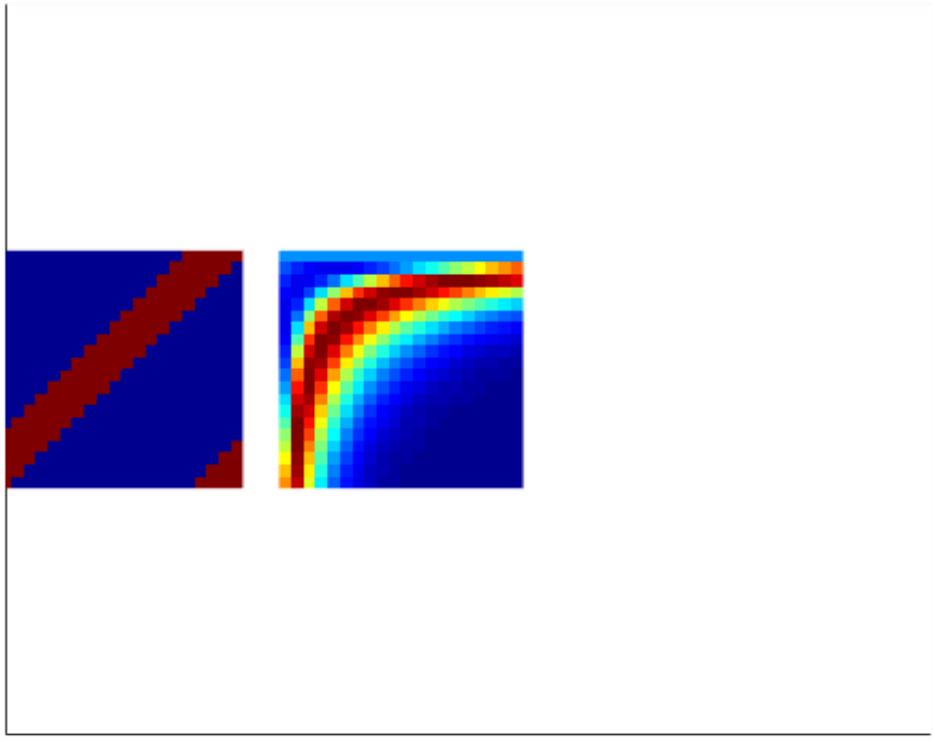
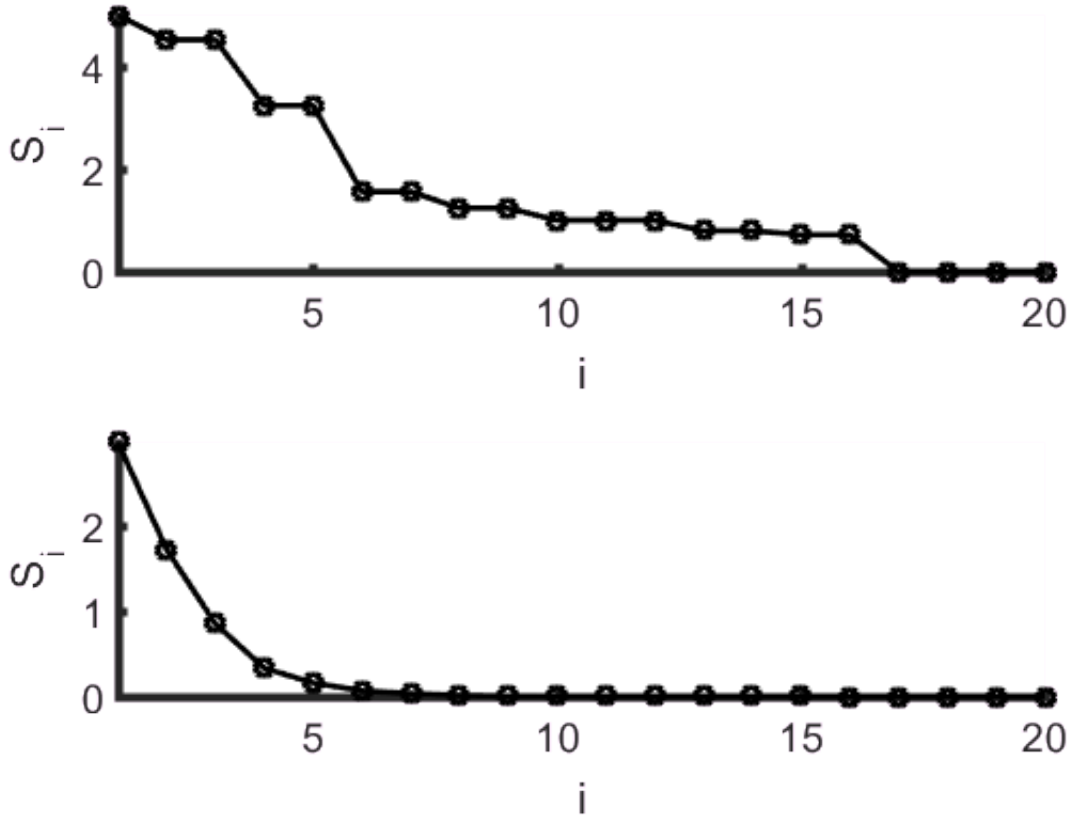
```
% gda07_04

% Singular Value Decomposition of two G's
% Both G's averages adjacent model pararmaters
% but the second is a smoother average
% supports FIgure 7.3

clear all;

% model parameters m(z) where z is an auxially variable
M=20;
mmin = 0.0;
mmax=5;
Dm = (mmax-mmin)/(M-1);
m = mmin + Dm*[0:M-1]';

% first G is a straight average, but wraps around the
% end of the (zmin,zmax) interval
g1 = [1, 1, 1, 1, 1]';
L=length(g1);
g=[ g1', zeros(1,M-L) ]';
N=M;
G1=zeros(N,M);
for i=[1:M]
   G1(i,:) = circshift(g,i-1)';
end
G1=fliplr(G1);

% Singular Value Decomposition of G
[U, S1, V] = svd(G1);
s1 = zeros(M,1);
sp = diag(S1);
p = length(sp);
s1 = [ sp', zeros(1,M-p) ]';

% second G is a smoother average, and does not wrap
cmin=0;
cmax=10*(1/M);
c = cmin + (cmax-cmin)*[0:M-1]'/(M-1);
G2 = exp( -(c * [1:M]) ) - 0.9*exp( -(2*c * [1:M]).^2 );

% draw the two G's
gda_draw(G1,' ',G2);
```



```
% Figure 7.3 (A) Hypothetical data kernel Gij for an inverse problem with M = 20 model paramet
