HW 2 Solution - ISE 754 Fall 2020

Contents

Question 1

```
P = [85 40; 75 40; 75 85; 45 35; 40 55; 35 55; 30 85; 55 90];
w = [11 46 36 20 32 23 20 18];
d1h = @(x,P) sum(abs(x - P), 2);
TDh = @(x) sum(w(:).*d1h(x,P));
xy = fminsearch(TDh,mean(P,1))
```

```
xy =

   55.0000   55.0000
```

Question 2

(a) First, determine monetary weights

Outbound

```
fout = [10 38 20 46];          % ton/yr
```

```
rout = 0.8;                    % $/ton-mi
wout = fout * rout             % $/mi-yr
% Inbound
BOM = [2 0.35 1.2 0.55];         % Bill-of-material ratio
fin = BOM * sum(fout)          % ton/yr
rin = [0.08 0.05 0.15 0.03];   % $/ton-mi
win = fin .* rin               % $/mi-yr
w = [win wout]                 % $/mi-yr
```

```
wout =

    8.0000   30.4000   16.0000   36.8000


fin =

  228.0000   39.9000  136.8000   62.7000


win =

   18.2400    1.9950   20.5200    1.8810


w =

  Columns 1 through 7

   18.2400    1.9950   20.5200    1.8810    8.0000   30.4000   16.0000

  Column 8

   36.8000
```

(a) Next, determine location

```
P = [270 150 420 50 50 190 220 295]';
d2h = @(x,P) sqrt(sum((x - P).^2, 2));  % mi
TCh = @(x) sum(w(:).*d2h(x,P));         % $/yr
x = fminsearch(TCh,mean(P,1));
disp(['2(a) Optimal location is at mile marker ' num2str(x) '.'])
fprintf('2(a) Optimal location is at mile marker %d.\n',round(x))
```

```
2(a) Optimal location is at mile marker 270.
2(a) Optimal location is at mile marker 270.
```

(b) Weight gaining or weight losing

```
[sum(fin) sum(fout)]
[sum(win) sum(wout)]
```

```
disp(['2(b) The product is ' ...
   iff(sum(win) < sum(wout),'Weight Gaining','Weight Losing') '.']);
```

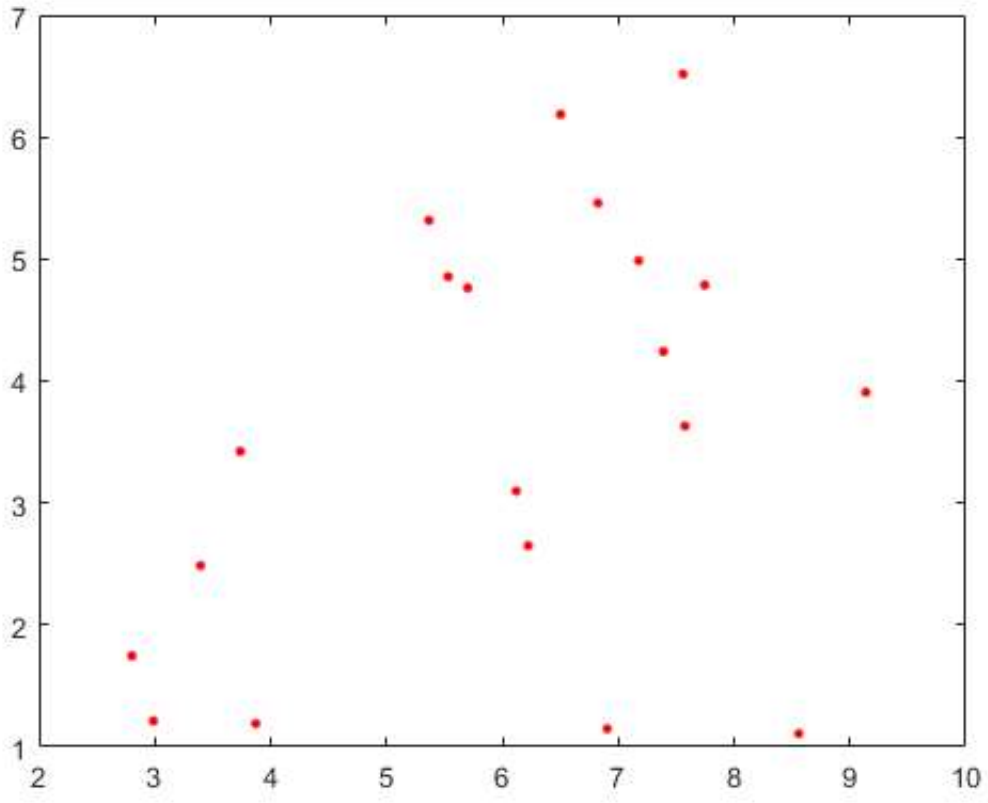
```
ans =

  467.4000  114.0000


ans =

   42.6360   91.2000

2(b) The product is Weight Gaining.
```

