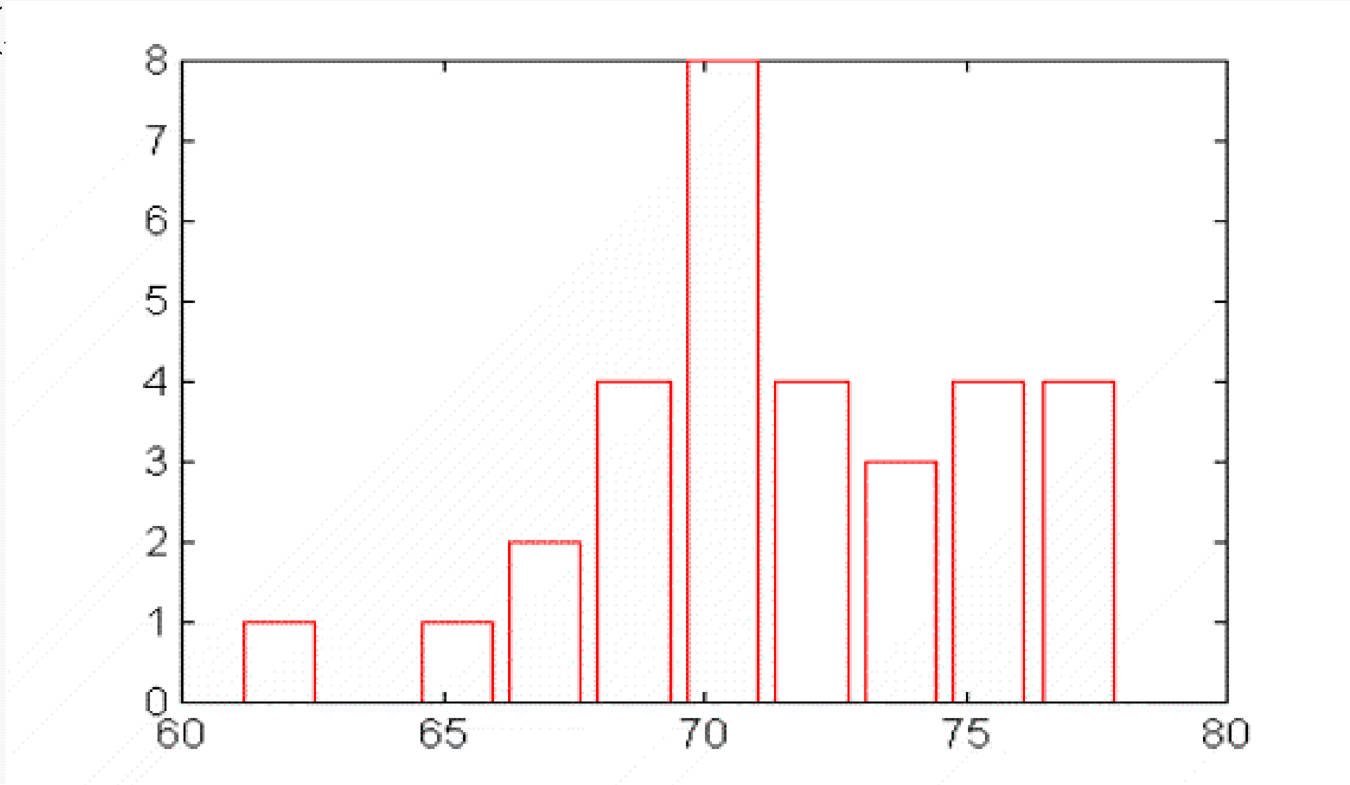
$$X \sim N\left(m_X,\sigma_X^2\right)$$

$$f_X(x)=\frac{1}{\sqrt{2\pi\sigma_X^2}}\exp\left(-\frac{(x-m_X)^2}{2\sigma_X^2}\right)$$

Histogram is an approximation to PDF, f(x)

