

```
% Homework 9
% Problem 8
% 8.(a)
```

```
A = [ 0 .707 1
      -.707 0 .707
      -1 -.707 0
      -.707 -1 -.707
      0 -.707 -1
      .707 0 -.707
      1 .707 0
      .707 1 .707
      0 -.707 1
      .707 0 -.707
      -1 .707 0
      .707 -1 .707
      0 .707 -1
      -.707 0 .707
      1 -.707 0
      -.707 1 -.707]
```

```
A =
```

```

      0      0.7070      1.0000
    -0.7070      0      0.7070
    -1.0000    -0.7070      0
    -0.7070    -1.0000    -0.7070
      0    -0.7070    -1.0000
      0.7070      0    -0.7070
      1.0000      0.7070      0
      0.7070      1.0000      0.7070
      0    -0.7070      1.0000
      0.7070      0    -0.7070
    -1.0000      0.7070      0
      0.7070    -1.0000      0.7070
      0      0.7070    -1.0000
    -0.7070      0      0.7070
      1.0000    -0.7070      0
    -0.7070      1.0000    -0.7070
```

```
b = [.707 0 -.707 -1 -.707 0 .707 1 0 0 0 0 0 0 0 0 0 0]
```

```
b =
```

```

      0.7070
      0
    -0.7070
    -1.0000
    -0.7070
      0
      0.7070
      1.0000
      0
      0
      0
      0
      0
      0
      0
      0
```

```
A\b
```

```
ans =
```

```
    0.3536
    0.5000
    0.3536
```

```
% 8.(b)
```

```
x = inv(A' * A) * A' * b
```

```
x =
```

```
    0.3536
    0.5000
    0.3536
```

```
pdist([x A\b'],'euclidean')
```

```
ans =
```

```
    7.8505e-17
```

```
% 8.(c)
```

```
[Q,R]= qr(A)
```

```
Q =
```

```
Columns 1 through 10
```

```
    0    -0.2500   -0.3536    0.4328    0.3000   -0.0086   -0.3121   -0.4328
-0.1708   -0.0086
    0.2500    0.0000   -0.2500    0.2122    0.2914    0.2000   -0.0086   -0.2122
0.1086    0.2000
    0.3536    0.2500   -0.0000   -0.1329    0.1122    0.2914    0.3000    0.1329
-0.3828    0.2914
    0.2500    0.3536    0.2500    0.8000   -0.1914   -0.0707    0.0914    0.2000
0.0500   -0.0707
    0    0.2500    0.3536   -0.0914    0.8500   -0.1207   -0.0207    0.0914
0.0854   -0.1207
   -0.2500   -0.0000    0.2500    0.0707   -0.0207    0.9000   -0.1207   -0.0707
0.0707   -0.1000
   -0.3536   -0.2500   -0.0000    0.1914    0.1207   -0.0207    0.8500   -0.1914
0.0146   -0.0207
   -0.2500   -0.3536   -0.2500    0.2000    0.1914    0.0707   -0.0914    0.8000
-0.0500    0.0707
    0    0.2500   -0.3536   -0.0500    0.0147    0.0707    0.0854    0.0500
0.8250    0.0707
   -0.2500   -0.0000    0.2500    0.0707   -0.0207   -0.1000   -0.1207   -0.0707
0.0707    0.9000
    0.3536   -0.2500    0.0000   -0.0500    0.0146    0.0707    0.0854    0.0500
0.0750    0.0707
   -0.2500    0.3536   -0.2500   -0.0000    0.0000    0.0000    0.0000    0.0000
-0.1768    0.0000
    0   -0.2500    0.3536    0.0500   -0.0147   -0.0707   -0.0854   -0.0500
0.1750   -0.0707
    0.2500    0.0000   -0.2500   -0.0707    0.0207    0.1000    0.1207    0.0707
-0.0707    0.1000
   -0.3536    0.2500   -0.0000    0.0500   -0.0146   -0.0707   -0.0854   -0.0500
-0.0750   -0.0707
    0.2500   -0.3536    0.2500    0.0000   -0.0000   -0.0000   -0.0000   -0.0000
0.1768   -0.0000
```