Question 3

Create data

```
R = [2 1; 10 7];
rng(2073)
P = R(1,:) + diff(R).*rand(20,size(R,2))
d2h = @(x,P) sqrt(sum((x - P).^2, 2));
close all, plot(P(:,1),P(:,2),'r.','Markersize',10,'DisplayName','EFs')
hold on
```

```
P =

    6.1202    3.0974
    6.2233    2.6487
    2.8022    1.7467
    2.9882    1.2117
    5.3677    5.3171
    3.3957    2.4854
    6.8266    5.4593
    7.5767    3.6306
    3.7383    3.4221
    5.7014    4.7630
    3.8717    1.1909
    9.1379    3.9075
    7.3905    4.2412
    5.5334    4.8545
    7.5604    6.5166
    6.5018    6.1859
    7.7479    4.7861
    6.9053    1.1484
    7.1775    4.9868
    8.5597    1.1078
```



Create IFF function if it doesn't exist (it's part of Matlog)

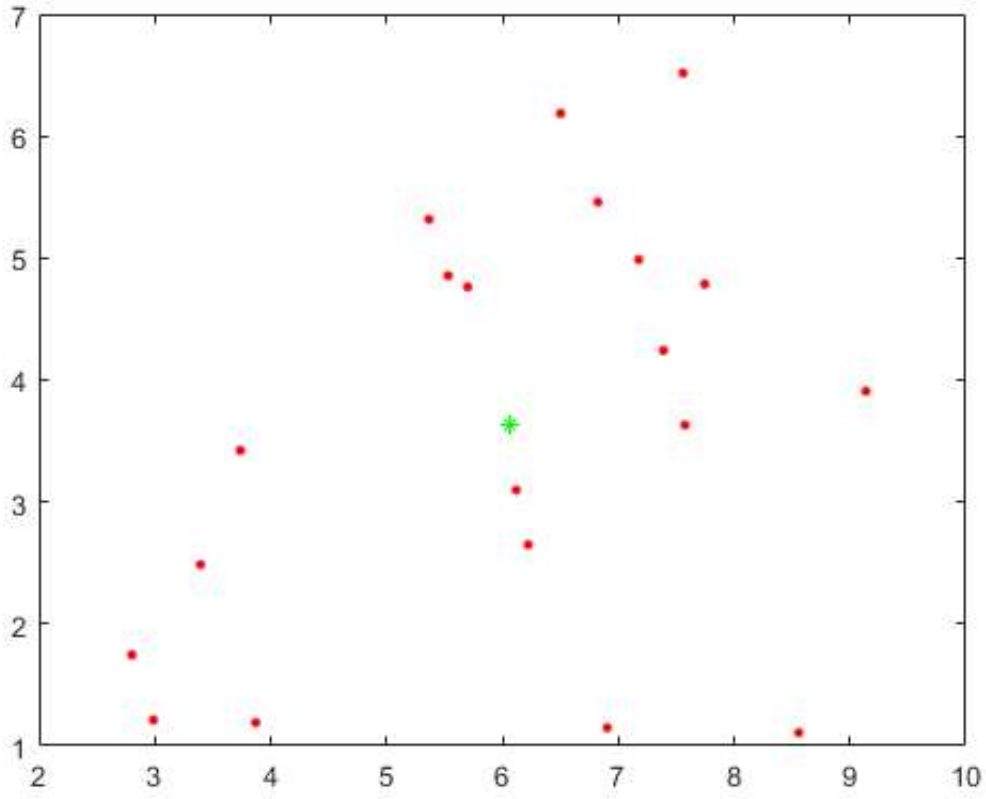
```
if ~exist('iff')
   fid = fopen('iff.m','wt');
   fprintf(fid,'function x=iff(a,b,c)\n if a,x=b;else x=c;end\n');
   fclose(fid);
end
```

