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```
clear all
close all
[t, y] = textread('Problem1_TExpo_sineData.txt','%f%f','headerlines',1);

xdata = t;
ydata = y;


x1=-0.1:.1:0.1;
x2 = linspace(-2*pi, 2*pi, 315);
[OMEGA,ALPHA] = meshgrid(x1,x2);
%R2 needs to be a matrix
%Make a meshgrid of alpha omega
%calculate R2ALT as a giant matrix

for row = 1:1:length(ALPHA)
    for col = 1:3
        model = t.*(exp( ALPHA(row,col)* t )).*(sin( OMEGA(row,col)*t ));
        RESIDUALS = y - model;
        R2 = norm(RESIDUALS)^2;
        R2altmat(row,col) = R2;
    end
end
figure;
contour(OMEGA, ALPHA, R2altmat)
title('Contour Plot of Residuals');

alpha = -1;
omega = 1;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;
```

```
mu_start = 0.1;
mu_down = 50;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;


x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);

residual2 = y - model2;

r22 = residual2' * residual2;

r22 < r2
%here m = 1
%mu remained the same, we can adjust it downhill
%after this
%now that we checked r22<r2_1
%change mu by mu_cont

%
% J1 = t.^3 .* exp(x0(i,j) .* t) .* sin(x0(i+1,j+1) .* t);
% J2 = t.^2 .* exp(x0(i,j) .* t) .* cos(x0(i+1 .* t);


% J = [J1 J2];

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];

% mutot = [mu_start];
%starting point for next iteration
%this is now iteration 1
mu = 0.1/50;
mtot = [1];
mutot = [mu_start mu];
rtotv = [r2 r22];

%generalize to loop
```

```
ans =

  logical

   1
```

Iteration 2

```
r2_it = 100;
r2_baseline = r22;
m = 1;
while r2_it > r2_baseline


    Ja1 = t.^3 .* exp(alphatot(2) .* t) .* sin(omegatot(2) .* t);
    Ja2 = t.^2 .* exp(alphatot(2) .* t) .* cos(omegatot(2) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual2;

    x1a = x0 - deltaxa;

    model3a = t .* (exp(x1a(1) .* t)) .* (sin(x1a(2)) .* t);

    residual3a = y - model3a;

    r2_it = residual3a' * residual3a;




    if r2_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatot x1a(1)];
    omegatota = [omegatot x1a(2)];
```

```
if r2_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r2_it];
disp('Iteration 2')
m
mu
r2_it
disp('Next Iteration')
```

```
m =

     2

Iteration 2

m =

     2


mu =

   4.0000e-05


r2_it =

   62.2236

Next Iteration
```

Iteration 3

```
r3_it = 100;
r2_baseline = r2_it;
m = 1;

while r3_it > r2_baseline || m == 5


    Ja1 = t.^3 .* exp(alphatota(3) .* t) .* sin(omegatota(3) .* t);
    Ja2 = t.^2 .* exp(alphatota(3) .* t) .* cos(omegatota(3) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual3a;

    x2a = x1a - deltaxa;

    model4a = t .* (exp(x2a(1) .* t)) .* (sin(x2a(2)) .* t);

    residual4a = y - model4a;
```

```
    r3_it = residual4a' * residual4a;



    if r3_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatota x2a(1)];
    omegatota = [omegatota x2a(2)];

if r3_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r3_it];
disp('Iteration 3')
m
mu
r3_it
disp('Next Iteration')
```

```
m =

     2

Iteration 3

m =

     2


mu =

   8.0000e-07


r3_it =

   60.8726

Next Iteration
```

Iteration 4

```
r4_it = 100;
r3_baseline = r3_it;
m = 1;

while r4_it > r3_baseline
```

```
    Ja1 = t.^3 .* exp(alphatota(4) .* t) .* sin(omegatota(4) .* t);
    Ja2 = t.^2 .* exp(alphatota(4) .* t) .* cos(omegatota(4) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual4a;

    x3a = x2a - deltaxa;

    model5a = t .* (exp(x3a(1) .* t)) .* (sin(x3a(2)) .* t);

    residual5a = y - model5a;

    r4_it = residual5a' * residual5a;



    if r4_it > r3_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x3a(1)];
    omegatota = [omegatota x3a(2)];

if r4_it < r3_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r4_it];
disp('Iteration 4')
m
mu
r4_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4


m =
```

```
     5

Iteration 4

m =

     5


mu =

   5.0000e-04


r4_it =

   62.7184

Next Iteration
```

Iteration 5

```
r5_it = 100;
r4_baseline = r4_it;
m = 1;

while r5_it > r4_baseline


    Ja1 = t.^3 .* exp(alphatota(5) .* t) .* sin(omegatota(5) .* t);
    Ja2 = t.^2 .* exp(alphatota(5) .* t) .* cos(omegatota(5) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual5a;

    x4a = x3a - deltaxa;

    model6a = t .* (exp(x4a(1) .* t)) .* (sin(x4a(2)) .* t);

    residual6a = y - model6a;

    r5_it = residual6a' * residual6a;



    if r5_it > r4_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x4a(1)];
    omegatota = [omegatota x4a(2)];

if r5_it < r4_baseline
```

```
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r5_it];
disp('Iteration 5')
m
mu
r5_it
disp('Next Iteration')
```

```
m =

     2

Iteration 5

m =

     2


mu =

   1.0000e-05


r5_it =

   62.6692

Next Iteration
```

Iteration 6

```
r6_it = 100;
r5_baseline = r5_it;
m = 1;

while r6_it > r5_baseline


    Ja1 = t.^3 .* exp(alphatota(6) .* t) .* sin(omegatota(6) .* t);
    Ja2 = t.^2 .* exp(alphatota(6) .* t) .* cos(omegatota(6) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual6a;

    x5a = x4a - deltaxa;

    model7a = t .* (exp(x5a(1) .* t)) .* (sin(x5a(2)) .* t);

    residual7a = y - model7a;

    r6_it = residual7a' * residual7a;
```

```
    if r6_it > r5_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x5a(1)];
    omegatota = [omegatota x5a(2)];

if r6_it < r5_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r6_it];
disp('Iteration 6')
m
mu
r6_it
disp('Next Iteration')
```

```
m =

     2

Iteration 6

m =

     2


mu =

   2.0000e-07


r6_it =

   62.1562

Next Iteration
```

Iteration 7

```
r7_it = 100;
r6_baseline = r6_it;
m = 1;
```

```
while r7_it > r6_baseline


    Ja1 = t.^3 .* exp(alphatota(7) .* t) .* sin(omegatota(7) .* t);
    Ja2 = t.^2 .* exp(alphatota(7) .* t) .* cos(omegatota(7) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual7a;

    x6a = x5a - deltaxa;

    model8a = t .* (exp(x6a(1) .* t)) .* (sin(x6a(2)) .* t);

    residual8a = y - model8a;

    r7_it = residual8a' * residual8a;



    if r7_it > r6_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x6a(1)];
    omegatota = [omegatota x6a(2)];

if r7_it < r6_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r7_it];
disp('Iteration 7')
m
mu
r7_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4
```

