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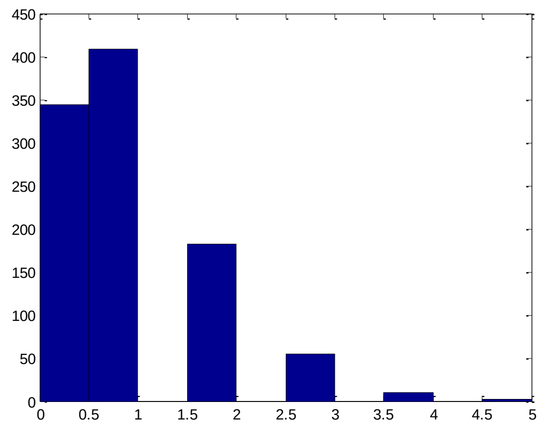
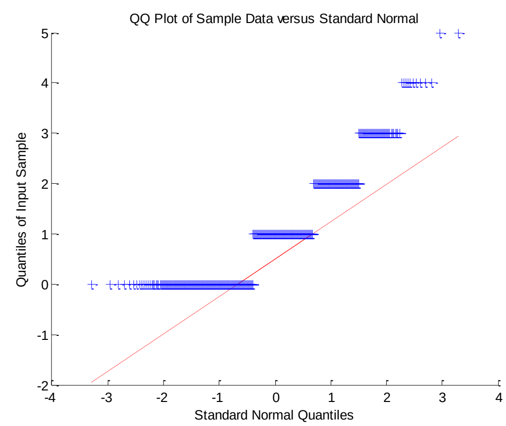
BENG 100 HW 6

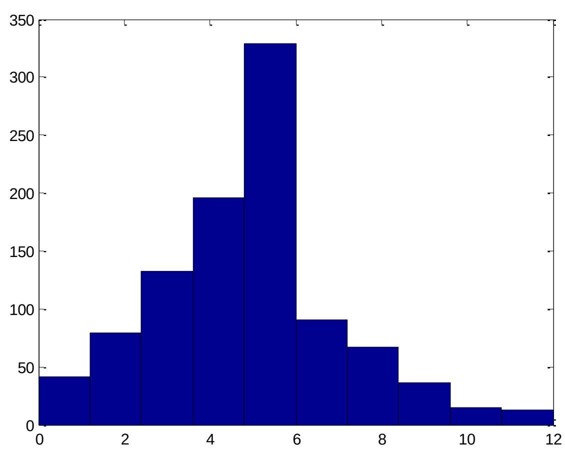
1a.

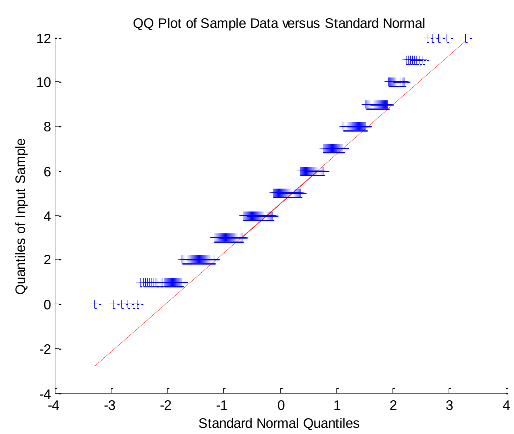
```
lambda = [1 5 15 25];

for i = 1:length(lambda)
y1a=poissrnd(lambda(i),1,1000)
hist(y1a)
figure
qqplot(y1a)
figure
end
```

Figures 1-8:









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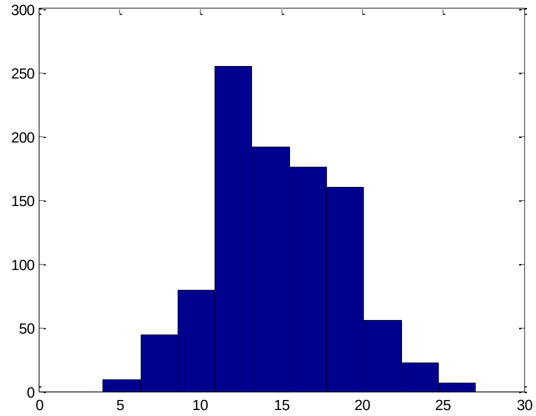

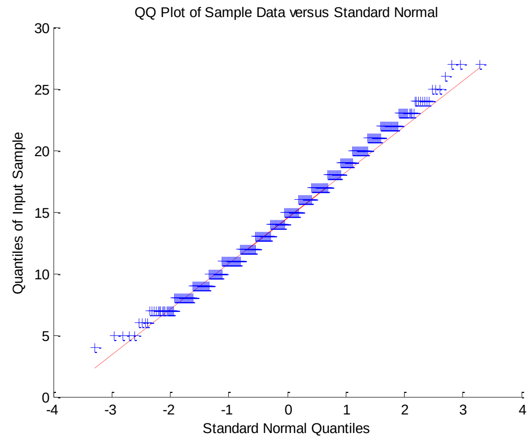

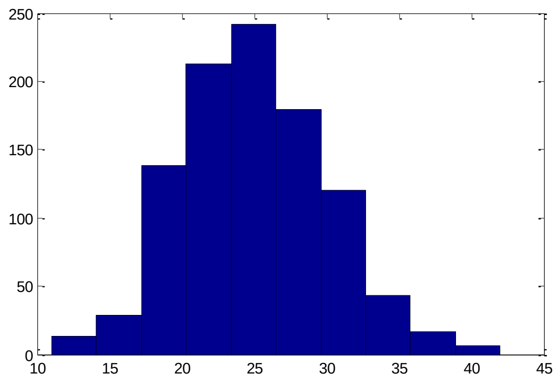

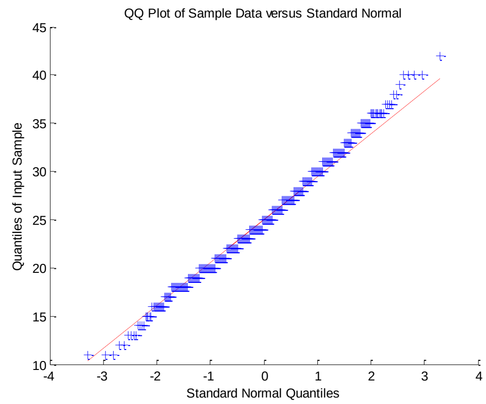

The Gaussian approximation is a good approximation of the Poisson PMF, as the rate increases. It is consistent with the Central Limit theorem, where lambda tending to infinity is equivalent to having a large number, n, of independent trials.