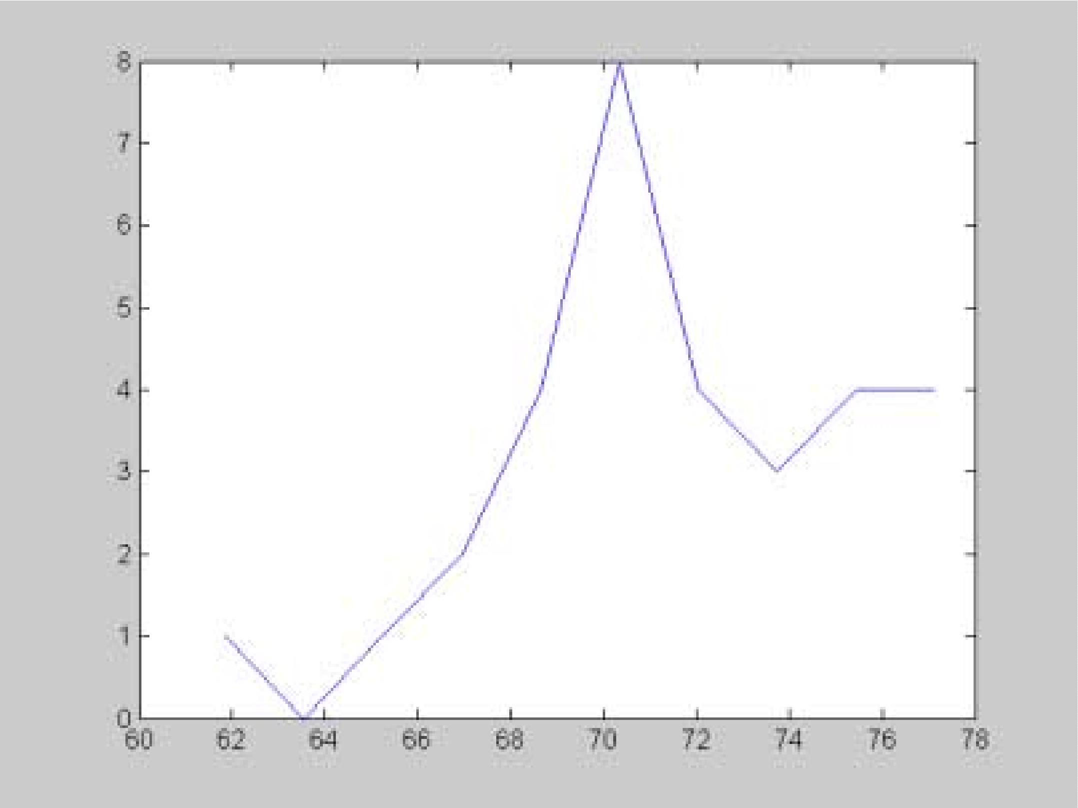
A=[78 71 61 67 72 73 72 70 69 70 72 65 70 71 75 71 69 70 67 69 73 76 76 76 78 78 78 74 71 72 68]

Hist(



Extracting X and Y info from Histogram

[yy,xx]=hist(A)