```
m =

     5

Iteration 7

m =

     5


mu =

   1.2500e-04


r7_it =

   62.2922

Next Iteration
```

Iteration 8

```
r8_it = 100;
r7_baseline = r7_it;
m = 1;

while r8_it > r7_baseline


    Ja1 = t.^3 .* exp(alphatota(8) .* t) .* sin(omegatota(8) .* t);
    Ja2 = t.^2 .* exp(alphatota(8) .* t) .* cos(omegatota(8) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual8a;

    x7a = x6a - deltaxa;

    model9a = t .* (exp(x7a(1) .* t)) .* (sin(x7a(2)) .* t);

    residual9a = y - model9a;

    r8_it = residual9a' * residual9a;



    if r8_it > r7_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x7a(1)];
```

```
    omegatota = [omegatota x7a(2)];

if r8_it < r7_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r8_it];
disp('Iteration 8')
m
mu
r8_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4


m =

     5

Iteration 8

m =

     5


mu =

    0.0781


r8_it =

   62.4239

Next Iteration
```

Iteration 9

```
r9_it = 100;
r8_baseline = r8_it;
```

```
m = 1;

while r9_it > r8_baseline


    Ja1 = t.^3 .* exp(alphatota(9) .* t) .* sin(omegatota(9) .* t);
    Ja2 = t.^2 .* exp(alphatota(9) .* t) .* cos(omegatota(9) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual9a;

    x8a = x7a - deltaxa;

    model10a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual10a = y - model10a;

    r9_it = residual10a' * residual10a;



    if r9_it > r8_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x8a(1)];
    omegatota = [omegatota x8a(2)];

if r9_it < r8_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r9_it];
disp('Iteration 9')
m
mu
r9_it
disp('Next Iteration')
```

```
m =

     2

Iteration 9

m =

     2


mu =
```

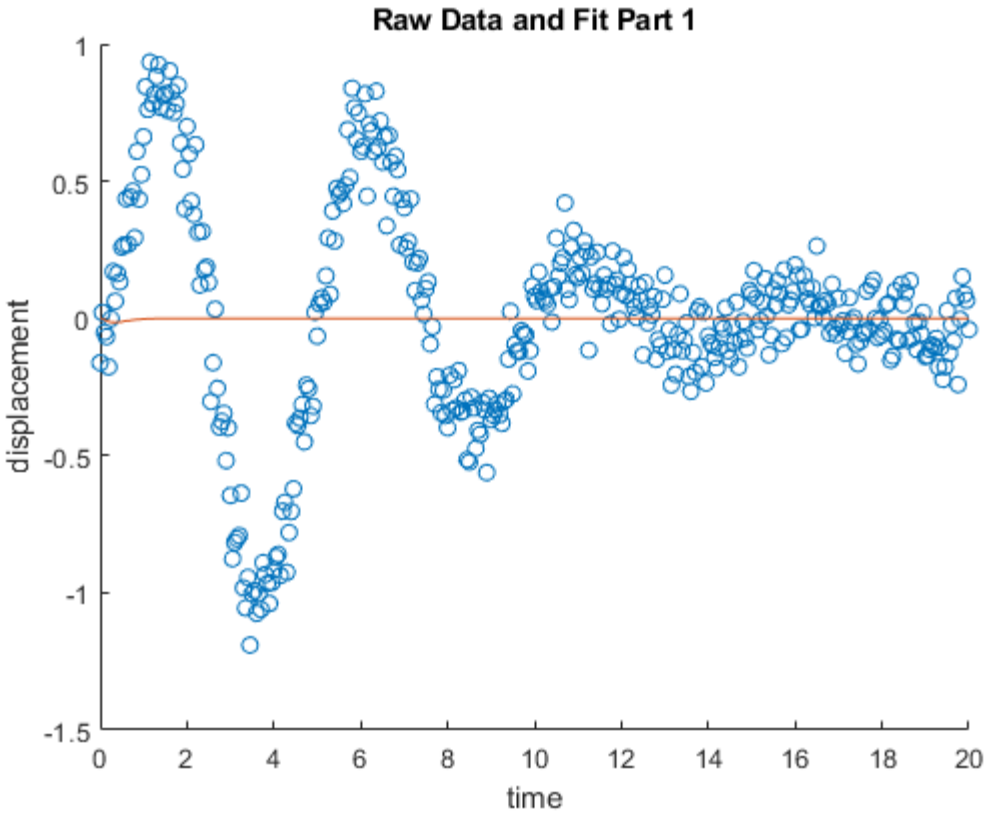
```
    0.0016


r9_it =

   62.3401

Next Iteration
```

Iteration 10

```
r10_it = 100;
r9_baseline = r9_it;
m = 1;

while r10_it > r9_baseline


    Ja1 = t.^3 .* exp(alphatota(10) .* t) .* sin(omegatota(10) .* t);
    Ja2 = t.^2 .* exp(alphatota(10) .* t) .* cos(omegatota(10) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual10a;

    x9a = x8a - deltaxa;

    model11a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual11a = y - model11a;

    r10_it = residual11a' * residual11a;



    if r10_it > r9_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x9a(1)];
    omegatota = [omegatota x9a(2)];

if r10_it < r9_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r10_it];
disp('Iteration 10')
m
mu
r10 it
```

```
disp('Next Iteration')


disp('Required 10 iterations to find final values')

%Plot the fit over normal scatter


f2 = figure('Name', 'Part 1 Plot over scatter');

scatter(t,y)
hold on
plot(t, model9a)
title('Raw Data and Fit Part 1')
xlabel('time')
ylabel('displacement')
```

```
m =

     2

Iteration 10

m =

     2


mu =

    0.0016


r10_it =

   62.3401

Next Iteration
Required 10 iterations to find final values
```



Echoing outputs for diary

```
diary vjprob1pt1.txt

echo on

mutot
mtot
rtotv
alphatota
omegatota

echo off
```

```
mutot

mutot =

  Columns 1 through 7

    0.1000    0.0020    0.0000    0.0000    0.0005    0.0000    0.0000

  Columns 8 through 11

    0.0001    0.0781    0.0016    0.0016

mtot

mtot =

     1     2     2     5     2     2     5     5     2     2
```

```
rtotv
```

```
rtotv =

  Columns 1 through 7

   70.7653   70.3216   62.2236   60.8726   62.7184   62.6692   62.1562

  Columns 8 through 11

   62.2922   62.4239   62.3401   62.3401
```

```
alphatota
```

```
alphatota =

  Columns 1 through 7

   -1.0000   -1.5512   -2.2599   -2.8885   -3.5067   -4.1389   -4.7705

  Columns 8 through 11

   -5.3992   -6.0282   -6.6565   -7.2861
```

```
omegatota
```

```
omegatota =

  Columns 1 through 7

    1.0000   -1.4855   -3.1781   -4.9803   -6.7584   -8.5695  -10.3812

  Columns 8 through 11

  -12.1781  -13.9749  -15.7592  -17.5617
```

```
echo off
```

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Prob 1 Part 2

```
clear all
close all

[t, y] = textread('Problem1_TExpo_sineData.txt','%f%f','headerlines',1);

alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 1;
mu_down = 50;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;
```

```
r22 = residual2' * residual2;
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];



mu = 0.1/50;
mtot = [1];
mutot = [mu_start mu];
rtotv = [r2 r22];
```

```
ans =

  logical

   1
```

Iteration 2

```
r2_it = 100;
r2_baseline = r22;
m = 1;
while r2_it > r2_baseline


    Ja1 = t.^3 .* exp(alphatot(2) .* t) .* sin(omegatot(2) .* t);
    Ja2 = t.^2 .* exp(alphatot(2) .* t) .* cos(omegatot(2) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual2;

    x1a = x0 - deltaxa;

    model3a = t .* (exp(x1a(1) .* t)) .* (sin(x1a(2)) .* t);

    residual3a = y - model3a;

    r2_it = residual3a' * residual3a;




    if r2_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatot x1a(1)];
    omegatota = [omegatot x1a(2)];

if r2_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
```

```
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r2_it];
disp('Iteration 2')
m
mu
r2_it
disp('Next Iteration')
```