% and N = 20 observations. (C) Another hypothetical data kernel, also with N = 20 and M = 20.

figure(2);
clf;

% plot singular values
subplot(2,1,1);
set(gca,'LineWidth',3);
set(gca,'FontSize',14);
hold on;
axis( [1, M, 0 max(s1) ] );
plot( [1:M]', s1, 'k-', 'LineWidth', 2 );
hold on;
plot( [1:M]', s1, 'ko', 'LineWidth', 2 );
xlabel('i');
ylabel('S_i');

% singular value decomposition
[U, S1, V] = svd(G2);
s1 = zeros(M,1);
sp = diag(S1);
p = length(sp);
s2 = [ sp', zeros(1,M-p) ]';

% plot singular values
subplot(2,1,2);
set(gca,'LineWidth',3);
set(gca,'FontSize',14);
hold on;
```

```
axis( [1, M, 0 max(s2) ] );
plot( [1:M]', s2, 'k-', 'LineWidth', 2 );
hold on;
plot( [1:M]', s2, 'ko', 'LineWidth', 2 );
xlabel('i');
ylabel('S_i');
```




```
% Figure 7.3 (B) Singular values λi corresponding to (A) have a clear cutoff at p = 16. (D) Sin
% corresponding to (C) do not have a clear cutoff, so the parameter, p, must be chosen in a mo
% fashion near p ≈ 7. MatLab Script gda07_04.
```