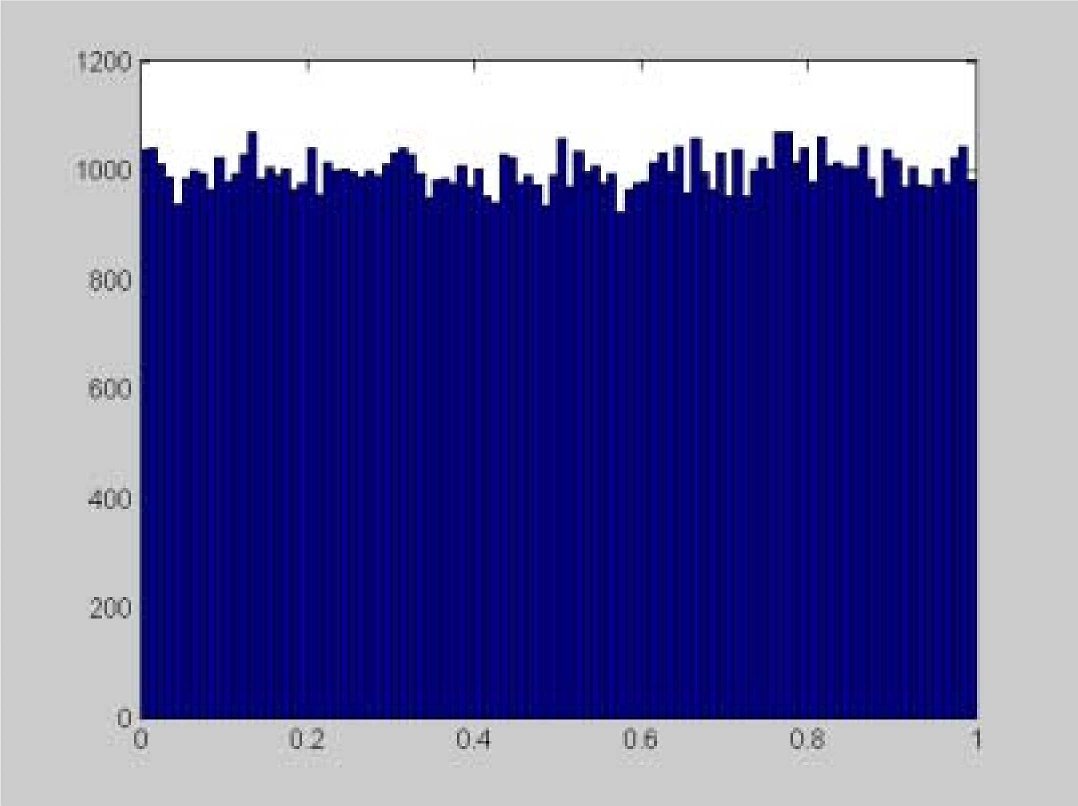
Using the Random Number Generator Features in MATLAB

x=rand(100000,1) %uniform random numbers

Base=0.005:0.01:1;

Hist(x,base)

Note: bin starts in center!!