```
m =

     2

Iteration 2

m =

     2


mu =

   4.0000e-05


r2_it =

   64.2528

Next Iteration
```

Iteration 3

```
r3_it = 100;
r2_baseline = r2_it;
m = 1;

while r3_it > r2_baseline || m == 5


    Ja1 = t.^3 .* exp(alphatota(3) .* t) .* sin(omegatota(3) .* t);
    Ja2 = t.^2 .* exp(alphatota(3) .* t) .* cos(omegatota(3) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual3a;

    x2a = x1a - deltaxa;

    model4a = t .* (exp(x2a(1) .* t)) .* (sin(x2a(2)) .* t);

    residual4a = y - model4a;

    r3_it = residual4a' * residual4a;



    if r3_it > r2_baseline
        mu = mu * mu_up;
```

```
    end
     m = m+1
end
    alphatota = [alphatota x2a(1)];
    omegatota = [omegatota x2a(2)];

if r3_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r3_it];
disp('Iteration 3')
m
mu
r3_it
disp('Next Iteration')
```

```
m =

     2

Iteration 3

m =

     2


mu =

   8.0000e-07


r3_it =

   62.9359

Next Iteration
```

Iteration 4

```
r4_it = 100;
r3_baseline = r3_it;
m = 1;

while r4_it > r3_baseline


    Ja1 = t.^3 .* exp(alphatota(4) .* t) .* sin(omegatota(4) .* t);
    Ja2 = t.^2 .* exp(alphatota(4) .* t) .* cos(omegatota(4) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual4a;

    x3a = x2a - deltaxa;
```

```
    model5a = t .* (exp(x3a(1) .* t)) .* (sin(x3a(2)) .* t);

    residual5a = y - model5a;

    r4_it = residual5a' * residual5a;



    if r4_it > r3_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x3a(1)];
    omegatota = [omegatota x3a(2)];

if r4_it < r3_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r4_it];
disp('Iteration 4')
m
mu
r4_it
disp('Next Iteration')
```

```
m =

     2

Iteration 4

m =

     2


mu =

   1.6000e-08


r4_it =

   62.7490

Next Iteration
```

Iteration 5

```
r5_it = 100;
r4_baseline = r4_it;
m = 1;

while r5_it > r4_baseline


    Ja1 = t.^3 .* exp(alphatota(5) .* t) .* sin(omegatota(5) .* t);
    Ja2 = t.^2 .* exp(alphatota(5) .* t) .* cos(omegatota(5) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual5a;

    x4a = x3a - deltaxa;

    model6a = t .* (exp(x4a(1) .* t)) .* (sin(x4a(2)) .* t);

    residual6a = y - model6a;

    r5_it = residual6a' * residual6a;



    if r5_it > r4_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x4a(1)];
    omegatota = [omegatota x4a(2)];

if r5_it < r4_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r5_it];
disp('Iteration 5')
m
mu
r5_it
disp('Next Iteration')
```

```
m =

     2

Iteration 5

m =

     2
```

```
mu =

   3.2000e-10


r5_it =

   62.7169

Next Iteration
```

Iteration 6

```
r6_it = 100;
r5_baseline = r5_it;
m = 1;

while r6_it > r5_baseline


    Ja1 = t.^3 .* exp(alphatota(6) .* t) .* sin(omegatota(6) .* t);
    Ja2 = t.^2 .* exp(alphatota(6) .* t) .* cos(omegatota(6) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual6a;

    x5a = x4a - deltaxa;

    model7a = t .* (exp(x5a(1) .* t)) .* (sin(x5a(2)) .* t);

    residual7a = y - model7a;

    r6_it = residual7a' * residual7a;



    if r6_it > r5_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x5a(1)];
    omegatota = [omegatota x5a(2)];

if r6_it < r5_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r6_it];
disp('Iteration 6')
```

```
m
mu
r6_it
disp('Next Iteration')
```

```
m =

     2

Iteration 6

m =

     2


mu =

   6.4000e-12


r6_it =

   62.7093

Next Iteration
```

Iteration 7

```
r7_it = 100;
r6_baseline = r6_it;
m = 1;

while r7_it > r6_baseline


    Ja1 = t.^3 .* exp(alphatota(7) .* t) .* sin(omegatota(7) .* t);
    Ja2 = t.^2 .* exp(alphatota(7) .* t) .* cos(omegatota(7) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual7a;

    x6a = x5a - deltaxa;

    model8a = t .* (exp(x6a(1) .* t)) .* (sin(x6a(2)) .* t);

    residual8a = y - model8a;

    r7_it = residual8a' * residual8a;



    if r7_it > r6_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
```

```
        break
    end
end
    alphatota = [alphatota x6a(1)];
    omegatota = [omegatota x6a(2)];

if r7_it < r6_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r7_it];
disp('Iteration 7')
m
mu
r7_it
disp('Next Iteration')
```

```
m =

     2

Iteration 7

m =

     2


mu =

   1.2800e-13


r7_it =

   62.7055

Next Iteration
```

Iteration 8

```
r8_it = 100;
r7_baseline = r7_it;
m = 1;

while r8_it > r7_baseline


    Ja1 = t.^3 .* exp(alphatota(8) .* t) .* sin(omegatota(8) .* t);
    Ja2 = t.^2 .* exp(alphatota(8) .* t) .* cos(omegatota(8) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual8a;

    x7a = x6a - deltaxa;
```

```
    model9a = t .* (exp(x7a(1) .* t)) .* (sin(x7a(2)) .* t);

    residual9a = y - model9a;

    r8_it = residual9a' * residual9a;



    if r8_it > r7_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x7a(1)];
    omegatota = [omegatota x7a(2)];

if r8_it < r7_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r8_it];
disp('Iteration 8')
m
mu
r8_it
disp('Next Iteration')
```

```
m =

     2

Iteration 8

m =

     2


mu =

   2.5600e-15


r8_it =

   62.7023

Next Iteration
```

Iteration 9

```
r9_it = 100;
r8_baseline = r8_it;
m = 1;

while r9_it > r8_baseline


    Ja1 = t.^3 .* exp(alphatota(9) .* t) .* sin(omegatota(9) .* t);
    Ja2 = t.^2 .* exp(alphatota(9) .* t) .* cos(omegatota(9) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual9a;

    x8a = x7a - deltaxa;

    model10a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual10a = y - model10a;

    r9_it = residual10a' * residual10a;



    if r9_it > r8_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x8a(1)];
    omegatota = [omegatota x8a(2)];

if r9_it < r8_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r9_it];
disp('Iteration 9')
m
mu
r9_it
disp('Next Iteration')
```