(a) Centroid

```
TCh = @(x) sum(d2h(x,P).^2);
x = mean(P,1); TCh(x)
[x,TC] = fminsearch(TCh,[0 0])  % Validate know mean solution
plot(x(1),x(2),'g*','DisplayName','Centroid')
```

```
ans =

  123.8131


x =

    6.0563    3.6354


TC =
```

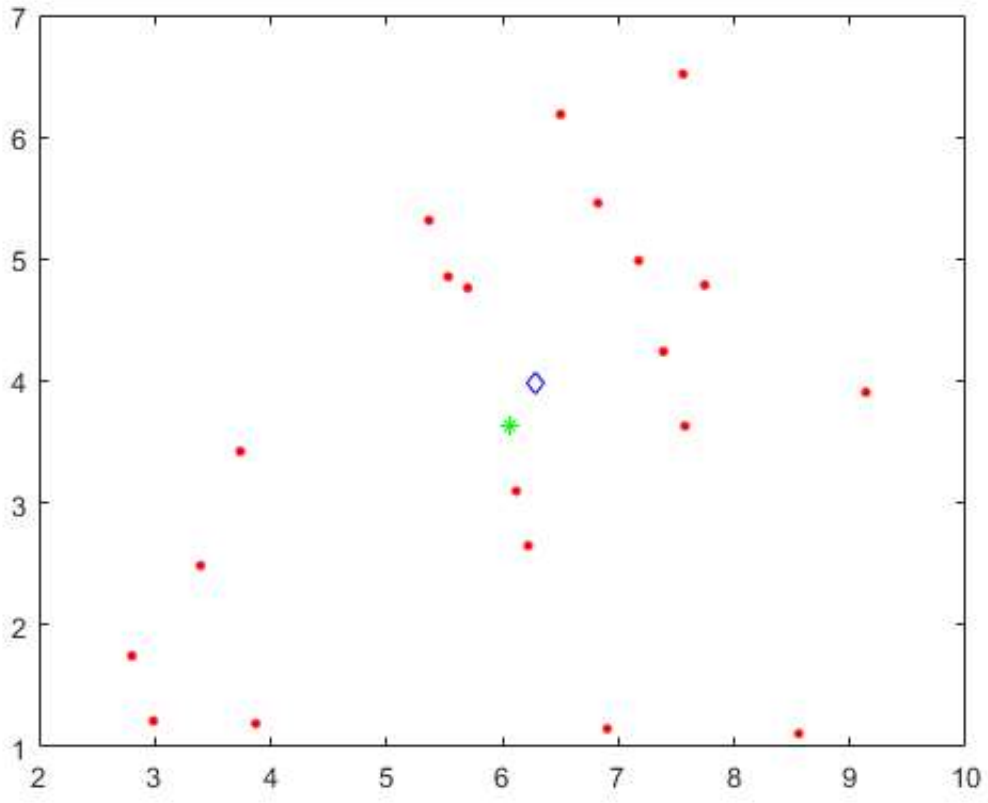
```
123.8131
```



(b) Minisum

```
opt = optimset('fminsearch'); opt.MaxFunEvals = 1e8; opt.TolFun = 1e-8;
TCh = @(x) sum(d2h(x,P));
[x,TC] = fminsearch(TCh,mean(P,1),opt)
plot(x(1),x(2),'bd','DisplayName','Minisum')
```