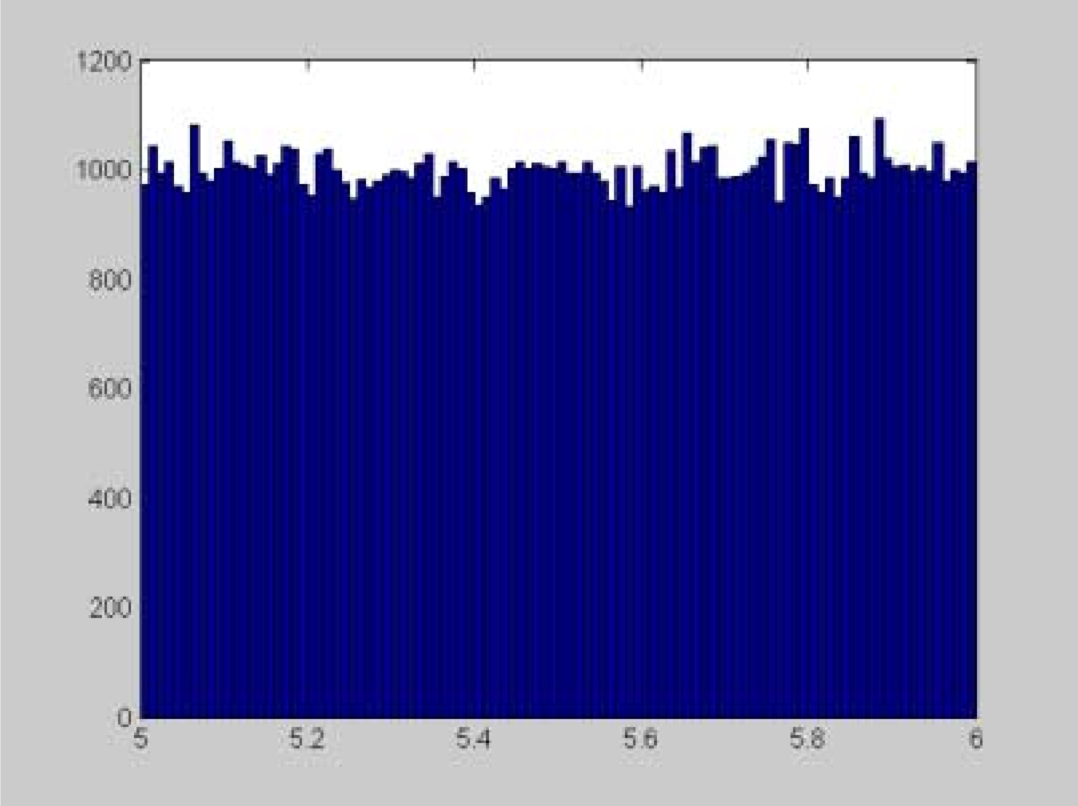
shifting RV’s

X=rand(100000,1)

Y=5+x;

Mean(y)=5.5

Std(y)=sqrt(1/12)



Scaling

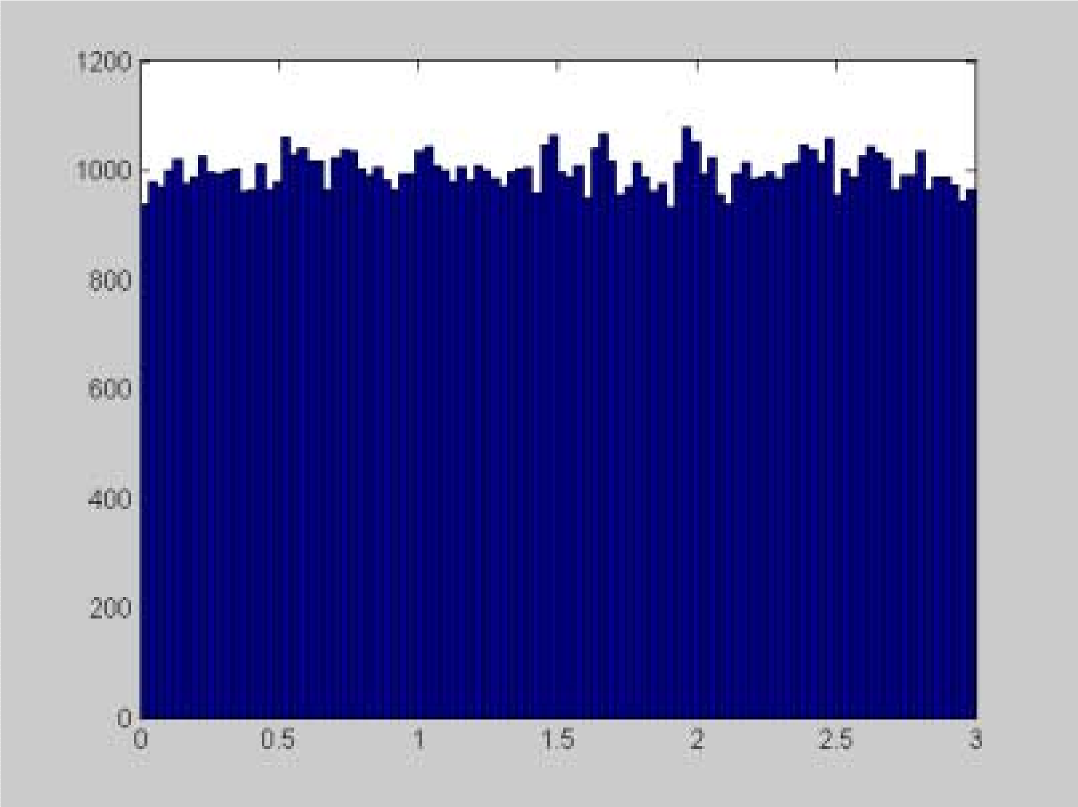
X=rand(10000,1)

Y=x*3;

Hist(y)