```
m =

     2

Iteration 9

m =

     2
```

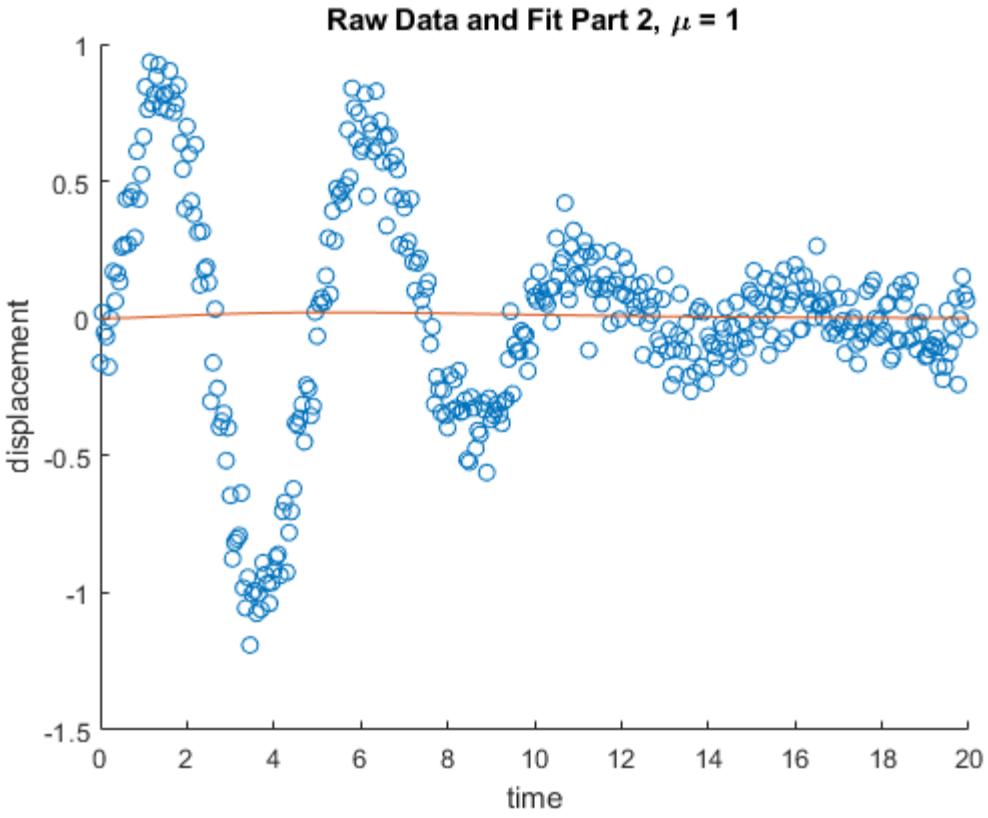
```
mu =

   5.1200e-17


r9_it =

   62.6992

Next Iteration
```

Iteration 10

```
r10_it = 100;
r9_baseline = r9_it;
m = 1;

while r10_it > r9_baseline


    Ja1 = t.^3 .* exp(alphatota(10) .* t) .* sin(omegatota(10) .* t);
    Ja2 = t.^2 .* exp(alphatota(10) .* t) .* cos(omegatota(10) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual10a;

    x9a = x8a - deltaxa;

    model11a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual11a = y - model11a;

    r10_it = residual11a' * residual11a;



    if r10_it > r9_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x9a(1)];
    omegatota = [omegatota x9a(2)];

if r10_it < r9_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r10_it];
disp('Iteration 10')
```

```
m
mu
r10_it
disp('Next Iteration')

disp('Required 10 iterations to find final values')

f2 = figure('Name', 'Part 2 Plot over scatter, mu = 1');

scatter(t,y)
hold on
plot(t, model10a)
title('Raw Data and Fit Part 2, \mu = 1')
xlabel('time')
ylabel('displacement')
```

```
m =

     2

Iteration 10

m =

     2


mu =

   5.1200e-17


r10_it =

   62.6992

Next Iteration
Required 10 iterations to find final values
```



Echoing outputs for diary

```
diary vjprob1pt2_groupA.txt

echo on

mutot
mtot
rtotv
alphatota
omegatota

echo off
```

```
mutot

mutot =

  Columns 1 through 7

    1.0000    0.0020    0.0000    0.0000    0.0000    0.0000    0.0000

  Columns 8 through 11

    0.0000    0.0000    0.0000    0.0000

mtot

mtot =

     1     2     2     2     2     2     2     2     2     2
```

```
rtotv
```

```
rtotv =

  Columns 1 through 7

  421.8764   79.5468   64.2528   62.9359   62.7490   62.7169   62.7093

  Columns 8 through 11

   62.7055   62.7023   62.6992   62.6992
```

```
alphatota
```

```
alphatota =

  Columns 1 through 7

   -0.4000   -0.4084   -0.4062   -0.4023   -0.3981   -0.3938   -0.3895

  Columns 8 through 11

   -0.3853   -0.3810   -0.3768   -0.3725
```

```
omegatota
```

```
omegatota =

  Columns 1 through 7

    0.5000    0.0980    0.0240    0.0097    0.0069    0.0064    0.0061

  Columns 8 through 11

    0.0060    0.0058    0.0057    0.0056
```

```
echo off
```

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Contents

- Prob 1 pt2 conservative mu = 100
- mu 1e+05
- Iteration 2
- Iteration 3
- Iteration 4
- Iteration 5
- Iteration 6
- Iteration 7
- Iteration 8
- Iteration 9
- Iteration 10
- Echoing outputs for diary

Prob 1 pt2 conservative mu = 100

```
clear all
close all

[t, y] = textread('Problem1_TExpo_sineData.txt','%f%f','headerlines',1);

alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 100;
mu_down = 50;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;
```

```
r22 = residual2' * residual2;
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];


mu = 0.1/50;

mtot = [1];
mutot = [mu_start mu];
rtotv = [r2 r22];
```

```
ans =

  logical

   1
```

mu 1e+05

```
disp('Conservative mu 1e+05')
alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 1e+05;
mu_down = 50;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;

r22 = residual2' * residual2;
```

```
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];


mu = 0.1/50;
```

```
Conservative mu 1e+05

ans =

  logical

   1
```

Iteration 2

```
r2_it = 1000000000000000;
r2_baseline = r22;
m = 1;
while r2_it > r2_baseline


    Ja1 = t.^3 .* exp(alphatot(2) .* t) .* sin(omegatot(2) .* t);
    Ja2 = t.^2 .* exp(alphatot(2) .* t) .* cos(omegatot(2) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual2;

    x1a = x0 - deltaxa;

    model3a = t .* (exp(x1a(1) .* t)) .* (sin(x1a(2)) .* t);

    residual3a = y - model3a;

    r2_it = residual3a' * residual3a;




    if r2_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatot x1a(1)];
    omegatota = [omegatot x1a(2)];

if r2_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
```

```
rtotv = [rtotv r2_it];
disp('Iteration 2')
m
mu
r2_it
disp('Next Iteration')
```

```
m =

     2

Iteration 2

m =

     2


mu =

   4.0000e-05


r2_it =

   79.9736

Next Iteration
```

Iteration 3

```
r3_it = 10000000000000000;
r2_baseline = r2_it;
m = 1;

while r3_it > r2_baseline || m == 5


    Ja1 = t.^3 .* exp(alphatota(3) .* t) .* sin(omegatota(3) .* t);
    Ja2 = t.^2 .* exp(alphatota(3) .* t) .* cos(omegatota(3) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual3a;

    x2a = x1a - deltaxa;

    model4a = t .* (exp(x2a(1) .* t)) .* (sin(x2a(2)) .* t);

    residual4a = y - model4a;

    r3_it = residual4a' * residual4a;



    if r3_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
```

```
end
    alphatota = [alphatota x2a(1)];
    omegatota = [omegatota x2a(2)];

if r3_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r3_it];
disp('Iteration 3')
m
mu
r3_it
disp('Next Iteration')
```

```
m =

     2

Iteration 3

m =

     2


mu =

   8.0000e-07


r3_it =

   64.3358

Next Iteration
```

Iteration 4

```
r4_it = 10000000000000000;
r3_baseline = r3_it;
m = 1;

while r4_it > r3_baseline


    Ja1 = t.^3 .* exp(alphatota(4) .* t) .* sin(omegatota(4) .* t);
    Ja2 = t.^2 .* exp(alphatota(4) .* t) .* cos(omegatota(4) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual4a;

    x3a = x2a - deltaxa;
```

```
    model5a = t .* (exp(x3a(1) .* t)) .* (sin(x3a(2)) .* t);

    residual5a = y - model5a;

    r4_it = residual5a' * residual5a;



    if r4_it > r3_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x3a(1)];
    omegatota = [omegatota x3a(2)];

if r4_it < r3_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r4_it];
disp('Iteration 4')
m
mu
r4_it
disp('Next Iteration')
```

```
m =

     2

Iteration 4

m =

     2


mu =

   1.6000e-08


r4_it =

   62.9533

Next Iteration
```

Iteration 5

```
r5_it = 10000000000000000;
r4_baseline = r4_it;
m = 1;

while r5_it > r4_baseline


    Ja1 = t.^3 .* exp(alphatota(5) .* t) .* sin(omegatota(5) .* t);
    Ja2 = t.^2 .* exp(alphatota(5) .* t) .* cos(omegatota(5) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual5a;

    x4a = x3a - deltaxa;

    model6a = t .* (exp(x4a(1) .* t)) .* (sin(x4a(2)) .* t);

    residual6a = y - model6a;

    r5_it = residual6a' * residual6a;



    if r5_it > r4_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x4a(1)];
    omegatota = [omegatota x4a(2)];

if r5_it < r4_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r5_it];
disp('Iteration 5')
m
mu
r5_it
disp('Next Iteration')
```