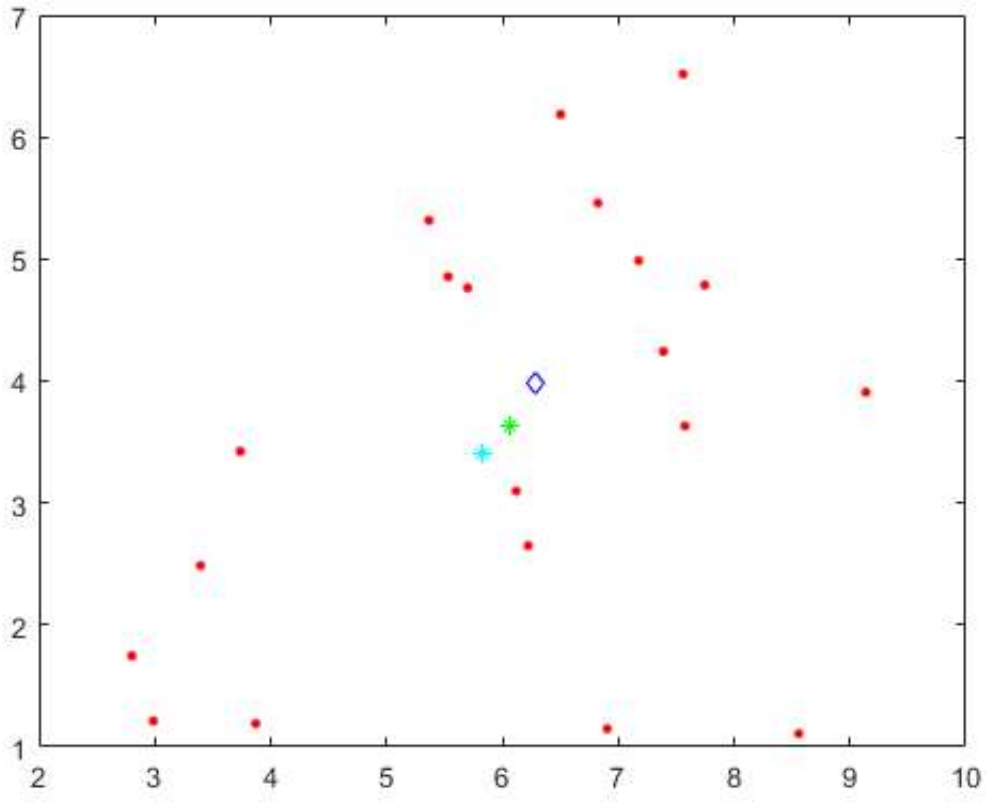
```
x =

    6.2904    3.9868


TC =

   45.5094
```



(c) Minimax

```
TC = @(x) max(d2h(x,P));
[x,TCh] = fminsearch(TC,mean(P,1),opt)
plot(x(1),x(2),'c*','DisplayName','Minimax')
```

```
x =

    5.8157    3.3975


TCh =

    3.5739
```



(d) Constrained

```
Z = [5 3; 7 5];
isinX = @(x,X) x(1)>=X(1,1)&&x(1)<=X(2,1)&&x(2)>=X(1,2)&&x(2)<=X(2,2);
TCh = @(x) iff(isinX(x,Z),Inf,sum(d2h(x,P)));
```

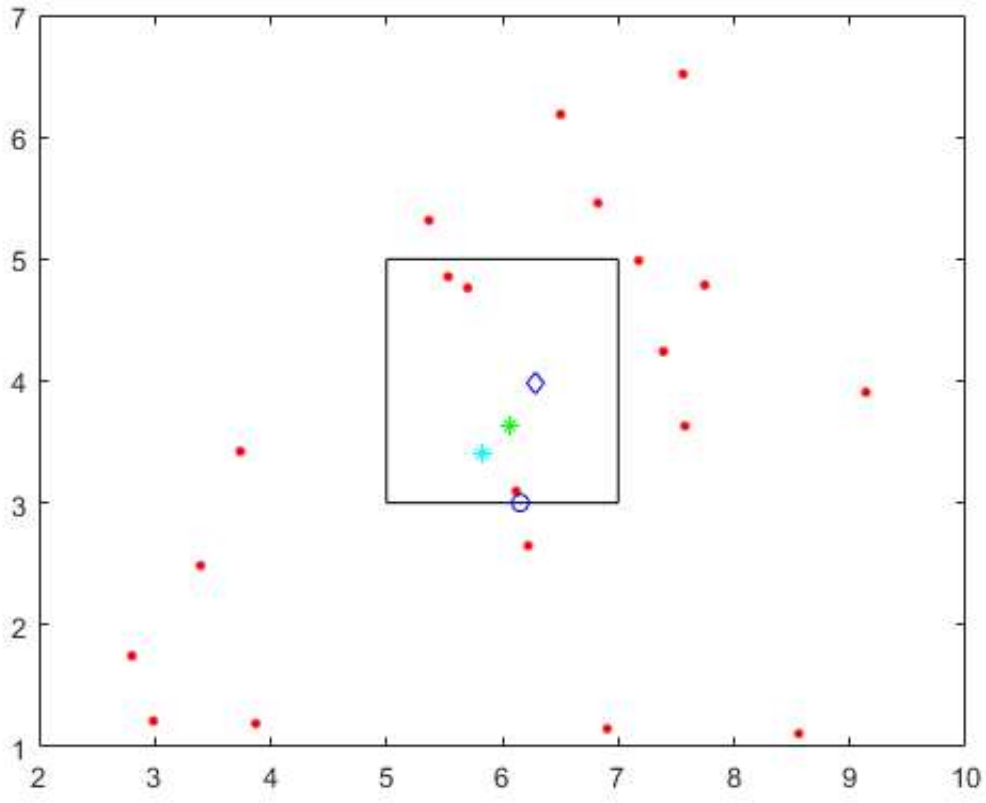
Use region corner points as staring points

```
TC = Inf;
for i = 1:2
   for j = 1:2
      [xij,TCij] = fminsearch(TCh,[R(i,1) R(j,2)],opt)
      if TCij < TC, x = xij; TC = TCij; end
   end
end
x, TC
```

```
xij =

    6.1557    3.0000


TCij =

   47.7253
```

```
xij =

    5.0000    3.7869


TCij =

   50.7557


xij =

    6.1557    3.0000


TCij =

   47.7253


xij =

    6.3263    5.0000


TCij =

   48.7032


x =

    6.1557    3.0000


TC =

   47.7253
```

```
rectangle('Position',[Z(1,:) diff(Z,[],1)])
plot(x(1),x(2),'bo','DisplayName','Constrained')
```