1b.

```
n = [15 25 50]
p = [.1 .3 .5]
for i = 1:length(n)
   for j = 1:length(p)
   y1b = binornd(n(i),p(j),1,1000)
   hist(y1b)
   figure
   qqplot(y1b)
   figure
   end
end

x = rand(1,1)*5+3
y = poissrnd(x,[10,1])
```

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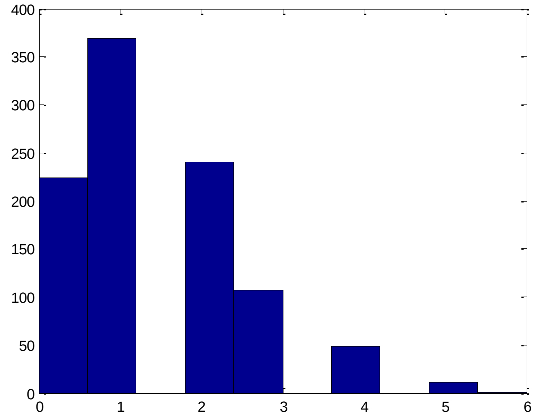
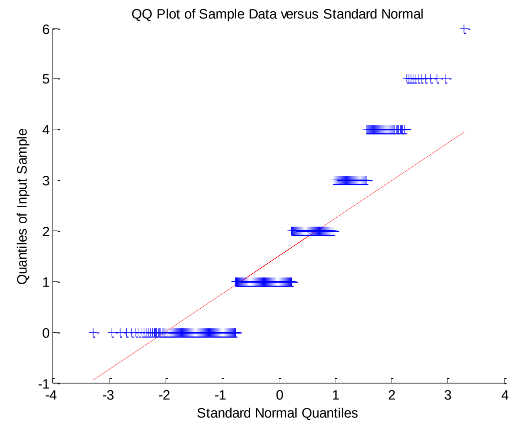
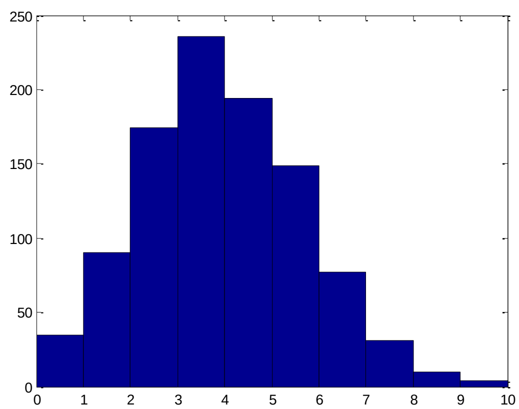
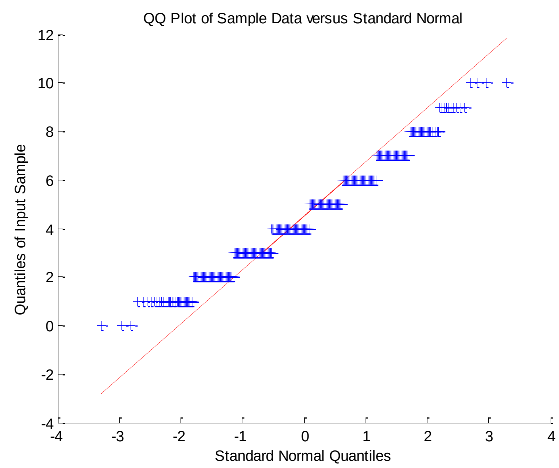
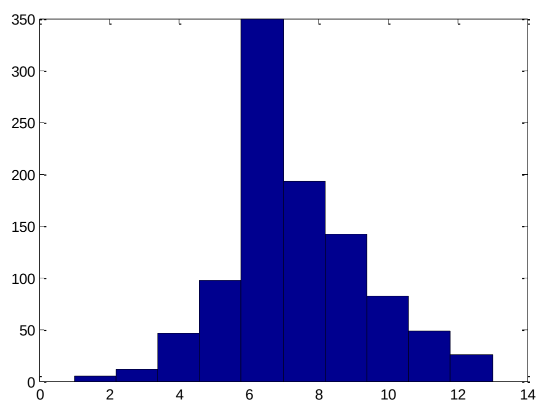
Figures 1-18:

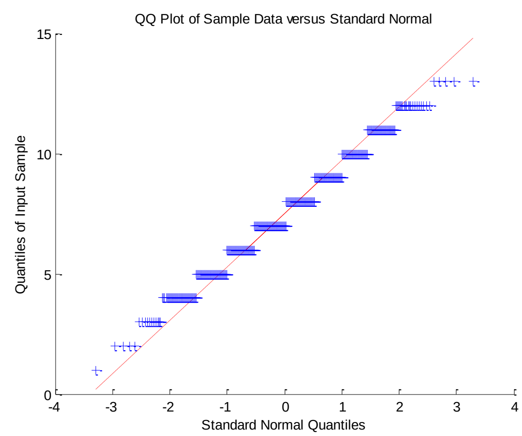












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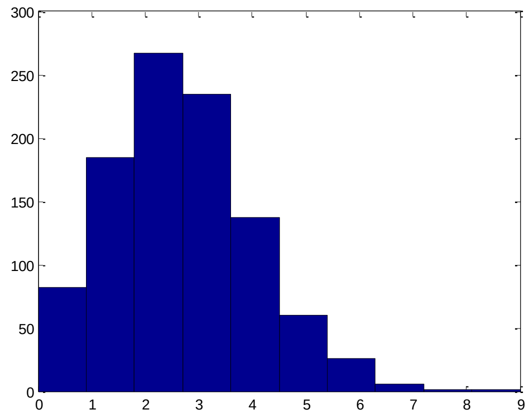