```
m =

     2

Iteration 5

m =
```

```
     2


mu =

   3.2000e-10


r5_it =

   62.7534

Next Iteration
```

Iteration 6

```
r6_it = 10000000000000000;
r5_baseline = r5_it;
m = 1;

while r6_it > r5_baseline


    Ja1 = t.^3 .* exp(alphatota(6) .* t) .* sin(omegatota(6) .* t);
    Ja2 = t.^2 .* exp(alphatota(6) .* t) .* cos(omegatota(6) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual6a;

    x5a = x4a - deltaxa;

    model7a = t .* (exp(x5a(1) .* t)) .* (sin(x5a(2)) .* t);

    residual7a = y - model7a;

    r6_it = residual7a' * residual7a;



    if r6_it > r5_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x5a(1)];
    omegatota = [omegatota x5a(2)];

if r6_it < r5_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
```

```
rtotv = [rtotv r6_it];
disp('Iteration 6')
m
mu
r6_it
disp('Next Iteration')
```

```
m =

     2

Iteration 6

m =

     2


mu =

   6.4000e-12


r6_it =

   62.7184

Next Iteration
```

Iteration 7

```
r7_it = 10000000000000000;
r6_baseline = r6_it;
m = 1;

while r7_it > r6_baseline


    Ja1 = t.^3 .* exp(alphatota(7) .* t) .* sin(omegatota(7) .* t);
    Ja2 = t.^2 .* exp(alphatota(7) .* t) .* cos(omegatota(7) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual7a;

    x6a = x5a - deltaxa;

    model8a = t .* (exp(x6a(1) .* t)) .* (sin(x6a(2)) .* t);

    residual8a = y - model8a;

    r7_it = residual8a' * residual8a;



    if r7_it > r6_baseline
        mu = mu * mu_up;
    end
```

```
     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x6a(1)];
    omegatota = [omegatota x6a(2)];

if r7_it < r6_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r7_it];
disp('Iteration 7')
m
mu
r7_it
disp('Next Iteration')
```

```
m =

     2

Iteration 7

m =

     2


mu =

   1.2800e-13


r7_it =

   62.7103

Next Iteration
```

Iteration 8

```
r8_it = 10000000000000000;
r7_baseline = r7_it;
m = 1;

while r8_it > r7_baseline


    Ja1 = t.^3 .* exp(alphatota(8) .* t) .* sin(omegatota(8) .* t);
    Ja2 = t.^2 .* exp(alphatota(8) .* t) .* cos(omegatota(8) .* t);
    Ja = [Ja1 Ja2];
```

```
    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual8a;

    x7a = x6a - deltaxa;

    model9a = t .* (exp(x7a(1) .* t)) .* (sin(x7a(2)) .* t);

    residual9a = y - model9a;

    r8_it = residual9a' * residual9a;



    if r8_it > r7_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x7a(1)];
    omegatota = [omegatota x7a(2)];

if r8_it < r7_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r8_it];
disp('Iteration 8')
m
mu
r8_it
disp('Next Iteration')
```

```
m =

     2

Iteration 8

m =

     2


mu =

   2.5600e-15


r8_it =

   62.7063
```

```
Next Iteration
```

Iteration 9

```
r9_it = 10000000000000000;
r8_baseline = r8_it;
m = 1;

while r9_it > r8_baseline


    Ja1 = t.^3 .* exp(alphatota(9) .* t) .* sin(omegatota(9) .* t);
    Ja2 = t.^2 .* exp(alphatota(9) .* t) .* cos(omegatota(9) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual9a;

    x8a = x7a - deltaxa;

    model10a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual10a = y - model10a;

    r9_it = residual10a' * residual10a;



    if r9_it > r8_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x8a(1)];
    omegatota = [omegatota x8a(2)];

if r9_it < r8_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r9_it];
disp('Iteration 9')
m
mu
r9_it
disp('Next Iteration')
```

```
m =

     2
```

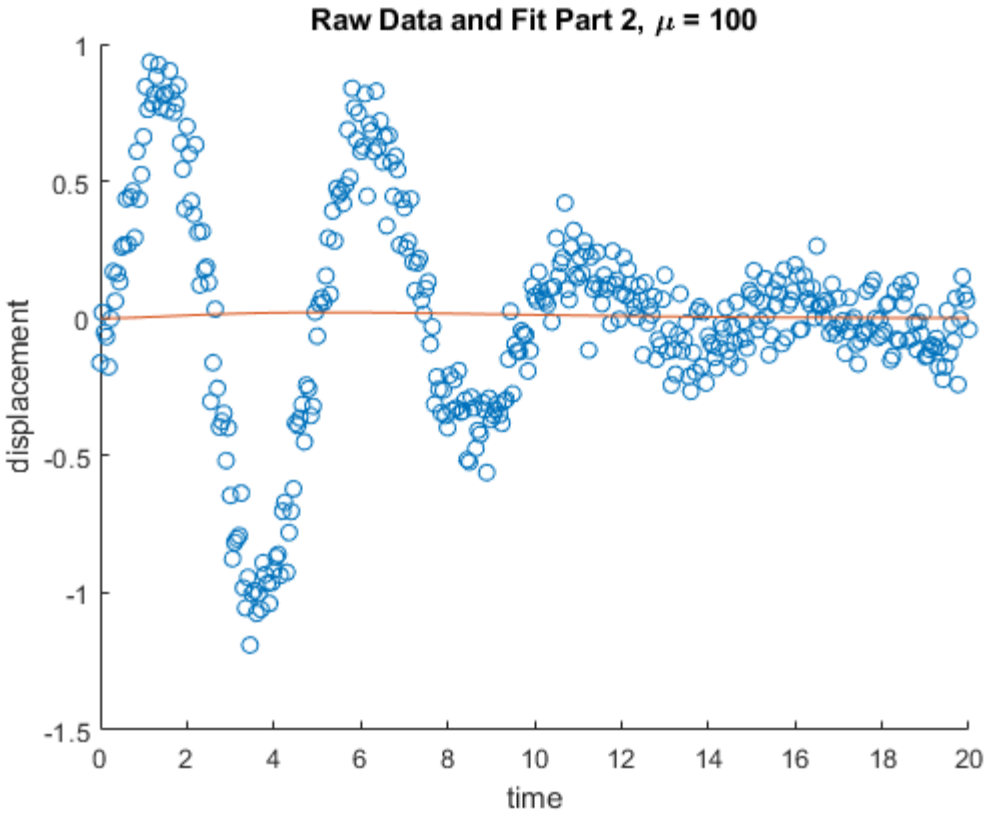
```
Iteration 9

m =

     2


mu =

   5.1200e-17


r9_it =

   62.7030

Next Iteration
```

Iteration 10

```
r10_it = 1000000000000000000;
r9_baseline = r9_it;
m = 1;

while r10_it > r9_baseline


    Ja1 = t.^3 .* exp(alphatota(10) .* t) .* sin(omegatota(10) .* t);
    Ja2 = t.^2 .* exp(alphatota(10) .* t) .* cos(omegatota(10) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual10a;

    x9a = x8a - deltaxa;

    model11a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual11a = y - model11a;

    r10_it = residual11a' * residual11a;



    if r10_it > r9_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x9a(1)];
    omegatota = [omegatota x9a(2)];

if r10_it < r9_baseline
    mu = mu/mu_down;
else
    mu = mu;
```

```
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r10_it];
disp('Iteration 10')
m
mu
r10_it
disp('Next Iteration')