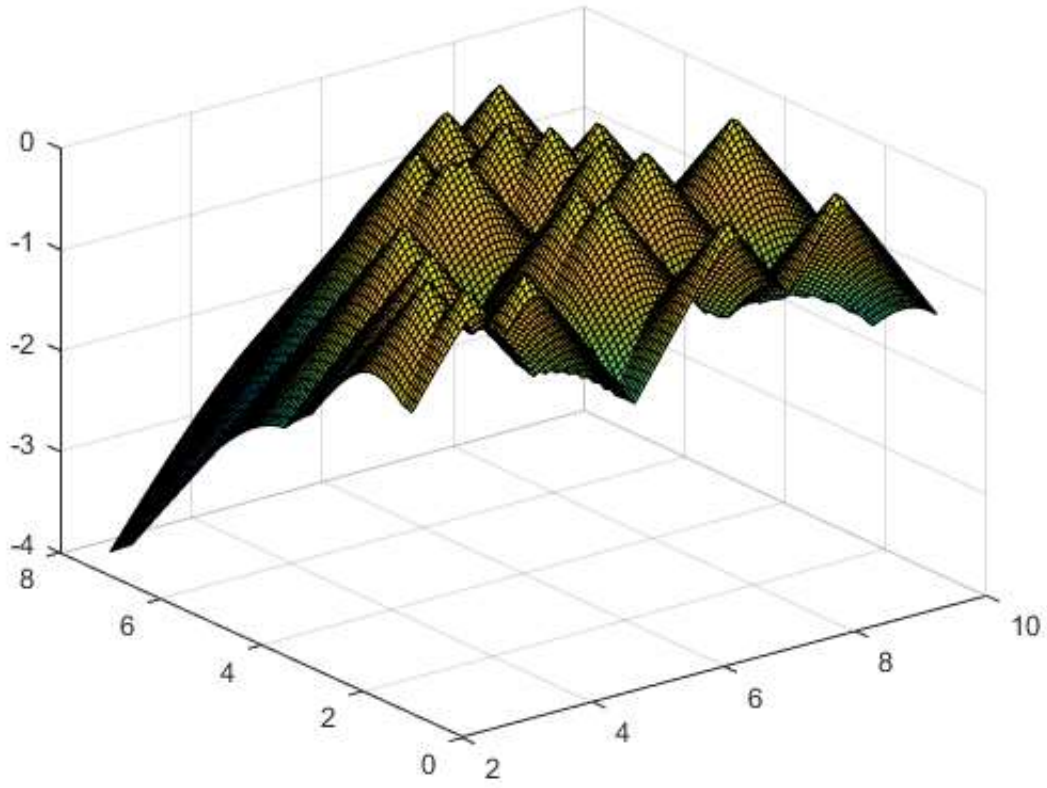


(e) Maximin

```
TCh = @(x) iff(isinX(x,R),-min(d2h(x,P)),Inf);
```

View surface

```
[X,Y] = meshgrid(linspace(R(1,1),R(2,1)),linspace(R(1,2),R(2,2)));
Z = zeros(size(X));
for i = 1:size(X,1)
   for j = 1:size(X,2)
      Z(i,j) = TCh([X(i,j) Y(i,j)]);
   end
end
h = gcf; figure
surf(X,Y,Z)
```



