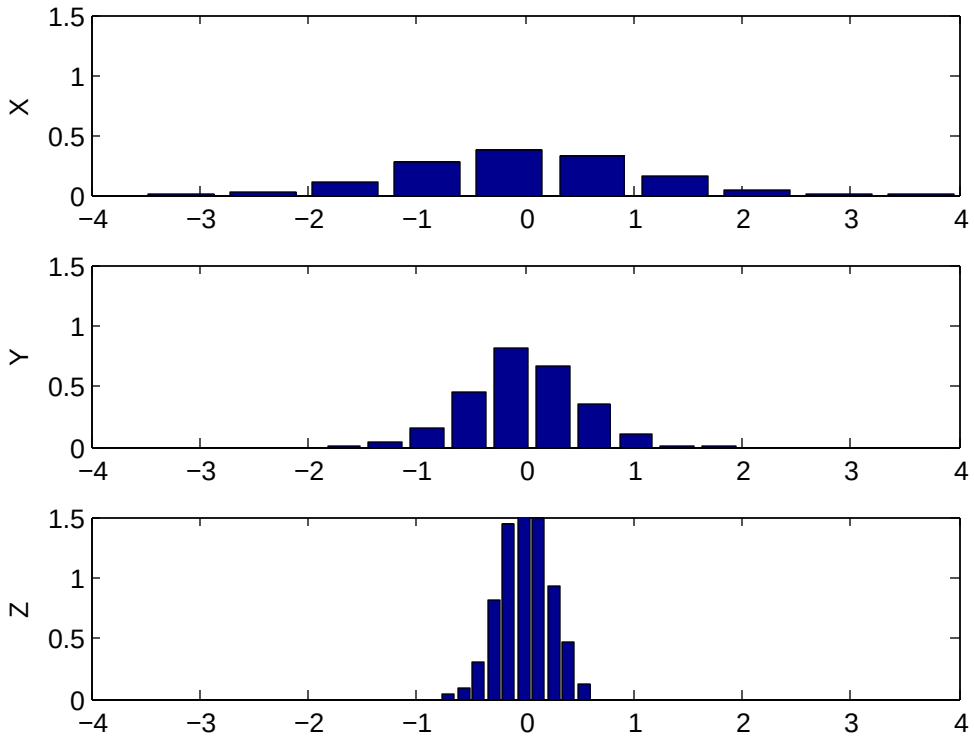
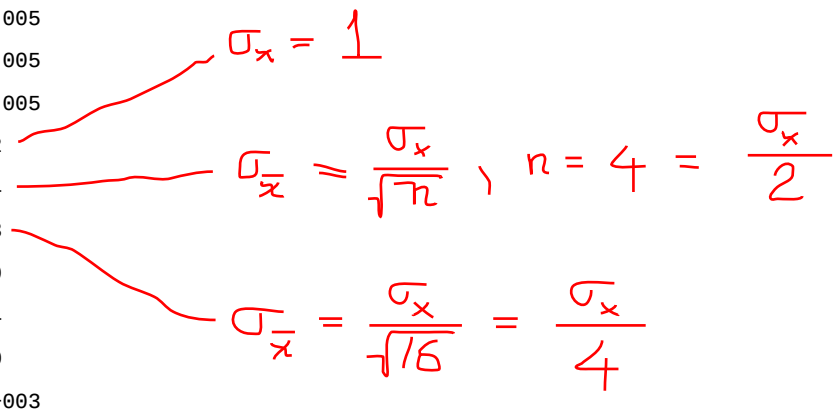


Conclusion from histograms: "averaging" reduces spread or variability, averaging over more samples makes greater reduction in spread / variability. Standard deviation or variance is a measure of this spread / variability. See quantitative argument next page. (All of this assumes that all samples are independent and unbiased.) Averaging over more samples = greater redundancy in LS language.