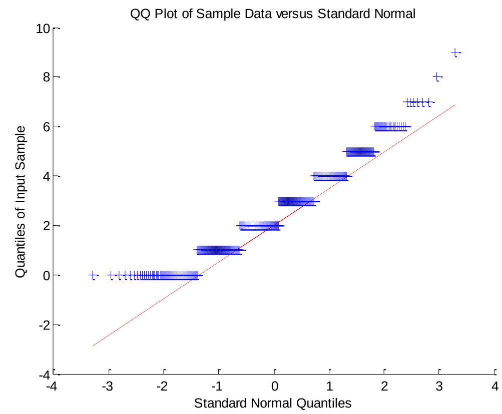

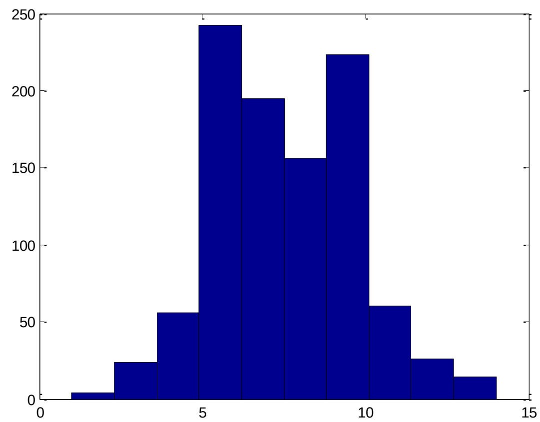

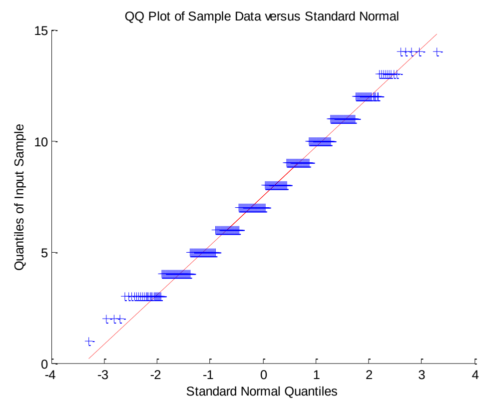

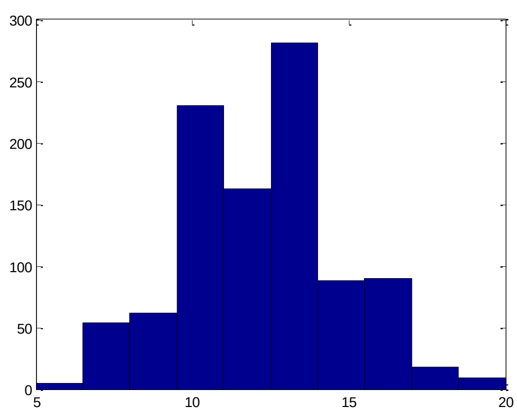

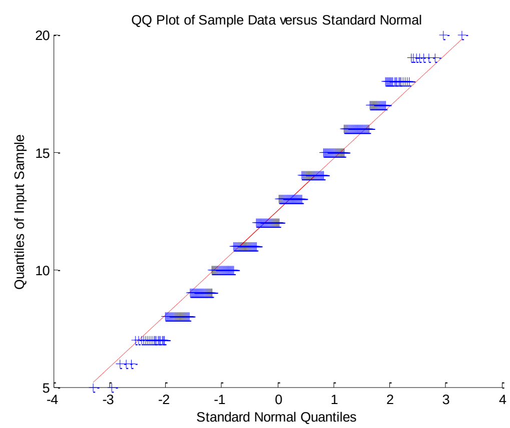

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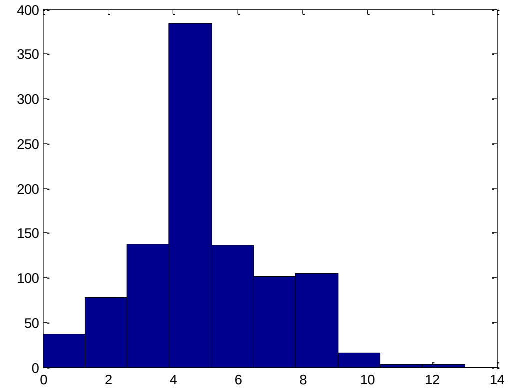