Approach 1: Use min value in Z as x0

```
[i,j] = ind2sub(size(Z),argmin(Z(:)));
[x1,TC1] = fminsearch(TCh,[X(i,j) Y(i,j)])
```

```
x1 =

     2     7


TC1 =

   -3.7648
```

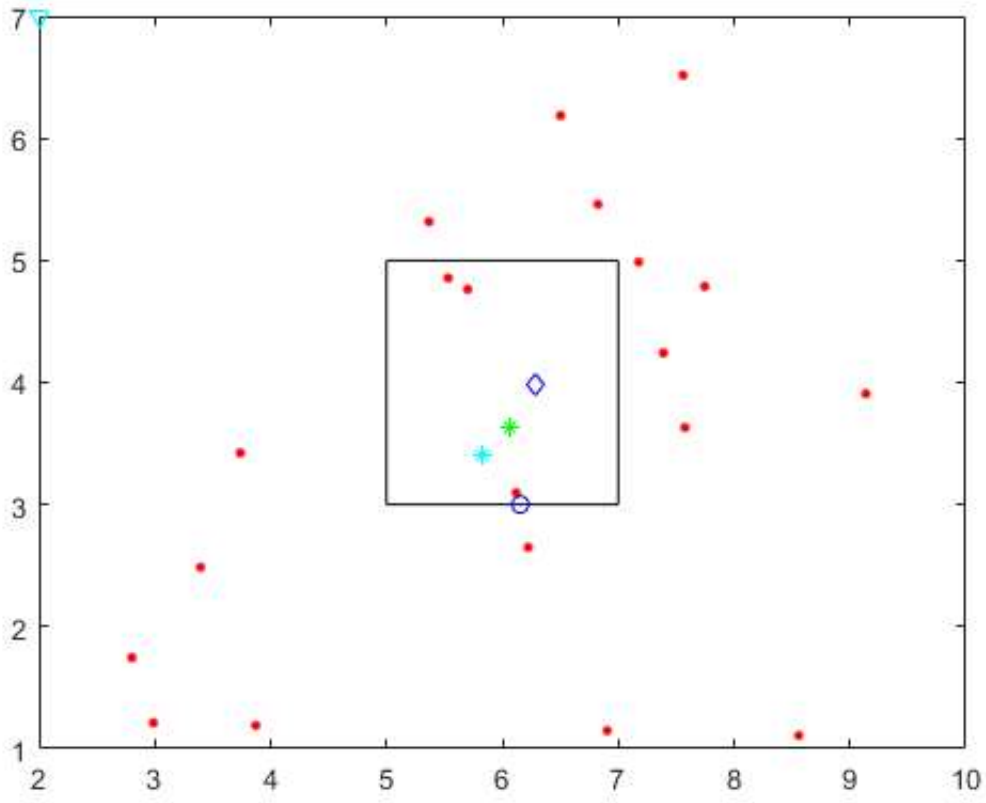
Approach 2: Use each EF as x0

```
TCh = @(x) iff(isinX(x,R),-min(d2h(x,P)),Inf);
TC2 = Inf;
for i = 1:size(P,1)
   [x2i,TC2i] = fminsearch(TCh,P(i,:));
   if TC2i < TC2, x2 = x2i; TC2 = TC2i; end
end
x2, TC2
```