```
hw21
meanx =
 -7.3298e-005
meany =
 -7.3298e-005
meanz =
 -7.3298e-005
stdx =
    0.9862
stdy =
    0.4904
stdz =
    0.2443
dsx =
    0.7659
dsy =
    0.3524
dsz =
    0.1390
Ax =
  7.6586e+003
Ay =
  880.9563
Az =
   86.8560
gx =
  Columns 1 through 8
    0.0054    0.0353    0.1442    0.3106    0.3894    0.2837    0.1094    0.0245
  Columns 9 through 10
    0.0031    0.0001
gy =
  Columns 1 through 8
    0.0079    0.0409    0.1635    0.5040    0.7912    0.7083    0.4370    0.1362
  Columns 9 through 10
    0.0454    0.0034
gz =
  Columns 1 through 8
    0.0230    0.1957    0.4605    0.9556    1.4161    1.6119    1.2895    0.7829
  Columns 9 through 10
    0.2993    0.1612
diary off
```



```
% hw21.m

x=random('norm',0,1,10000,1);
y=zeros(2500,1);
z=zeros(625,1);

m=0;
for i=1:2500
  sm=0;
  for k=1:4
    sm=sm + x(m+k);
    end;
  y(i)=sm/4;
  m=m+4;
  end

m=0;
for i=1:625
  sm=0;
  for k=1:16
    sm=sm + x(m+k);
    end;
  z(i)=sm/16;
  m=m+16;
  end

meanx=mean(x)
meany=mean(y)
meanz=mean(z)
stdx=std(x)
stdy=std(y)
stdz=std(z)

[hx,sx]=hist(x);
[hy,sy]=hist(y);
[hz,sz]=hist(z);
dsx=sx(2)-sx(1)
dsy=sy(2)-sy(1)
dsz=sz(2)-sz(1)
Ax=0;
Ay=0;
Az=0;
for i=1:10
  Ax=Ax + hx(i)*dsx;
  Ay=Ay + hy(i)*dsy;
  Az=Az + hz(i)*dsz;
  end
Ax
Ay
Az
gx=hx/Ax
gy=hy/Ay
gz=hz/Az

subplot(3,1,1);
bar(sx,gx);
ylabel('X');
axis([-4 4 0 1.5]);

subplot(3,1,2);
bar(sy,gy);
ylabel('Y');
axis([-4 4 0 1.5]);

subplot(3,1,3);
bar(sz,gz);
ylabel('Z');
axis([-4 4 0 1.5]);
```

```
hw22
B =
    -1    -1    -1    -1
    -1    -2    -1    -2
    -1    -3    -1    -3
    -1    -1    -2    -2
    -1    -2    -2    -4
    -1    -3    -2    -6
    -1    -1    -3    -3
    -1    -2    -3    -6
    -1    -3    -3    -9
f =
   -1.5900
   -1.7400
   -2.3600
   -1.7900
   -2.4000
   -2.9400
   -2.1900
   -2.8100
   -3.4300
W =
  Columns 1 through 8
    1.0000         0         0         0         0         0         0         0
         0    1.0000         0         0         0         0         0         0
         0         0    1.0000         0         0         0         0         0
         0         0         0    1.0000         0         0         0         0
         0         0         0         0  100.0000         0         0         0
         0         0         0         0         0    1.0000         0         0
         0         0         0         0         0         0    1.0000         0
         0         0         0         0         0         0         0    1.0000
         0         0         0         0         0         0         0         0
  Column 9
         0
         0
         0
         0
         0
         0
         0
         0
    1.0000
a0 =
    0.9001
a1 =
    0.2917
a2 =
    0.2217
a3 =
    0.1175
v =
   -0.0591
    0.2001
   -0.0107
    0.0801
   -0.0032
   -0.0166
    0.0193
    0.0434
    0.0676
zhat =
    1.5309
    1.9401
    2.3493
    1.8701
    2.3968
    2.9234
    2.2093
    2.8534
    3.4976
diary off
```

```
% hw22.m  29-sep-09

n=9;
n0=4;
r=5;
u=4;
z=[1.59;1.74;2.36;1.79;2.40;2.94;2.19;2.81;3.43];
s=[0.1;0.1;0.1;0.1;0.01;0.1;0.1;0.1;0.1];
x=[1;2;3;1;2;3;1;2;3];
y=[1;1;1;2;2;2;3;3;3];
B=zeros(n,u);
f=zeros(n,1);
s0=0.1;
W=zeros(n,n);
for i=1:n
  W(i,i)=s0^2 / s(i)^2;
  end
for i=1:n
  B(i,:)=[-1 -x(i) -y(i) -x(i)*y(i)];
  f(i)=-z(i);
  end
B
f
W

del=inv(B'*W*B)*B'*W*f;
a0=del(1)
a1=del(2)
a2=del(3)
a3=del(4)
v=f - B*del
zhat=z+v
```

```
hw23
A =
     1     1     1     1     0     0     0
     1     1     0     0    -1     0     0
     0     0     1     1     0    -1     0
     0     1     1     0     0     0    -1
f =
    0.4300
   -0.3500
   -0.1100
   -0.0400
W =
     1     0     0     0     0     0     0
     0     1     0     0     0     0     0
     0     0     1     0     0     0     0
     0     0     0     1     0     0     0
     0     0     0     0     1     0     0
     0     0     0     0     0     1     0
     0     0     0     0     0     0     1
k =
    0.6162
   -0.4850
   -0.4050
   -0.1275
v =
    0.1312
    0.0037
    0.0837
    0.2112
    0.4850
    0.4050
    0.1275
lhat =
   30.0012
  144.8038
   50.3937
   44.8012
  174.8050
   95.1950
  195.1975
diary off
```

```
% hw23.m  29-sep-09

n=7;
n0=3;
r=4;
c=r;
l=[29.87;144.80;50.31;44.59;174.32;94.79;195.07];
s=0.5;
s0=0.5;
W=eye(7);
Q=W;
A=[1 1 1 1  0  0  0;
   1 1 0 0 -1  0  0;
   0 0 1 1  0 -1  0;
   0 1 1 0  0  0 -1];
d=[270;0;0;0];
f=d - A*l;

A
f
W

Qe=A*Q*A';
We=inv(Qe);
k=We*f
v=Q*A'*k
lhat=l+v
```