Columns 11 through 16

0.1829	-0.2500	0.1708	0.0086	-0.1829	0.2500
-0.3914	0.3536	-0.1086	-0.2000	0.3914	-0.3536
-0.0293	-0.2500	0.3828	-0.2914	0.0293	0.2500
0.0500	-0.0000	-0.0500	0.0707	-0.0500	0.0000
0.0854	0.0000	-0.0854	0.1207	-0.0854	-0.0000
0.0707	0.0000	-0.0707	0.1000	-0.0707	-0.0000
0.0147	0.0000	-0.0146	0.0207	-0.0147	0.0000
-0.0500	0.0000	0.0500	-0.0707	0.0500	-0.0000
0.0750	-0.1768	0.1750	-0.0707	-0.0750	0.1768
0.0707	0.0000	-0.0707	0.1000	-0.0707	-0.0000
0.8250	0.1768	-0.0750	-0.0707	0.1750	-0.1768
0.1768	0.7500	0.1768	-0.0000	-0.1768	0.2500
-0.0750	0.1768	0.8250	0.0707	0.0750	-0.1768
-0.0707	-0.0000	0.0707	0.9000	0.0707	0.0000
0.1750	-0.1768	0.0750	0.0707	0.8250	0.1768
-0.1768	0.2500	-0.1768	0.0000	0.1768	0.7500

R =

-2.8282	0.0000	0.0000
0	-2.8282	0.0000
0	0	-2.8282
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

R\ (Q'\*b)

ans =

0.3536
0.5000
0.3536

% Problem 9

% 9.(a)

y = [111.98

113.54

112.89

110.69

113.62

114.35

118.77

121.19

118.40

121.33

122.67

123.64

124.07

```
124.49
120.19
120.38
117.50
118.75
120.50
125.09
123.66
121.55
123.90
123.00
122.34
119.65
121.89
120.56
122.04
122.04
121.26
127.17
132.75
132.30
130.33
132.35
132.39
134.07
137.73
138.10
138.91
138.12
140.00
143.75
143.70
134.89
137.26
146.00
143.85
141.43
131.76
135.00
136.49
131.85
135.25
135.03
134.01
126.39
125.00
127.79
124.03
119.90
117.05
122.06
122.22
127.57
132.51];

x = [1:67]';

% best least-squares line
polyfit(x,y,1)

ans =
```

```
0.2709 117.7299

% best least-squares quadratic
polyfit(x,y,2)

ans =

-0.0128 1.1412 107.7215

% best least-squares cubic
polyfit(x,y,3)

ans =

-0.0005 0.0408 -0.3283 116.3551

% 9.(b)
% least squares line difference
p = polyfit(x,y,1)

p =

0.2709 117.7299

f = polyval(p,x);
tot = 0;
for i = 1:67
tot = tot + (y(i) - f(i))^2;
end
tot

tot =

3.2671e+03

% least squares quadratic difference
p = polyfit(x,y,2)

p =

-0.0128 1.1412 107.7215

f = polyval(p,x);
tot = 0;
for i = 1:67
tot = tot + (y(i) - f(i))^2;
end
tot

tot =

2.0398e+03

% least squares cubic difference
p = polyfit(x,y,3)

p =

-0.0005 0.0408 -0.3283 116.3551

f = polyval(p,x);
tot = 0;
```

```
for i = 1:67
tot = tot + (y(i) - f(i))^2;
end
tot

tot =

    1.4434e+03

% Problem 10
X = [(1:67)'.^0 (1:67)'.^1 (1:67)'.^2 (1:67)'.^3];
% X' * X
X' * X

ans =

    1.0e+11 *

    0.0000    0.0000    0.0000    0.0001
    0.0000    0.0000    0.0001    0.0028
    0.0000    0.0001    0.0028    0.1576
    0.0001    0.0028    0.1576    9.1172

% condition number of X' * X
cond(X' * X)

ans =

    2.4713e+11
```