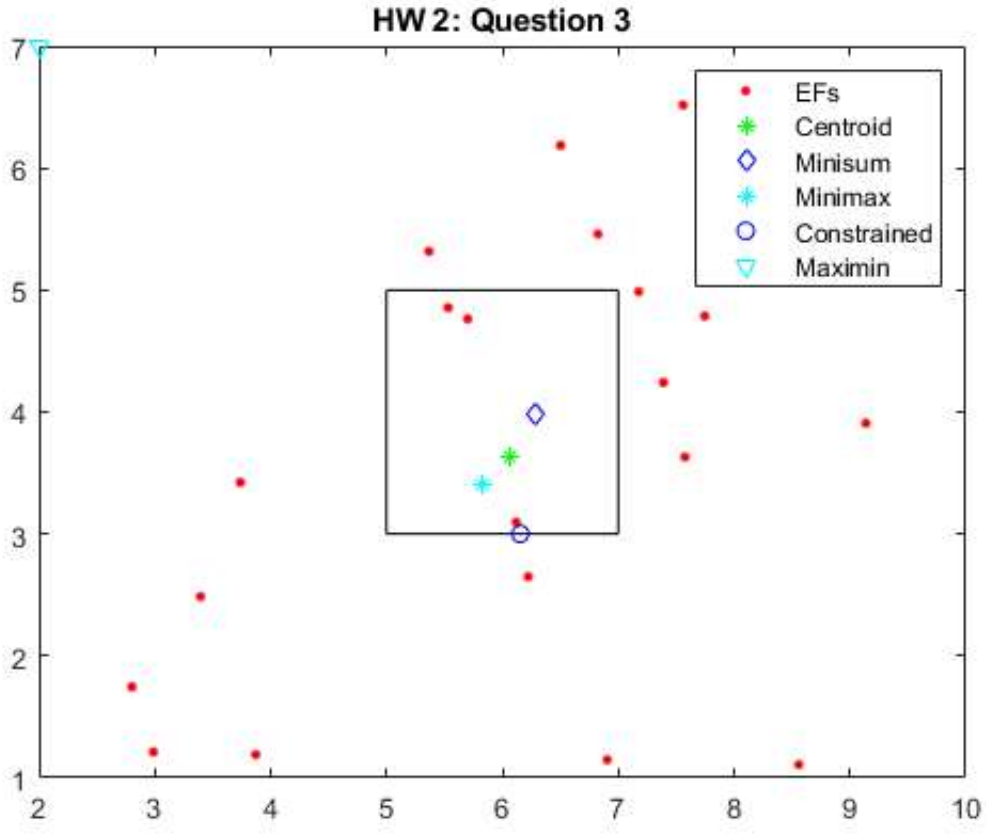
```
x2 =

    9.9998    7.0000


TC2 =

   -2.4869
```

Use best result

```
if TC1 < TC2
   x = x1;
else x = x2
end
figure(h)
plot(x(1),x(2),'cv','DisplayName','Maximin')
```



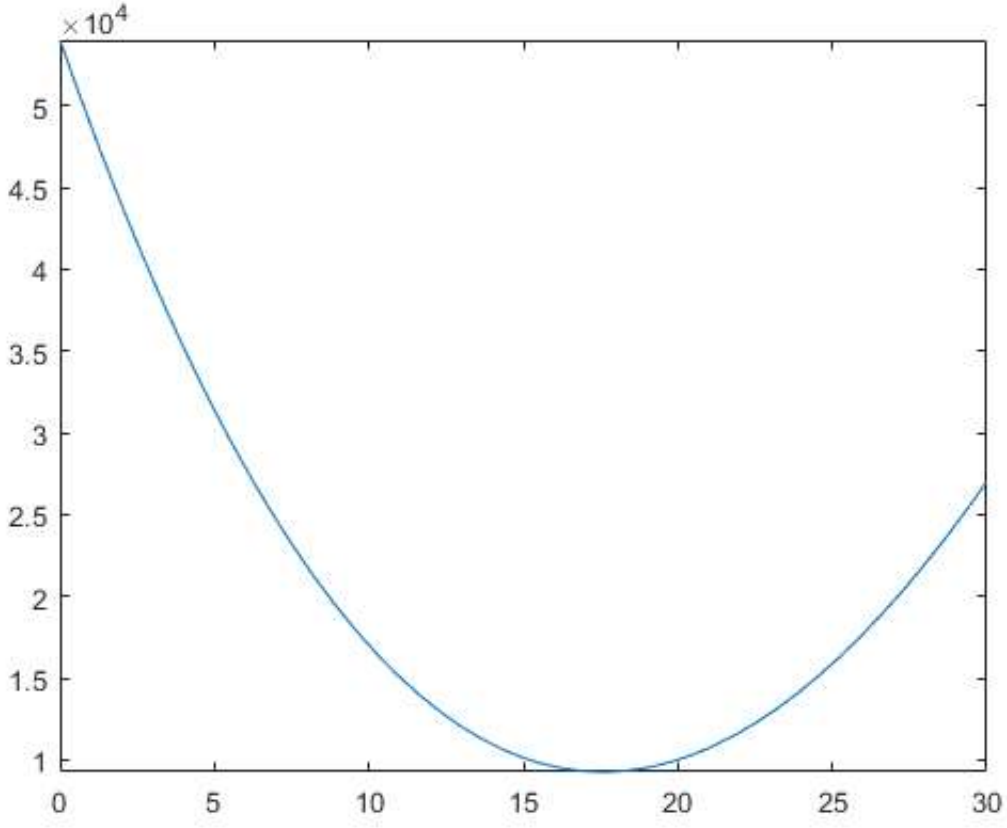

```
legend('show')
title('HW 2: Question 3')
figure
```

