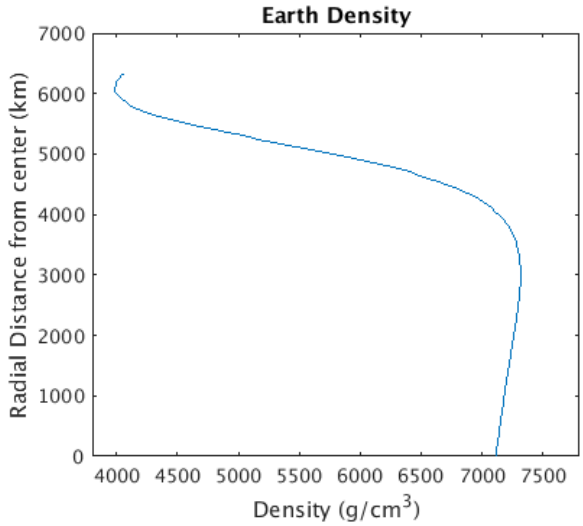
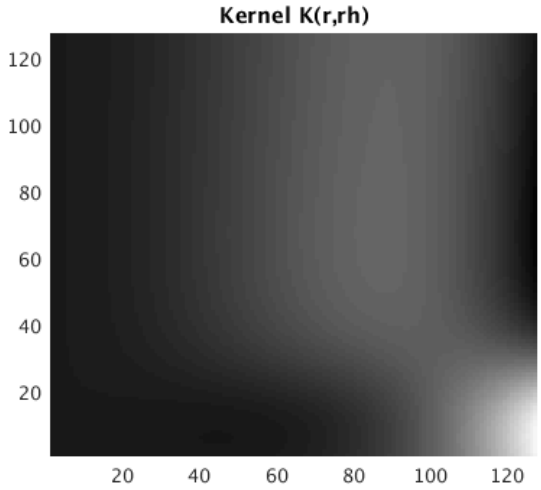
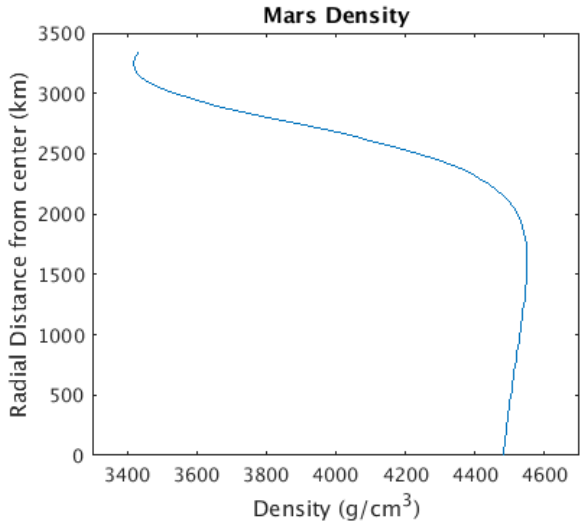
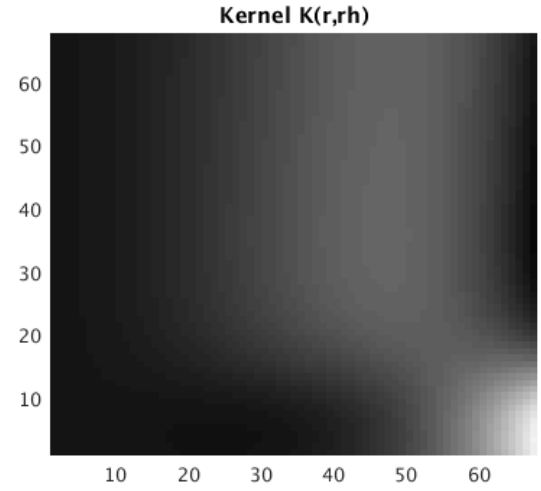
```
% midterm 1, problem 3


% set r to be variable
r = sym('r');
% mass and inertia equations
Md = (4.*pi.*r.^2);
Id = ((8/3).*pi.*r.^4);
G  = [Md; Id];
M  = int(Md,r);
I  = int(Id,r);

%EARTH
% parameters for earth (data)
Re = 6.3708e6;
Me = 5.972e24;
Ie = 8.034e37;
d  = [Me; Ie];

% calculate q
q1 = eval(int(Md,r, 0, Re));
q2 = eval(int(Id,r, 0, Re));
q  = [q1; q2];

% set up to interate over all radii
Ri = [0:50000:Re];
mest_all = [];
k_all = [];

% interate over radii
for i=1:length(Ri)
    % radius
    ri = Ri(i);
    % calculate H
    H0 = G*G'*((r-ri).^2);
    H = eval(int(H0, 0, Re));
    %calculate c
    c = (inv(H)*q)./(q'*inv(H)*q);
    % calculate mest
    mest = c'*d;
    mest_all = [mest_all; mest];
    % calculate k
    k(r) = c'*G;
    k_all = [k_all; eval(k(Ri))];
end

figure('units','normalized','outerposition',[0 0 .7 .5]);
subplot(1,2,1)
plot(mest_all, Ri./1e3);
title('Earth Density');
xlabel('Density (g/cm^3)');
ylabel('Radial Distance from center (km)');
xlim([3800 7800]);
subplot(1,2,2)
pcolor(flipud(k_all)); shading flat;
colormap gray
title('Kernel K(r,rh)');

% MARS
% parameters for mars (data)
Re = 3.389e6;
Me = 0.642e24;
Ie = 2.709e36;
d  = [Me; Ie];

% calculate q
q1 = eval(int(Md,r, 0, Re));
q2 = eval(int(Id,r, 0, Re));
q  = [q1; q2];

% set up to interate over all radii
Ri = [0:50000:Re];
mest_all = [];
k_all = [];

% interate over radii
for i=1:length(Ri)
    % radius
    ri = Ri(i);
    % calculate H
    H0 = G*G'*((r-ri).^2);
    H = eval(int(H0, 0, Re));
    %calculate c
```

```
    c = (inv(H)*q)./(q'*inv(H)*q);
    % calculate mest
    mest = c'*d;
    mest_all = [mest_all; mest];
    % calculate k
    k(r) = c'*G;
    k_all = [k_all; eval(k(Ri))];
end

figure('units','normalized','outerposition',[0 0 .7 .5]);
subplot(1,2,1)
plot(mest_all, Ri./1e3);
title('Mars Density');
xlabel('Density (g/cm^3)');
ylabel('Radial Distance from center (km)');
xlim([3300 4700]);
subplot(1,2,2)
pcolor(flipud(k_all)); shading flat;
colormap gray
title('Kernel K(r,rh)');
```









Published with MATLAB® R2017a