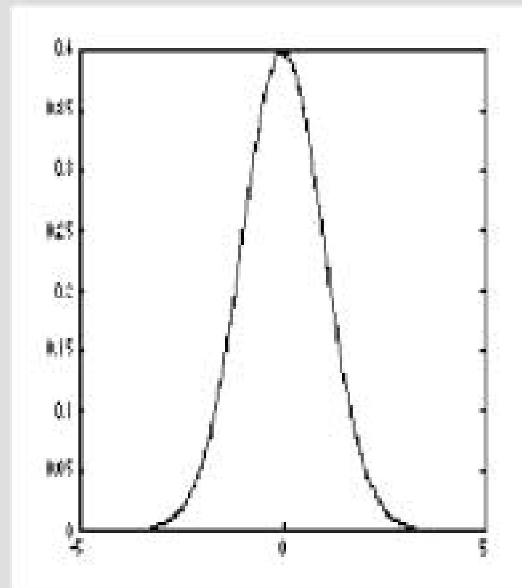
Mean(y)=1.5

Std(y)=3sqrt(1/12)



Gaussian RV

$$p(x) = \frac{1}{\sqrt{2\pi\sigma_x^2}} e^{-\frac{(x-m_x)^2}{2\sigma_x^2}}$$



A Gaussian random variable is completely determined by its mean and Variance

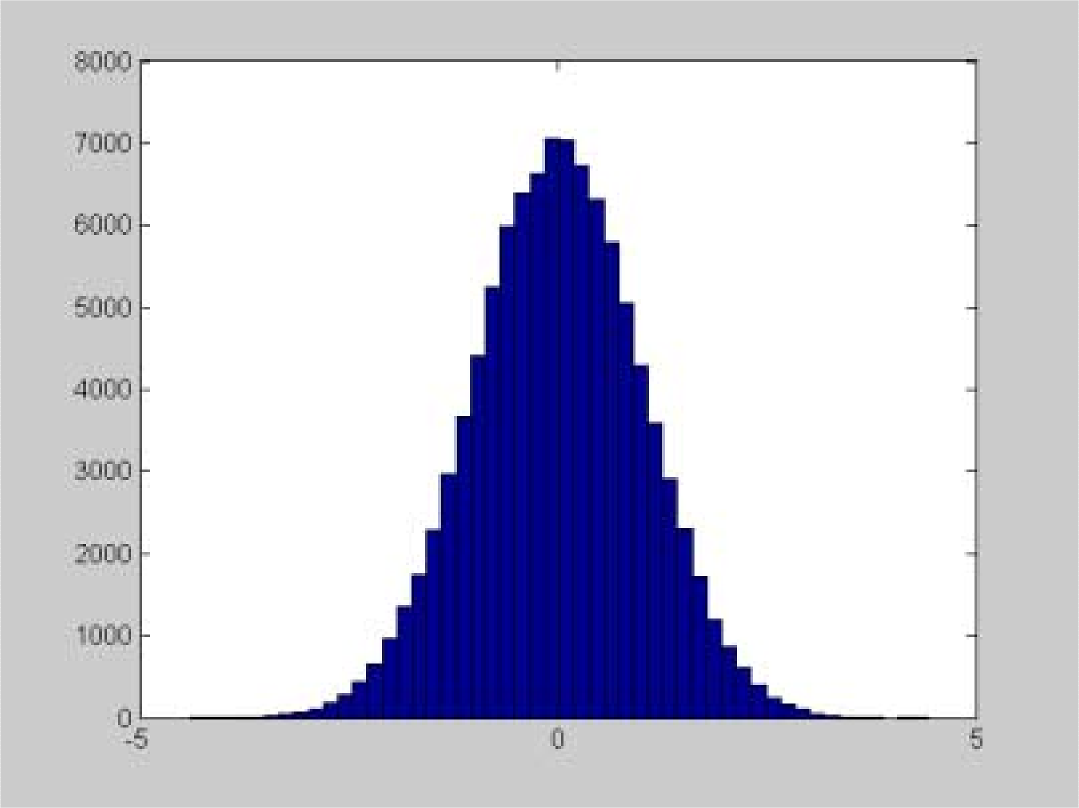
Normal Random Numbers

X=randn(100000,1)