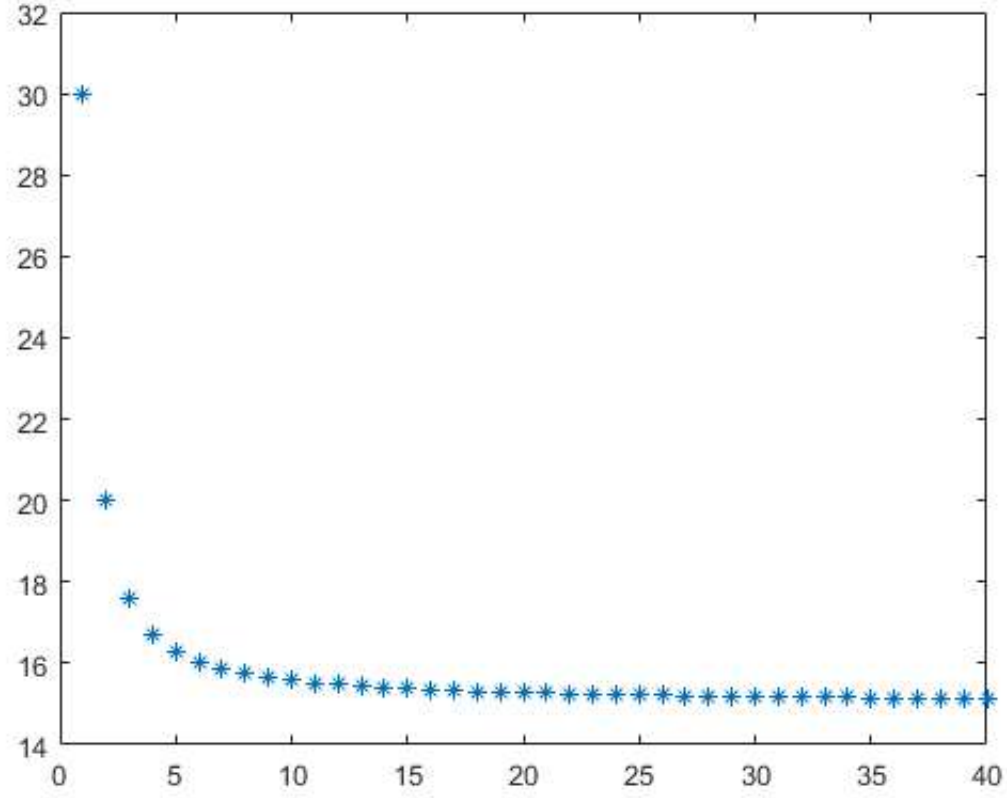

HW 2: Question 3
EFs
Centroid
Minisum
Minimax
Constrained
Maximin
7
6
5
4
3
2
1
2
3
4
5
6
7
8
9
10

Question 4

```
a = [0;30];
w = [1 2];
R  = [0 30];
% the following is the by hand solution where I have taken the first order
% derivative and esolved for d by equating it to 0.
syms d
TC = w*abs((d-a)).^3
xopt_byhand = vpasolve(diff(TC,d),d)

fplot ( @(x) w*abs((x-a)).^3 ,R)
figure
for k = 1:40
    TC =  @(x) w*abs((x-a)).^k;
    xopt(k) = fminsearch(TC,0);
end
plot(xopt,'*')
```

```
TC =

abs(d)^3 + 2*abs(d - 30)^3


xopt_byhand =

17.573593128807148535949338273709
```


×10^4
5
4.5
4
3.5
3
2.5
2
1.5
1
0
5
10
15
20
25
30


32
30
28
26
24
22
20
18
16
14
0
5
10
15
20
25
30
35
40

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