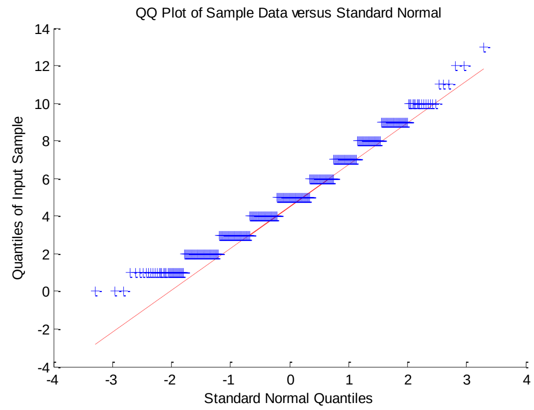

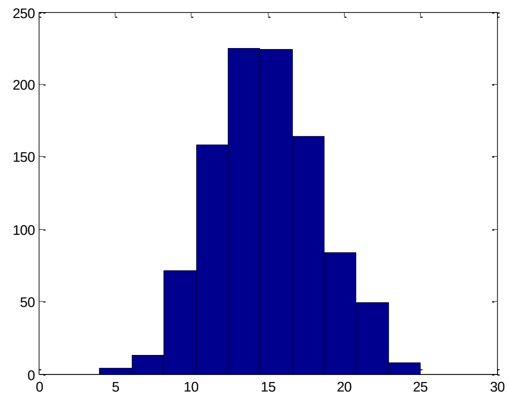

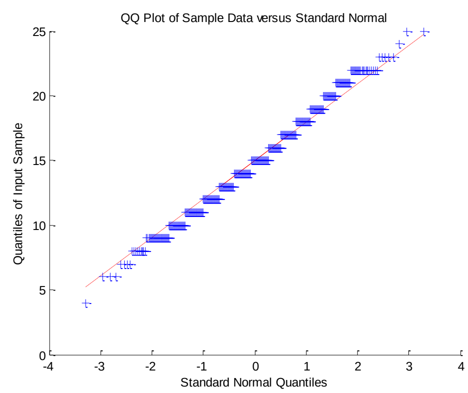

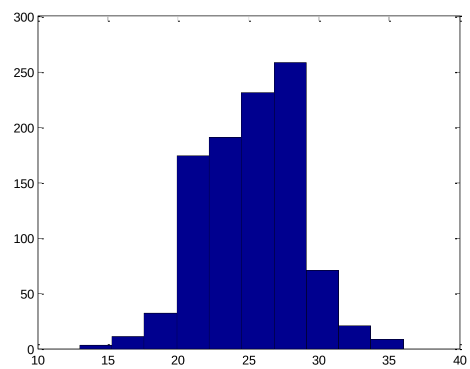

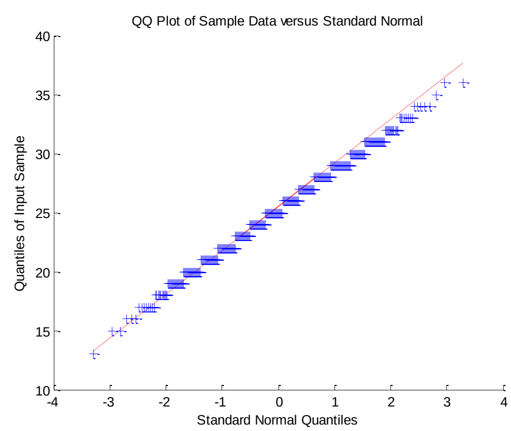

Above are the PMF figures for Binomial. Figures for QQ plots will be analogous to those above. As p << n and np tends to infinity, Binominal, Poisson, and Gaussian all have closely the same distribution.

d.

```
a=cumsum(rand(6,10000));

figure
```

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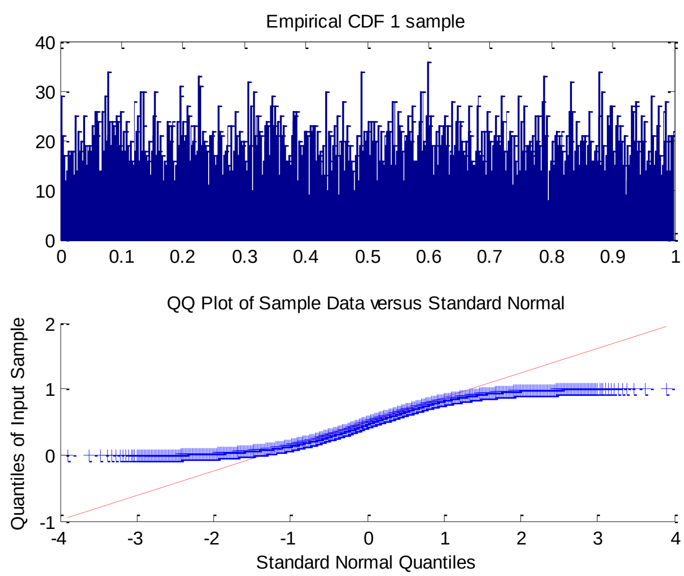
```
subplot(2,1,1),hist(a(1,:),500)
title('Empirical CDF 1 sample')
subplot(2,1,2),qqplot(a(1,:))
figure
subplot(2,1,1),hist(a(2,:)/2,500)
title('Empirical CDF 2 samples')
subplot(2,1,2),qqplot(a(2,:)/2)
figure
subplot(2,1,1),hist(a(3,:)/3,500)
title('Empirical CDF 3 samples')
subplot(2,1,2),qqplot(a(3,:)/3)
figure
subplot(2,1,1),hist(a(4,:)/4,500)
title('Empirical CDF 4 samples')
subplot(2,1,2),qqplot(a(4,:)/4)
figure
subplot(2,1,1),hist(a(5,:)/5,500)
title('Empirical CDF 5 samples')
subplot(2,1,2),qqplot(a(5,:)/5)
figure
subplot(2,1,1),hist(a(6,:)/6,500)
title('Empirical CDF 6 samples')
subplot(2,1,2),qqplot(a(6,:)/6)
```

Figure 1-6



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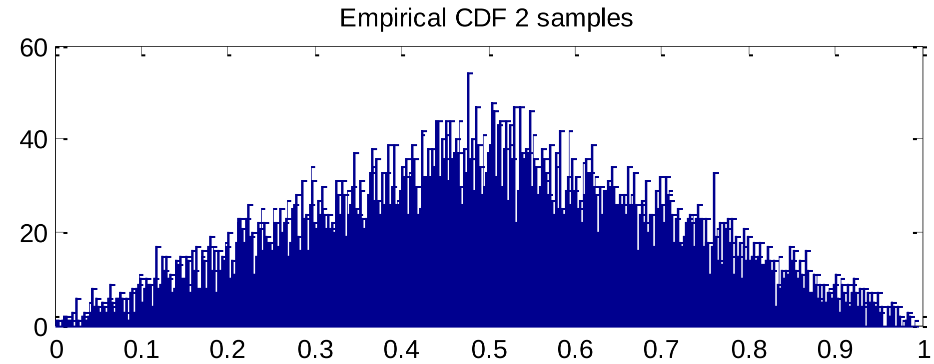