% disp('Required 10 iterations to find final values')


f2 = figure('Name', 'Part 2 Plot over scatter, mu = 100');

scatter(t,y)
hold on
plot(t, model10a)
title('Raw Data and Fit Part 2, \mu = 100')
xlabel('time')
ylabel('displacement')
```

```
m =

     2

Iteration 10

m =

     2


mu =

   5.1200e-17


r10_it =

   62.7030

Next Iteration
```



Echoing outputs for diary

```
diary vjprob1pt2_groupB.txt

echo on

mutot
mtot
rtotv
alphatota
omegatota

echo off
```

```
mutot

mutot =

  Columns 1 through 7

  100.0000    0.0020    0.0000    0.0000    0.0000    0.0000    0.0000

  Columns 8 through 11

    0.0000    0.0000    0.0000    0.0000

mtot

mtot =

     1     2     2     2     2     2     2     2     2     2
```

```
rtotv
```

```
rtotv =

  Columns 1 through 7

  421.8764   97.5580   79.9736   64.3358   62.9533   62.7534   62.7184

  Columns 8 through 11

   62.7103   62.7063   62.7030   62.7030
```

```
alphatota
```

```
alphatota =

  Columns 1 through 7

   -0.4000   -0.4014   -0.4095   -0.4073   -0.4034   -0.3992   -0.3949

  Columns 8 through 11

   -0.3906   -0.3863   -0.3821   -0.3778
```

```
omegatota
```

```
omegatota =

  Columns 1 through 7

    0.5000    0.4972    0.1000    0.0249    0.0099    0.0070    0.0064

  Columns 8 through 11

    0.0062    0.0060    0.0059    0.0057
```

```
echo off
```

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Contents

- Problem 1 part 2 mu 1e+05
- mu 1e+05
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- Iteration 8
- Iteration 9
- Iteration 10
- Echoing outputs for diary

Problem 1 part 2 mu 1e+05

```
clear all
close all

[t, y] = textread('Problem1_TExpo_sineData.txt','%f%f','headerlines',1);

alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 1e+05;
mu_down = 50;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;
```

```
r22 = residual2' * residual2;
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];

%Iteration 0 values

mu = 0.1/50;
mtot = [1];
mutot = [mu_start mu];
rtotv = [r2 r22];
```

```
ans =

  logical

   1
```

mu 1e+05

```
disp('Conservative mu 1e+05')
alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 1e+05;
mu_down = 50;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;

r22 = residual2' * residual2;
```

```
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];


mu = 0.1/50;
```

```
Conservative mu 1e+05

ans =

  logical

   1
```

Iteration 2

```
r2_it = 1000000000000000;
r2_baseline = r22;
m = 1;
while r2_it > r2_baseline


    Ja1 = t.^3 .* exp(alphatot(2) .* t) .* sin(omegatot(2) .* t);
    Ja2 = t.^2 .* exp(alphatot(2) .* t) .* cos(omegatot(2) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual2;

    x1a = x0 - deltaxa;

    model3a = t .* (exp(x1a(1) .* t)) .* (sin(x1a(2)) .* t);

    residual3a = y - model3a;

    r2_it = residual3a' * residual3a;




    if r2_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatot x1a(1)];
    omegatota = [omegatot x1a(2)];

if r2_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
```

```
rtotv = [rtotv r2_it];
disp('Iteration 2')
m
mu
r2_it
disp('Next Iteration')
```

```
m =

     2

Iteration 2

m =

     2


mu =

   4.0000e-05


r2_it =

   79.9736

Next Iteration
```

Iteration 3

```
r3_it = 10000000000000000;
r2_baseline = r2_it;
m = 1;

while r3_it > r2_baseline || m == 5


    Ja1 = t.^3 .* exp(alphatota(3) .* t) .* sin(omegatota(3) .* t);
    Ja2 = t.^2 .* exp(alphatota(3) .* t) .* cos(omegatota(3) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual3a;

    x2a = x1a - deltaxa;

    model4a = t .* (exp(x2a(1) .* t)) .* (sin(x2a(2)) .* t);

    residual4a = y - model4a;

    r3_it = residual4a' * residual4a;



    if r3_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
```

```
end
    alphatota = [alphatota x2a(1)];
    omegatota = [omegatota x2a(2)];

if r3_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r3_it];
disp('Iteration 3')
m
mu
r3_it
disp('Next Iteration')
```

```
m =

     2

Iteration 3

m =

     2


mu =

   8.0000e-07


r3_it =

   64.3358

Next Iteration
```

Iteration 4

```
r4_it = 10000000000000000;
r3_baseline = r3_it;
m = 1;

while r4_it > r3_baseline


    Ja1 = t.^3 .* exp(alphatota(4) .* t) .* sin(omegatota(4) .* t);
    Ja2 = t.^2 .* exp(alphatota(4) .* t) .* cos(omegatota(4) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual4a;

    x3a = x2a - deltaxa;
```

```
    model5a = t .* (exp(x3a(1) .* t)) .* (sin(x3a(2)) .* t);

    residual5a = y - model5a;

    r4_it = residual5a' * residual5a;



    if r4_it > r3_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x3a(1)];
    omegatota = [omegatota x3a(2)];

if r4_it < r3_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r4_it];
disp('Iteration 4')
m
mu
r4_it
disp('Next Iteration')
```

```
m =

     2

Iteration 4

m =

     2


mu =

   1.6000e-08


r4_it =

   62.9533

Next Iteration
```

Iteration 5

```
r5_it = 10000000000000000;
r4_baseline = r4_it;
m = 1;

while r5_it > r4_baseline


    Ja1 = t.^3 .* exp(alphatota(5) .* t) .* sin(omegatota(5) .* t);
    Ja2 = t.^2 .* exp(alphatota(5) .* t) .* cos(omegatota(5) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual5a;

    x4a = x3a - deltaxa;

    model6a = t .* (exp(x4a(1) .* t)) .* (sin(x4a(2)) .* t);

    residual6a = y - model6a;

    r5_it = residual6a' * residual6a;



    if r5_it > r4_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x4a(1)];
    omegatota = [omegatota x4a(2)];

if r5_it < r4_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r5_it];
disp('Iteration 5')
m
mu
r5_it
disp('Next Iteration')
```

```
m =

     2

Iteration 5

m =
```

```
     2


mu =

   3.2000e-10


r5_it =

   62.7534

Next Iteration
```

Iteration 6

```
r6_it = 10000000000000000;
r5_baseline = r5_it;
m = 1;

while r6_it > r5_baseline


    Ja1 = t.^3 .* exp(alphatota(6) .* t) .* sin(omegatota(6) .* t);
    Ja2 = t.^2 .* exp(alphatota(6) .* t) .* cos(omegatota(6) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual6a;

    x5a = x4a - deltaxa;

    model7a = t .* (exp(x5a(1) .* t)) .* (sin(x5a(2)) .* t);

    residual7a = y - model7a;

    r6_it = residual7a' * residual7a;



    if r6_it > r5_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x5a(1)];
    omegatota = [omegatota x5a(2)];

if r6_it < r5_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
```

```
rtotv = [rtotv r6_it];
disp('Iteration 6')
m
mu
r6_it
disp('Next Iteration')
```

```
m =

     2

Iteration 6

m =

     2


mu =

   6.4000e-12


r6_it =

   62.7184

Next Iteration
```

Iteration 7

```
r7_it = 10000000000000000;
r6_baseline = r6_it;
m = 1;

while r7_it > r6_baseline


    Ja1 = t.^3 .* exp(alphatota(7) .* t) .* sin(omegatota(7) .* t);
    Ja2 = t.^2 .* exp(alphatota(7) .* t) .* cos(omegatota(7) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual7a;

    x6a = x5a - deltaxa;

    model8a = t .* (exp(x6a(1) .* t)) .* (sin(x6a(2)) .* t);

    residual8a = y - model8a;

    r7_it = residual8a' * residual8a;



    if r7_it > r6_baseline
        mu = mu * mu_up;
    end
```

```
     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x6a(1)];
    omegatota = [omegatota x6a(2)];

if r7_it < r6_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r7_it];
disp('Iteration 7')
m
mu
r7_it
disp('Next Iteration')
```

