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% LS_line_fit_OO.m  11-sept-2014
% example matlab script to solve observation only problem
% fitting a line to 3 points
% y=observations, x=constants, equal weights
% (y3 - y1)/(x3 - x1) = (y2 - y1)/(x2 - x1)
% y3 - y1 = 2*y2 - 2*y1
% y3 - 2*y2 + y1 = 0                  actually these should be yhat!
% (y3+v3) - 2*(y2+v2) + (y1+v1) = 0    rearrange, v's left, y's right
% v3 - 2*v2 + v1 = -(y3 - 2*y2 + y1)   put in form A*v = f
% [1 -2 1][v1] = -[1 -2 1][y1]
%         [v2]            [y2]
%         [v3]            [y3]

n=3;
n0=2;
r=n - n0;

y=[1.0;1.6;2.0];
x=[1.0;2.0;3.0];

W=[1 0 0;
   0 1 0;
   0 0 1];

A=[1 -2 1];
f=-A*y;

% form and solve the full normal equations

N=[-W A';
    A 0];
t=[0;0;0;f];
sol=inv(N)*t;
v=sol(1:3)
k=sol(4)

yhat=y + v

% for the plot we need slope and intercept

m=(yhat(3)-yhat(1))/(x(3)-x(1));
x0=x(3);
y0=yhat(3);
b=y0 - m*x0;

plot(x,y,'r*');
hold on
px=[0;4];
py=[b;m*4+b];
plot(px,py,'b-');

for i=1:n
  px=[x(i);x(i)];
  py=[y(i);yhat(i)];
  plot(px,py,'k-');
  end
axis equal
```