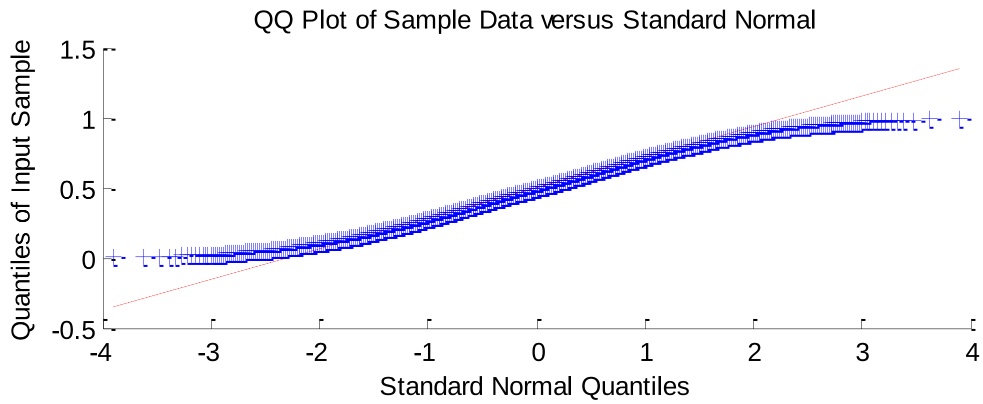

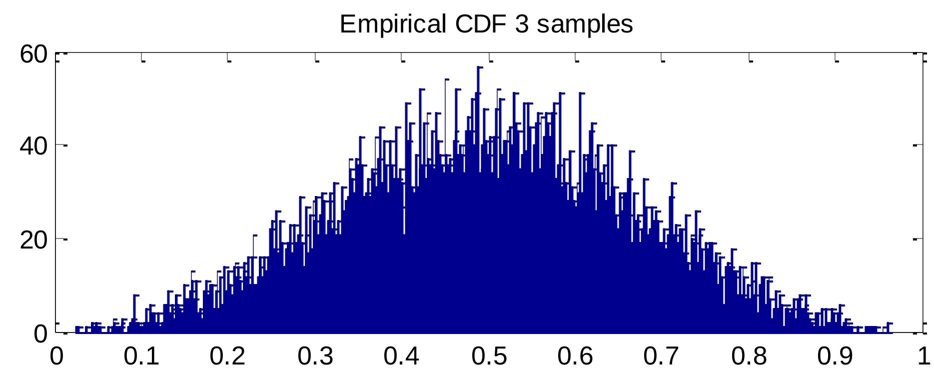

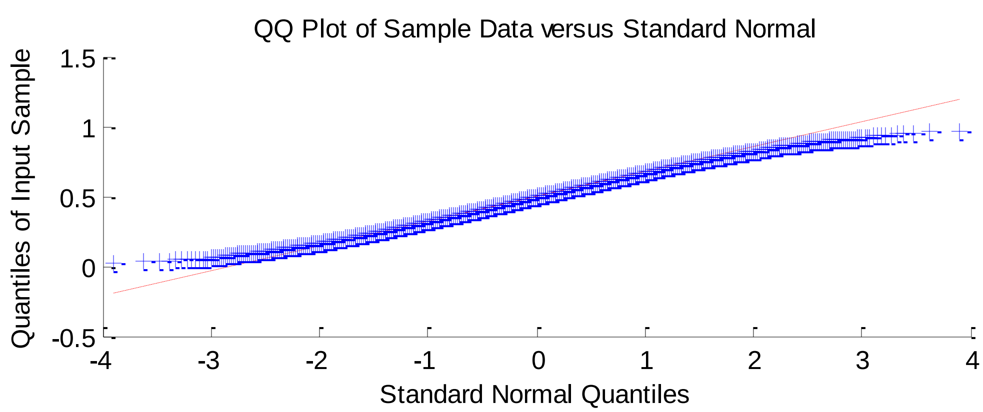

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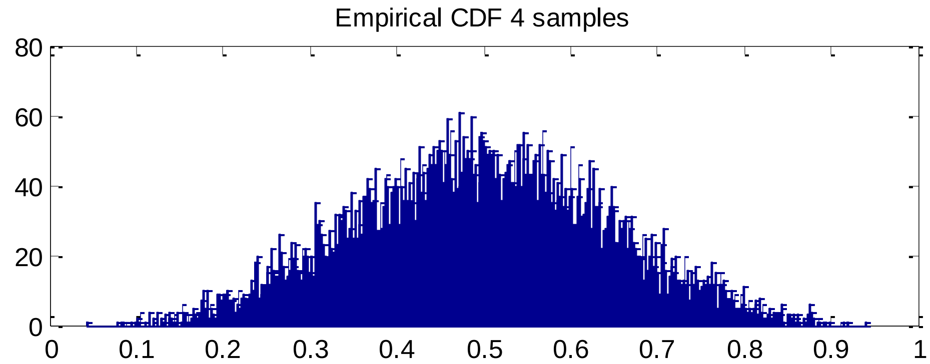