```
m =

     2

Iteration 7

m =

     2


mu =

   1.2800e-13


r7_it =

   62.7103

Next Iteration
```

Iteration 8

```
r8_it = 10000000000000000;
r7_baseline = r7_it;
m = 1;

while r8_it > r7_baseline


    Ja1 = t.^3 .* exp(alphatota(8) .* t) .* sin(omegatota(8) .* t);
    Ja2 = t.^2 .* exp(alphatota(8) .* t) .* cos(omegatota(8) .* t);
    Ja = [Ja1 Ja2];
```

```
    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual8a;

    x7a = x6a - deltaxa;

    model9a = t .* (exp(x7a(1) .* t)) .* (sin(x7a(2)) .* t);

    residual9a = y - model9a;

    r8_it = residual9a' * residual9a;



    if r8_it > r7_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x7a(1)];
    omegatota = [omegatota x7a(2)];

if r8_it < r7_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r8_it];
disp('Iteration 8')
m
mu
r8_it
disp('Next Iteration')
```

```
m =

     2

Iteration 8

m =

     2


mu =

   2.5600e-15


r8_it =

   62.7063
```

```
Next Iteration
```

Iteration 9

```
r9_it = 10000000000000000;
r8_baseline = r8_it;
m = 1;

while r9_it > r8_baseline


    Ja1 = t.^3 .* exp(alphatota(9) .* t) .* sin(omegatota(9) .* t);
    Ja2 = t.^2 .* exp(alphatota(9) .* t) .* cos(omegatota(9) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual9a;

    x8a = x7a - deltaxa;

    model10a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual10a = y - model10a;

    r9_it = residual10a' * residual10a;



    if r9_it > r8_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x8a(1)];
    omegatota = [omegatota x8a(2)];

if r9_it < r8_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r9_it];
disp('Iteration 9')
m
mu
r9_it
disp('Next Iteration')
```

```
m =

     2
```

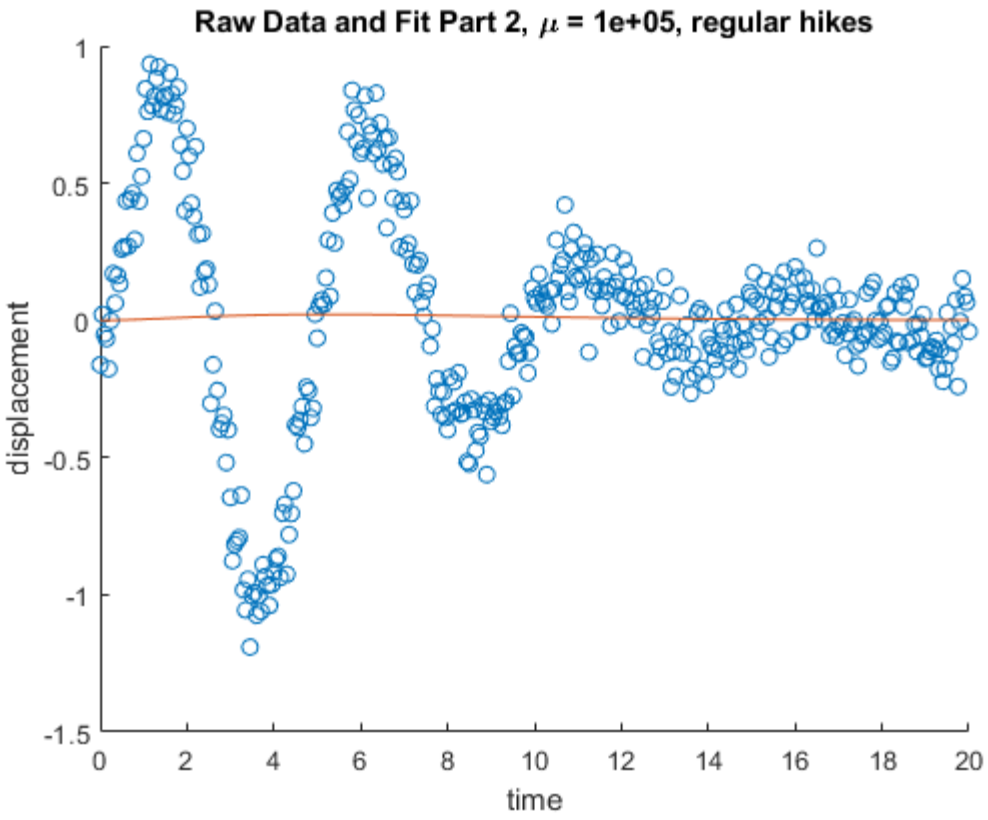
```
Iteration 9

m =

     2


mu =

   5.1200e-17


r9_it =

   62.7030

Next Iteration
```

Iteration 10

```
r10_it = 1000000000000000000;
r9_baseline = r9_it;
m = 1;

while r10_it > r9_baseline


    Ja1 = t.^3 .* exp(alphatota(10) .* t) .* sin(omegatota(10) .* t);
    Ja2 = t.^2 .* exp(alphatota(10) .* t) .* cos(omegatota(10) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual10a;

    x9a = x8a - deltaxa;

    model11a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual11a = y - model11a;

    r10_it = residual11a' * residual11a;



    if r10_it > r9_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x9a(1)];
    omegatota = [omegatota x9a(2)];

if r10_it < r9_baseline
    mu = mu/mu_down;
else
    mu = mu;
```

```
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r10_it];
disp('Iteration 10')
m
mu
r10_it
disp('Next Iteration')

% disp('Required 10 iterations to find final values')

f2 = figure('Name', 'Part 2 Plot over scatter, mu = 1e+05, regular hikes');

scatter(t,y)
hold on
plot(t, model10a)
title('Raw Data and Fit Part 2, \mu = 1e+05, regular hikes')
xlabel('time')
ylabel('displacement')
```

```
m =

     2

Iteration 10

m =

     2


mu =

   5.1200e-17


r10_it =

   62.7030

Next Iteration
```



Echoing outputs for diary

```
diary vjprob1pt2_groupC.txt

echo on

mutot
mtot
rtotv
alphatota
omegatota

echo off
```

```
mutot

mutot =

   1.0e+05 *

  Columns 1 through 7

    1.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

  Columns 8 through 11

    0.0000    0.0000    0.0000    0.0000

mtot

mtot =
```

```
     1     2     2     2     2     2     2     2     2     2
```

```
rtotv
```

```
rtotv =

  Columns 1 through 7

  421.8764  412.2513   79.9736   64.3358   62.9533   62.7534   62.7184

  Columns 8 through 11

   62.7103   62.7063   62.7030   62.7030
```

```
alphatota
```

```
alphatota =

  Columns 1 through 7

   -0.4000   -0.4014   -0.4095   -0.4073   -0.4034   -0.3992   -0.3949

  Columns 8 through 11

   -0.3906   -0.3863   -0.3821   -0.3778
```

```
omegatota
```

```
omegatota =

  Columns 1 through 7

    0.5000    0.4972    0.1000    0.0249    0.0099    0.0070    0.0064

  Columns 8 through 11

    0.0062    0.0060    0.0059    0.0057
```

```
echo off
```

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Problem 1 part 2 mu 1e+05 change hike

```
clear all
close all

[t, y] = textread('Problem1_TExpo_sineData.txt','%f
%f','headerlines',1);

alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 1e+05;
mu_down = 5;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;

mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;
```

```
model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;

r22 = residual2' * residual2;
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];


mu = 0.1/50;

mtot = [1];
mutot = [mu_start mu];
rtotv = [r2 r22];
```

```
ans =

  logical

   1
```

mu 1e+05

```
disp('Conservative mu 1e+05')
alpha = -0.4;
omega = 0.5;
xk = [alpha omega]';

