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```
% SIO 229 Gravity and Geomagnetism HW #2
clear all; close all; clc
```

Question 2A

Write in the data vector d associated with this data

```
% Site location in latitude and longitude. Converted to theta and phi
siteLat = [-85.00; 85.00; 85.00; 37.80; 51.50; 30.00; 40.70; -23.5;
 -33.90;
    -31.95; -33.90];
siteLon = [180.00; 0.00; 116.40; -122.40; -0.13; 31.20; -74.00;
 -46.60;
    18.42; 115.90; 151.20];

theta = 90 - siteLat;           % theta in degrees
phi = siteLon;                  % phi in degrees
N = length(theta);

% Elements of the magnetic field in nT
X = -[-11489.98; 4299.58; 28149.16; 22271.61; 19513.26; 31272.19;
 20512.93;
    16604.76; 9202.13; 23415.41; 24400.95];
Y = [9038.53; 7.02; -3373.34; 5685.59; -241.62; 2841.33; -4781.95;
 -5766.60;
    -4666.18; -549.91; 5652.93];
Z = -[-56215.10; 55749.08; 46548.43; 42496.19; 44814.76; 30123.66;
 46697.48;
    -14384.17; -23644.95; -53993.09; -50885.50];

% Data vector containing all the magnetic field
d = [X; Y; Z]
```

```
d =

   1.0e+04 *
```

```
    1.1490
   -0.4300
   -2.8149
   -2.2272
   -1.9513
   -3.1272
   -2.0513
   -1.6605
   -0.9202
   -2.3415
   -2.4401
    0.9039
    0.0007
   -0.3373
    0.5686
   -0.0242
    0.2841
   -0.4782
   -0.5767
   -0.4666
   -0.0550
    0.5653
    5.6215
   -5.5749
   -4.6548
   -4.2496
   -4.4815
   -3.0124
   -4.6697
    1.4384
    2.3645
    5.3993
    5.0885
```

Question 2C

Evaluate the elements of this G matrix

```
% Columns of G
G1 = [sind(theta); zeros(N,1); 2*cosd(theta)];
G2 = [-cosd(theta).*cosd(phi); -sind(phi); 2*sind(theta).*cosd(phi)];
G3 = [-cosd(theta).*sind(phi); cosd(phi); 2*sind(theta).*sind(phi)];

G = [G1 G2 G3]


G =

    0.0872   -0.9962         0
    0.0872   -0.9962         0
    0.0872    0.4429   -0.8923
    0.7902    0.3284    0.5175
```

```
    0.6225   -0.7826    0.0018
    0.8660   -0.4277   -0.2590
    0.7581   -0.1797    0.6268
    0.9171    0.2740   -0.2897
    0.8300    0.5292    0.1762
    0.8485   -0.2311    0.4760
    0.8300   -0.4888    0.2687
         0         0   -1.0000
         0         0    1.0000
         0   -0.8957   -0.4446
         0    0.8443   -0.5358
         0    0.0023    1.0000
         0   -0.5180    0.8554
         0    0.9613    0.2756
         0    0.7266    0.6871
         0   -0.3160    0.9488
         0   -0.8996   -0.4368
         0   -0.4818   -0.8763
   -1.9924   -0.1743         0
    1.9924    0.1743         0
    1.9924   -0.0775    0.1561
    1.2258   -0.8468   -1.3343
    1.5652    1.2450   -0.0028
    1.0000    1.4815    0.8972
    1.3042    0.4179   -1.4575
   -0.7975    1.2602   -1.3326
   -1.1155    1.5750    0.5245
   -1.0584   -0.7413    1.5266
   -1.1155   -1.4547    0.7997
```

Question 2D

Calculate G'G, G'd, (G'G)^-1

```
GtG  = G'*G
Gtd = G'*d
invGtG = inv(GtG)


GtG =

   28.1053    2.3422   -3.2720
    2.3422   19.5783   -0.9854
   -3.2720   -0.9854   18.3164


Gtd =

   1.0e+05 *

   -8.1803
   -1.4843
```

```
    1.7842


invGtG =

    0.0367   -0.0041    0.0063
   -0.0041    0.0517    0.0021
    0.0063    0.0021    0.0558
```

Question 2E

Find the least squares solution for the l=1 model parameters

```
% b is the vector g01 g11 h11 in nT
b = G\d


b =

   1.0e+04 *

   -2.8253
   -0.3976
    0.4480
```

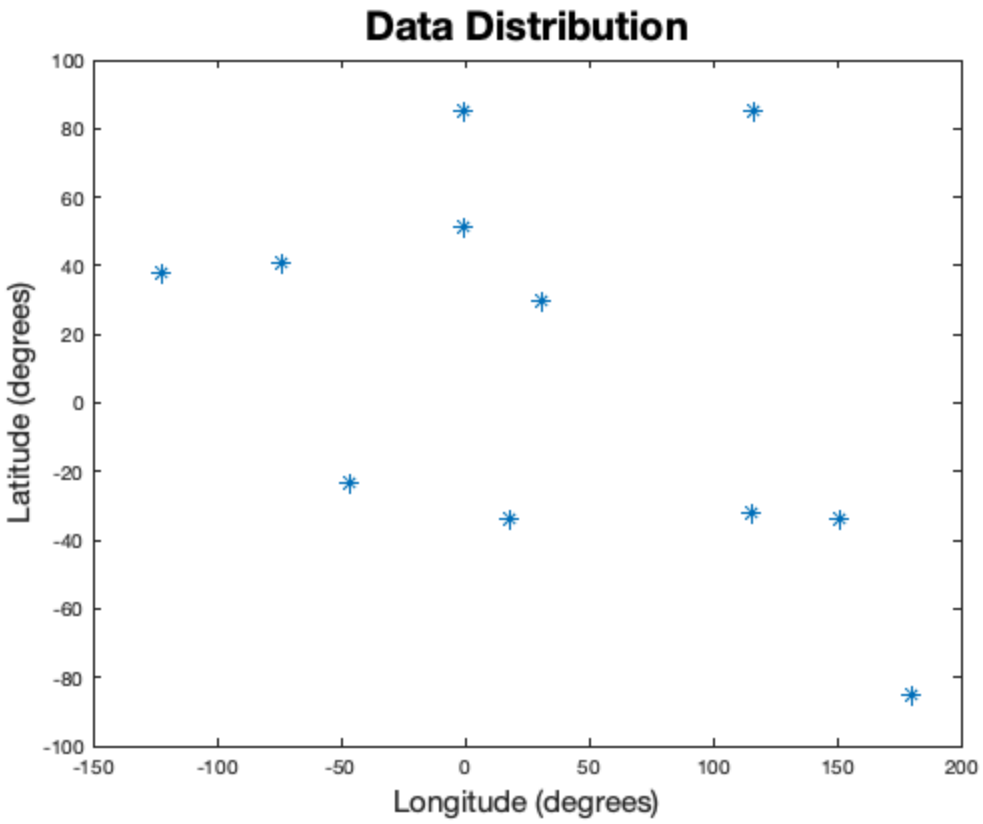
Question 2F

```
IFRP2020 = [-29404.58; -1450.9; 4652.5];
```

Question 2G

Do your results depend on the available data distribution?

```
figure(1)
plot(siteLon, siteLat,'*')
set(gcf,'color','w');
xlabel('Longitude (degrees)','FontSize',15)
ylabel('Latitude (degrees)','FontSize',15)
title('Data Distribution','FontSize',20)
```



Question 2h

```
f = 1/(298.257);
```

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