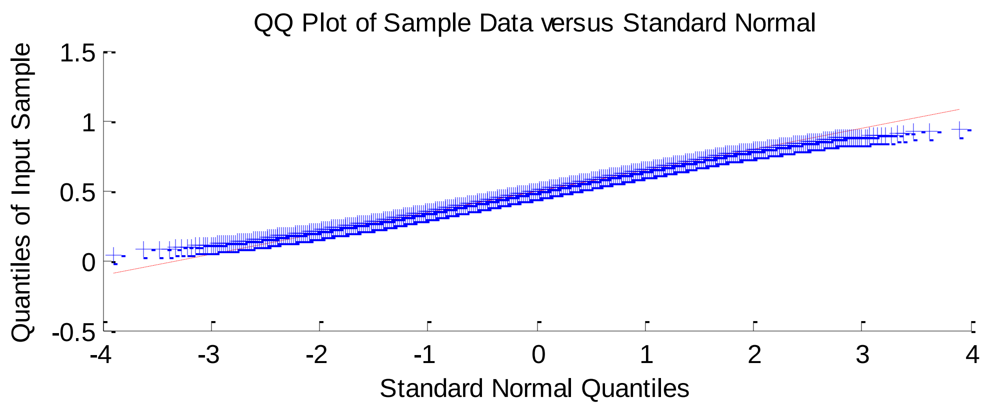

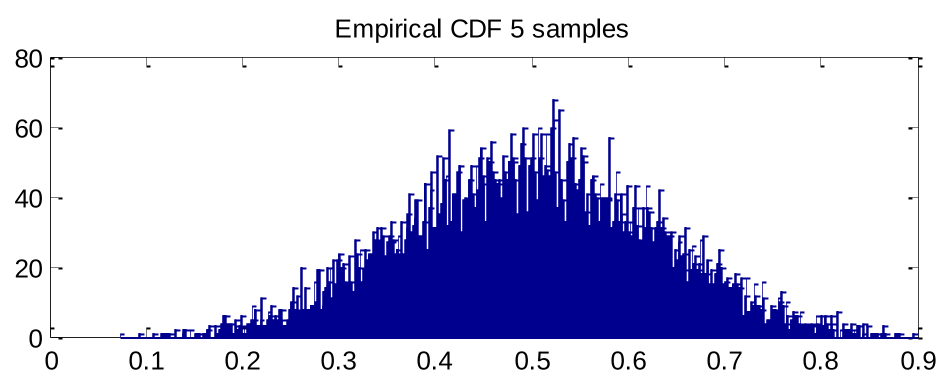

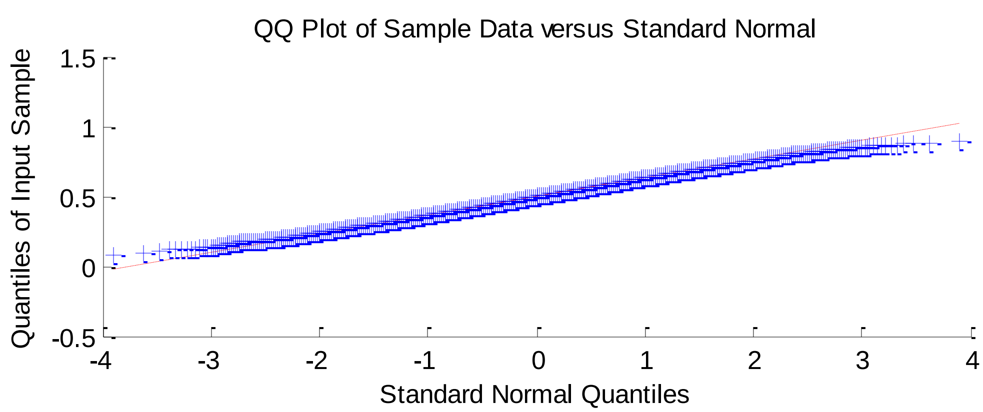

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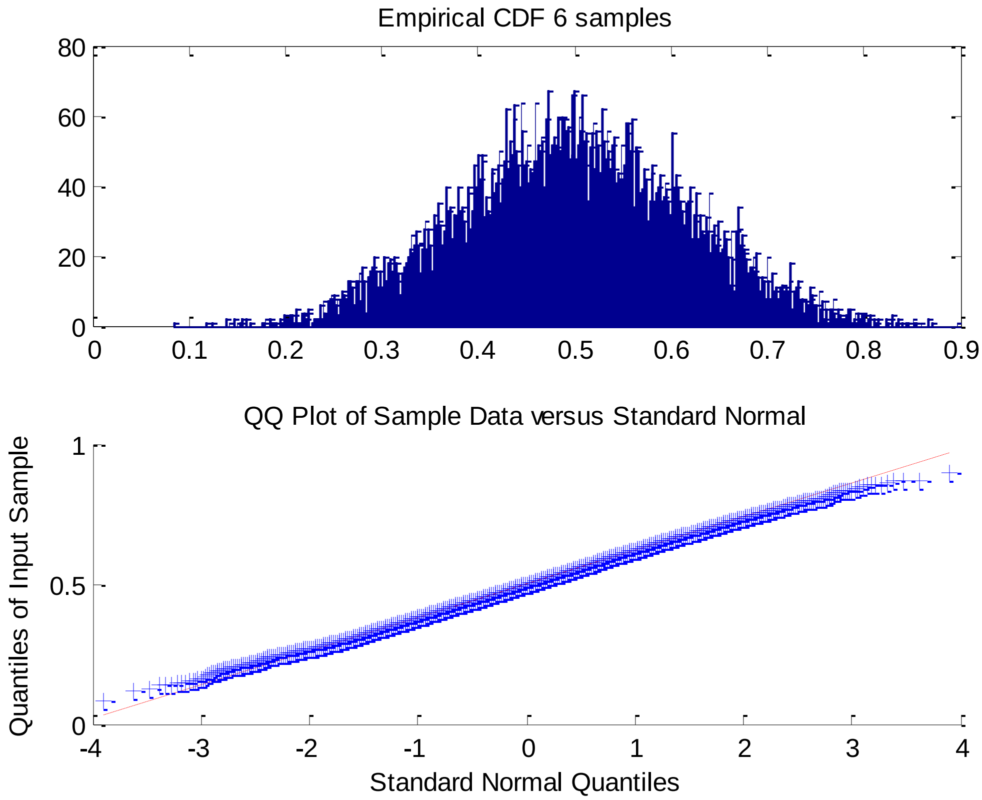

Doing exactly the procedure we mentioned will do the trick: take a sum of a collection of uniform random variables. This is a re-statement of the central limit theorem.

3c.

```
function HW6_3c
fun=(1/(sqrt(2*pi*3)))*exp(-((x+10).^2)/6);
x=-30.00001:30;
plot(x,fun,'c-')

end
```

