```
% gda07_03

% solved Gm=d using Singular Value Decomposition
% for a G that averages adjacent model pararmaters
% supports Section 7.6 and Figure 7.4.

clear all;

% model parameters m(z) where z is an auxially variable
M=20;
zmin = 0.0;
zmax = 5.0;
Lz = zmax-zmin;
Dz = (zmax-zmin)/(M-1);
z = zmin + Dz*[0:M-1]';

% tre model parameter is a sine wave
mtrue = sin( 2*pi*z/Lz );

% data kernel avarages L adjacent model parameters
% but wraps around from the end to the beginning of
% the model
g1 = [1, 1, 1.1, 1, 1]';
L=length(g1);
g=[ g1', zeros(1,M-L) ]';
N=M;
G=zeros(N,M);
for i=[1:M]
   G(i,:) = circshift(g,i-1)';
end
G=fliplr(G);

% observed data is true data plus random noise
sigmad=0.01;
dobs = G*mtrue + random('Normal',0.0,sigmad,N,1);

% singular value decomposition of data kernel
[U, L, V] = svd(G);
lambda = diag(L);

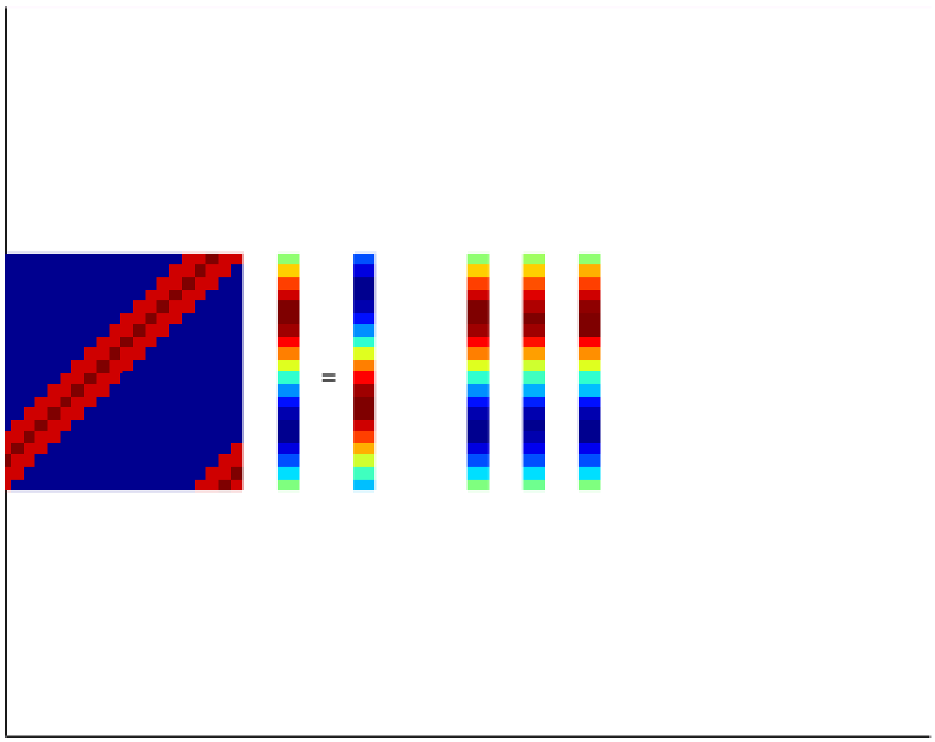
% selection of non-zero singular valies
p = 16;

% throw out part of decomposition associated with zero singular values
lambdap = lambda(1:p);
Up=U(:,1:p);
Vp=V(:,1:p);

% natural solution
mest = Vp*((Up'*dobs)./lambdap);

% damped least squares solution, for comparison
e2=1e-2;
mestDML = G'*((G*G'+e2*eye(N,N))\dobs);

% draw dobs = G m for various m's
gda_draw(G,' ',mtrue,'=',' ',dobs,' ',' ',' ',' ',mtrue,' ',mest,' ',mestDML);
```

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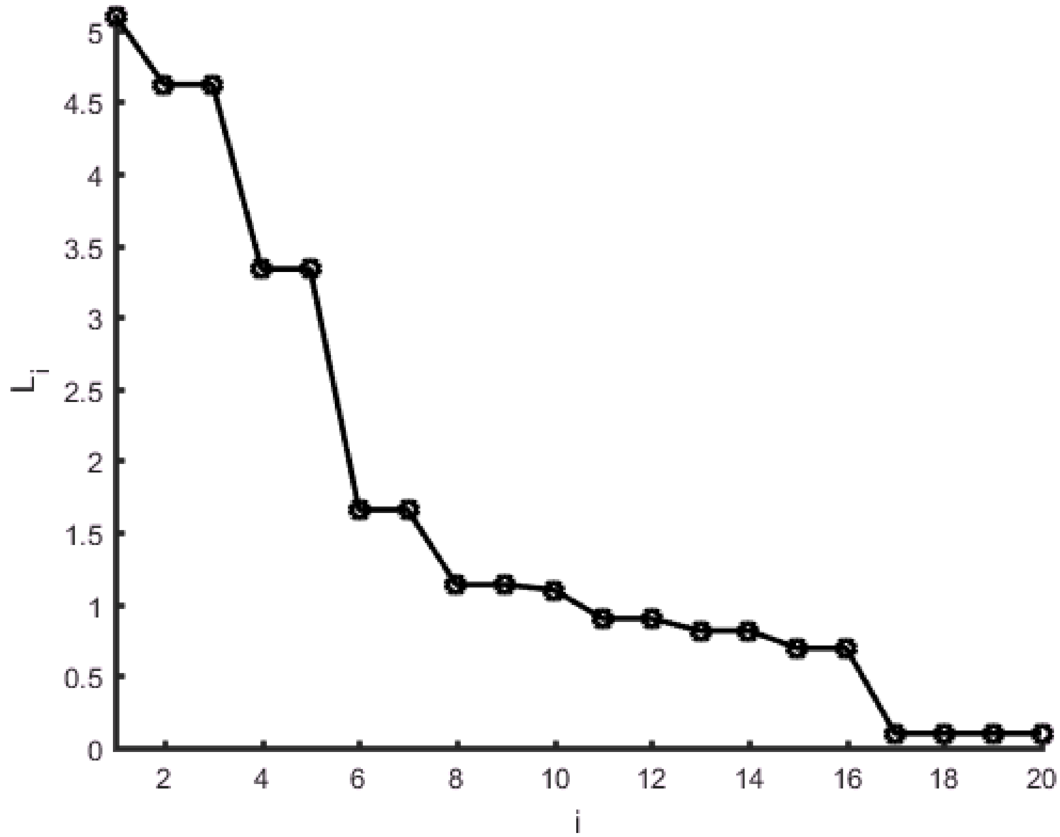
% Figure 7.4 (A) Same linear problem as in Figure 7.3A, where dobs = Gmtrue + n,
% with n uncorrelated Gaussian noise. (B) Corresponding solutions, true solutions
% mtrue, natural solution (mest)N, and damped minimum-length solution (mest)DML.

figure(2);
clf;

% plot singular values
set(gca,'LineWidth',2);
hold on;
axis( [1, M, 0 max(lambda) ] );
plot( [1:M]', lambda, 'k-', 'LineWidth', 2 );
hold on;
plot( [1:M]', lambda, 'ko', 'LineWidth', 2 );
xlabel('i');
ylabel('L_i');
```




```
% Figure 7.3 (B) Singular values λi have a clear cutoff at p = 16.
```