Hist(x,50)

Mean(x)

Std(x)



Scaling standard deviation

X=randn(10000,1)

Std(x)=1.0

Y=σ*x;

Std(y)= σ

Flipping 30 coins 10,000 times

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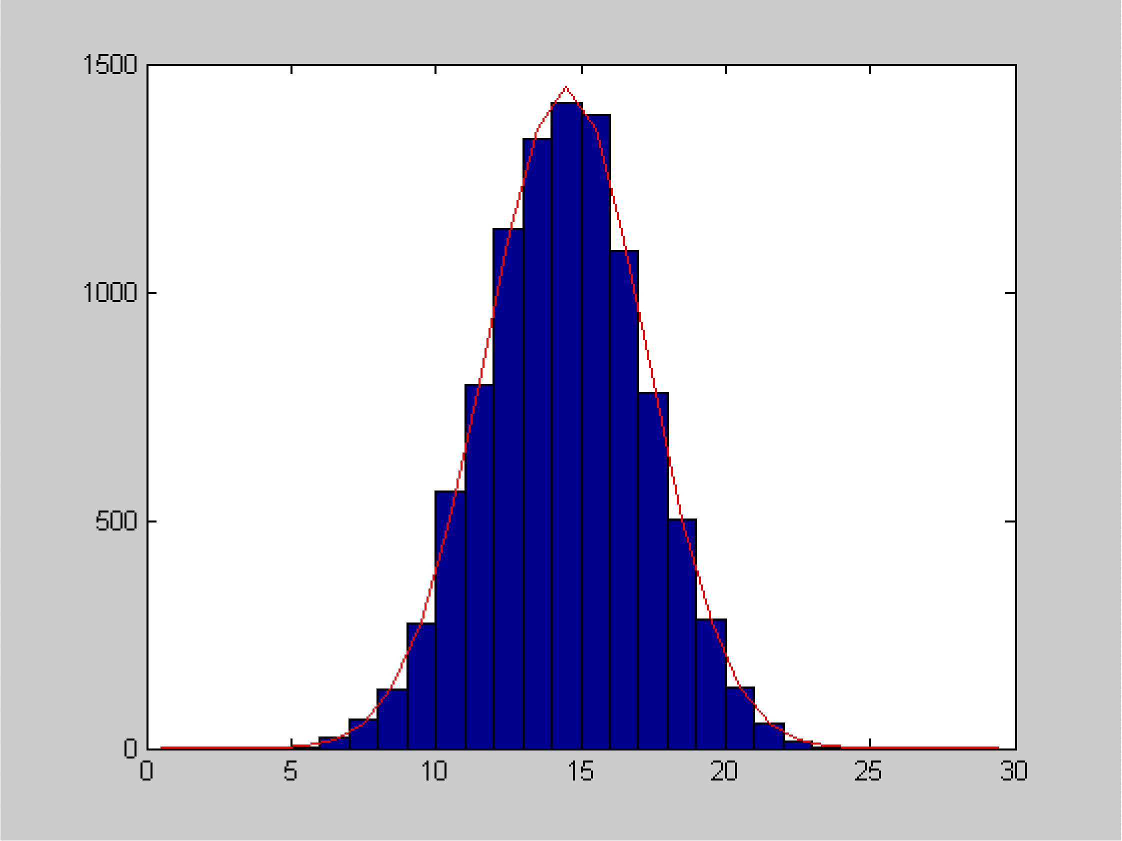
x=rand(30,10000); %30 samples, 10000 times
x=x-0.5; %change from +- 0.5
y=(sign(x)+1)/2; %take sign and add 1 to make 0->1;
a=sum(z);  %count number of flips
b=0.5:1:30;
hist(a,b) % do histogram
Std(a)
Mean(a)
```

Each time ball hits peg, it goes right or left (same as flipping a coin)

30 flips, 10,000 times



std-=2.713

Mean=14.956

Sqrt(30*p*q)=2.738