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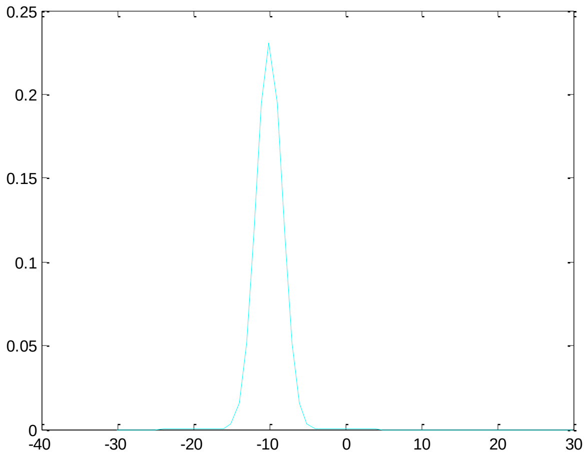
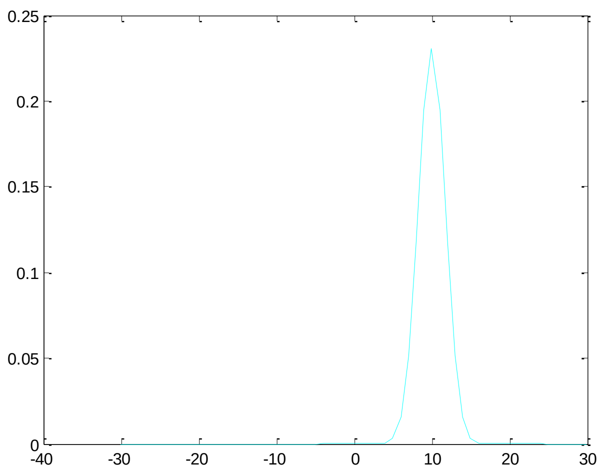



```
function HW6_3c2
fun=(1/(sqrt(2*pi*3)))*exp(-((x-10).^2)/6);
x=-30.00001:30;
plot(x,fun,'c-')
end
```



3d.

```
function HW6_3d
fun= .5*((1/sqrt(2*pi*3)))*exp(-((x+10).^2)/6) + (1/(sqrt(2*pi*3)))*exp(-((x-10).^2)/6));
x=-30:.0001:30;
plot(x,fun,'r-')
end
```

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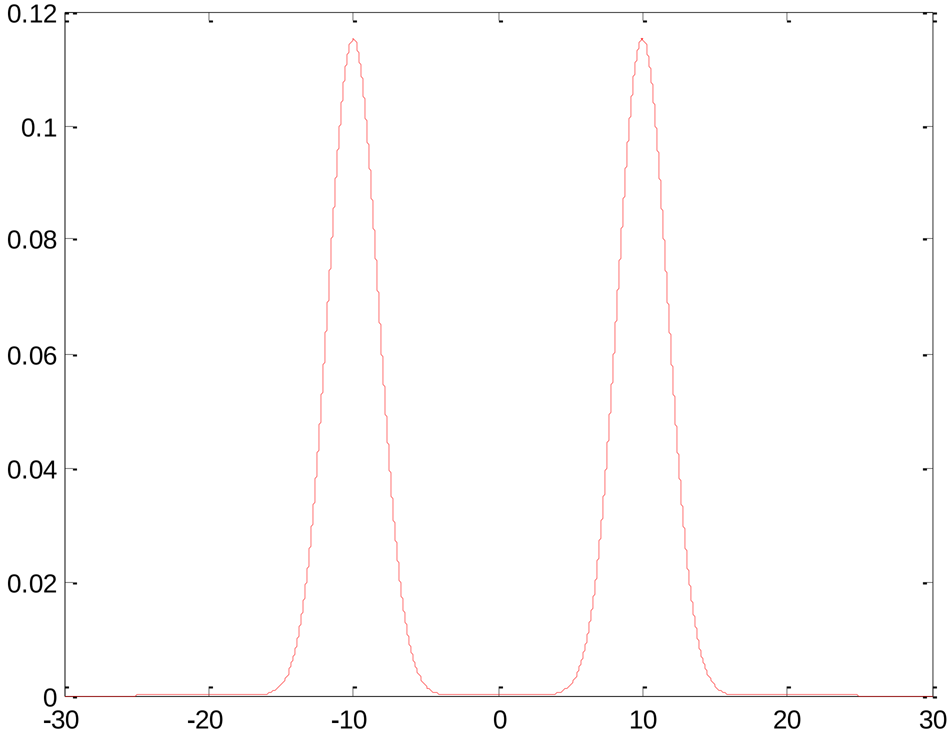

3e.

```
normc=1;
v = 13.3;
vectoru = -2:0.01:2;
for i=1:length(vectoru),
    u = vectoru(i);
    plotXvector(i) = pdfX3cde(u,normc);
    priorX = plotXvector(i);
    likelihoodYgivenX = pdfYgivenX(v,u,muN,variN);
    plot2Xvector(i) = priorX*likelihoodYgivenX;
end

normc = sum(plot2Xvector*0.01);
plot2Xvector = plot2Xvector/normc;
subplot(2,1,1);
plot(vectoru,plotXvector);
xlabel('u');
ylabel('f{X}(u)');
subplot(2,1,2);
plot(vectoru,plot2Xvector);
xlabel('u');
ylabel('f{X|Y}(u|13.3)');
```

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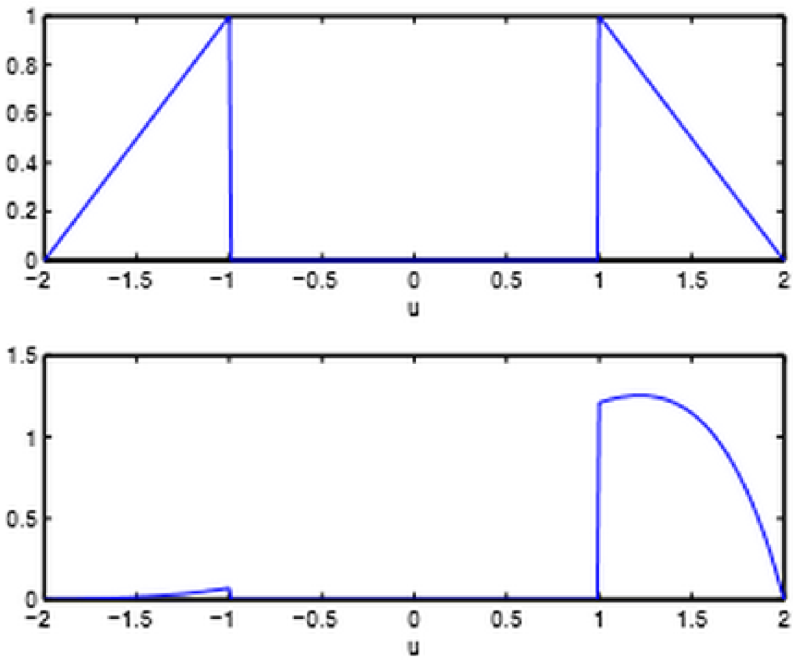
```
function f=pdfX3cde(u,normc)
if 1<=u&u<=2
  f=normc*(2-u);
elseif -2<=u&u<=-1
  f=normc*(2+u);
else
  f=0;
end
```

```
function f=pdfX(u,normc)
if 1<=u&u<=2
   f=normc*(2-u);
elseif -2<=u&u<=-1
   f=normc*(2+u);
else
   f=0;
end
```



4a.

```
a=2.5;
b=5.5;
D=rand;
X=a*D+b
for i=1:10,
```

```
    vectorY(i) = poissrnd(X);
end
vectorY
```

X =

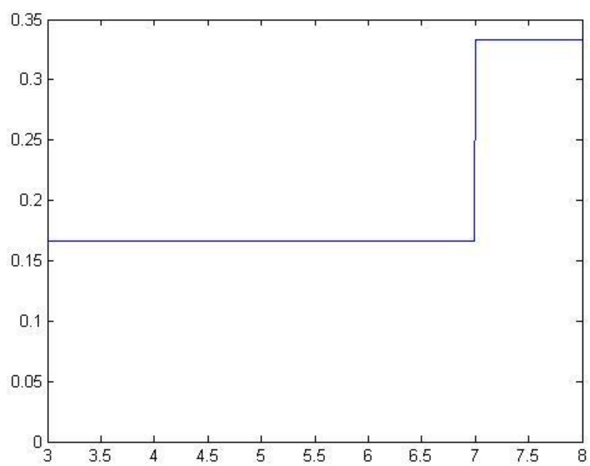
    6.4144

vectorY =

     3   9   7   3   9   7   7   5   3   5

4c.

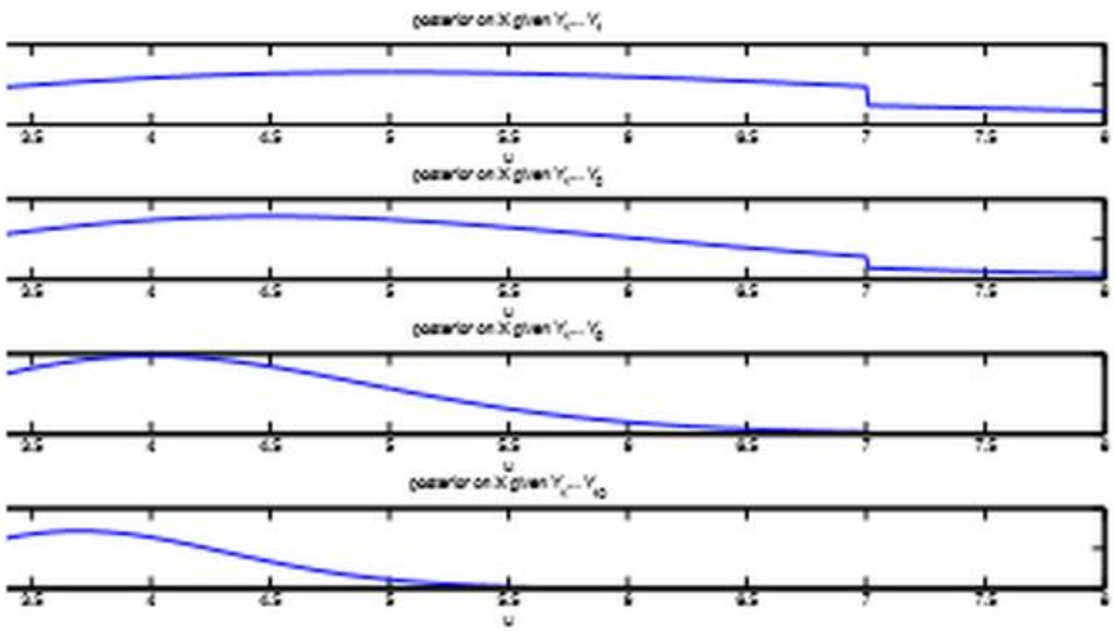
```
vectorU=3:0.0001:8;
for i=1:length(vectorU)
    u=vectorU(i);
    pdfXvector(i)=pdfX(u);
end
figure;
plot(vectorU,pdfXvector);
xlabel('u');
ylabel('fX(u)');
```



4e.

```
vectory = [5,4,6,3,2,3,4,3,5,2];
vectorN = [1,2,5,10];
for i=1:length(vectorN)
    n=vectorN(i);
    sumY=sum(vectory(1:n));
    for i2=1:length(vectorU),
```

```
        u=vectorU(i2);
        vector2X(i,i2)=pdfX(u)*(u^sumY)*exp(-n*u);
    end
normC = sum(vector2X(i,:)*0.01);
vector2X(i,:) = vector2X(i,:)/normC;
subplot(4,1,i)
plot(vectorU,vector2X(i,:));
xlabel('u');
title(sprintf('X|Y1 to Y{%d}',n));
end
end
function func=pdfX(u)
  if 3<=u&u<= 7
      func=2/3;
  elseif 7<=u&u<=8
      func=1/3;
  else func=0;
  end
```



5f.

```
vectory=[5,4,6,3,2,3,4,3,5,2];
vectorN=[1,2,5,10];
for i=1:length(vectorN)
   n=vectorN(i);
   yvector(i)=sum(vectory(1:n))/n;
   epsil(i)=4*sqrt(10/n);
   confidence(i,1)=yvector(i)-epsil(i);
   confidence(i,2)=yvector(i)+epsil(i);
end
disp(yvector)
disp(epsil)
```

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disp(confidence)

```
  5.0000    4.5000    4.0000    3.7000


   12.6491    8.9443    5.6569    4.0000


   -7.6491   17.6491
   -4.4443   13.4443
   -1.6569    9.6569
   -0.3000    7.7000
```