J1 = t.^3 .* exp(alpha .* t) .* sin(omega .* t);
J2 = t.^2 .* exp(alpha .* t) .* cos(omega .* t);


J = [J1 J2];

model = t .* (exp(alpha .* t)) .* (sin(omega) .* t);

residual = y - model;

r2 = residual' * residual;


mu_start = 1e+05;
mu_down = 5;
mu_up = 5;

% mu_rscout = mu_old * mu_up;
% mu_cont = mu_old/mu_down;
```

```
mmax = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = t .* (exp(x0(1) .* t)) .* (sin(x0(2)) .* t);
residual2 = y - model2;

r22 = residual2' * residual2;
r22 < r2

alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];


mu = 0.1/50;

Conservative mu 1e+05

ans =

  logical

   1
```

Iteration 2

```
r2_it = 1000000000000000;
r2_baseline = r22;
m = 1;
while r2_it > r2_baseline


    Ja1 = t.^3 .* exp(alphatot(2) .* t) .* sin(omegatot(2) .* t);
    Ja2 = t.^2 .* exp(alphatot(2) .* t) .* cos(omegatot(2) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual2;

    x1a = x0 - deltaxa;

    model3a = t .* (exp(x1a(1) .* t)) .* (sin(x1a(2)) .* t);

    residual3a = y - model3a;

    r2_it = residual3a' * residual3a;



    if r2_it > r2_baseline
```

```
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatot x1a(1)];
    omegatota = [omegatot x1a(2)];

if r2_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r2_it];
disp('Iteration 2')
m
mu
r2_it
disp('Next Iteration')
```

```
m =

     2

Iteration 2

m =

     2


mu =

   4.0000e-04


r2_it =

   79.9736

Next Iteration
```

Iteration 3

```
r3_it = 1000000000000000;
r2_baseline = r2_it;
m = 1;

while r3_it > r2_baseline || m == 5
```

```
    Ja1 = t.^3 .* exp(alphatota(3) .* t) .* sin(omegatota(3) .* t);
    Ja2 = t.^2 .* exp(alphatota(3) .* t) .* cos(omegatota(3) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual3a;

    x2a = x1a - deltaxa;

    model4a = t .* (exp(x2a(1) .* t)) .* (sin(x2a(2)) .* t);

    residual4a = y - model4a;

    r3_it = residual4a' * residual4a;



    if r3_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
end
    alphatota = [alphatota x2a(1)];
    omegatota = [omegatota x2a(2)];

if r3_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r3_it];
disp('Iteration 3')
m
mu
r3_it
disp('Next Iteration')


m =

     2

Iteration 3

m =

     2


mu =

   8.0000e-05
```

```
r3_it =

   64.3359

Next Iteration
```

Iteration 4

```
r4_it = 10000000000000000;
r3_baseline = r3_it;
m = 1;

while r4_it > r3_baseline


    Ja1 = t.^3 .* exp(alphatota(4) .* t) .* sin(omegatota(4) .* t);
    Ja2 = t.^2 .* exp(alphatota(4) .* t) .* cos(omegatota(4) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual4a;

    x3a = x2a - deltaxa;

    model5a = t .* (exp(x3a(1) .* t)) .* (sin(x3a(2)) .* t);

    residual5a = y - model5a;

    r4_it = residual5a' * residual5a;



    if r4_it > r3_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x3a(1)];
    omegatota = [omegatota x3a(2)];

if r4_it < r3_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
```

```
rtotv = [rtotv r4_it];
disp('Iteration 4')
m
mu
r4_it
disp('Next Iteration')
```

```
m =

     2

Iteration 4

m =

     2


mu =

   1.6000e-05


r4_it =

   62.9533

Next Iteration
```

Iteration 5

```
r5_it = 1000000000000000;
r4_baseline = r4_it;
m = 1;

while r5_it > r4_baseline


    Ja1 = t.^3 .* exp(alphatota(5) .* t) .* sin(omegatota(5) .* t);
    Ja2 = t.^2 .* exp(alphatota(5) .* t) .* cos(omegatota(5) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual5a;

    x4a = x3a - deltaxa;

    model6a = t .* (exp(x4a(1) .* t)) .* (sin(x4a(2)) .* t);

    residual6a = y - model6a;

    r5_it = residual6a' * residual6a;
```

```
    if r5_it > r4_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x4a(1)];
    omegatota = [omegatota x4a(2)];

if r5_it < r4_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r5_it];
disp('Iteration 5')
m
mu
r5_it
disp('Next Iteration')
```

```
m =

     2

Iteration 5

m =

     2


mu =

   3.2000e-06


r5_it =

   62.7534

Next Iteration
```

Iteration 6

```
r6_it = 10000000000000000;
r5_baseline = r5_it;
m = 1;

while r6_it > r5_baseline


    Ja1 = t.^3 .* exp(alphatota(6) .* t) .* sin(omegatota(6) .* t);
    Ja2 = t.^2 .* exp(alphatota(6) .* t) .* cos(omegatota(6) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual6a;

    x5a = x4a - deltaxa;

    model7a = t .* (exp(x5a(1) .* t)) .* (sin(x5a(2)) .* t);

    residual7a = y - model7a;

    r6_it = residual7a' * residual7a;



    if r6_it > r5_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x5a(1)];
    omegatota = [omegatota x5a(2)];

if r6_it < r5_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r6_it];
disp('Iteration 6')
m
mu
r6_it
disp('Next Iteration')
```

```
m =

     2

Iteration 6

m =

     2


mu =

   6.4000e-07


r6_it =

   62.7184

Next Iteration
```

Iteration 7

```
r7_it = 10000000000000000;
r6_baseline = r6_it;
m = 1;

while r7_it > r6_baseline


    Ja1 = t.^3 .* exp(alphatota(7) .* t) .* sin(omegatota(7) .* t);
    Ja2 = t.^2 .* exp(alphatota(7) .* t) .* cos(omegatota(7) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual7a;

    x6a = x5a - deltaxa;

    model8a = t .* (exp(x6a(1) .* t)) .* (sin(x6a(2)) .* t);

    residual8a = y - model8a;

    r7_it = residual8a' * residual8a;



    if r7_it > r6_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
```

```
        break
    end
end
    alphatota = [alphatota x6a(1)];
    omegatota = [omegatota x6a(2)];

if r7_it < r6_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r7_it];
disp('Iteration 7')
m
mu
r7_it
disp('Next Iteration')
```

```
m =

     2

Iteration 7

m =

     2


mu =

   1.2800e-07


r7_it =

   62.7103

Next Iteration
```

Iteration 8

```
r8_it = 1000000000000000;
r7_baseline = r7_it;
m = 1;

while r8_it > r7_baseline
```

```
    Ja1 = t.^3 .* exp(alphatota(8) .* t) .* sin(omegatota(8) .* t);
    Ja2 = t.^2 .* exp(alphatota(8) .* t) .* cos(omegatota(8) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual8a;

    x7a = x6a - deltaxa;

    model9a = t .* (exp(x7a(1) .* t)) .* (sin(x7a(2)) .* t);

    residual9a = y - model9a;

    r8_it = residual9a' * residual9a;



    if r8_it > r7_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x7a(1)];
    omegatota = [omegatota x7a(2)];

if r8_it < r7_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r8_it];
disp('Iteration 8')
m
mu
r8_it
disp('Next Iteration')


m =

     2

Iteration 8

m =

     2
```

```
mu =

   2.5600e-08


r8_it =

   62.7063

Next Iteration
```

Iteration 9

```
r9_it = 10000000000000000;
r8_baseline = r8_it;
m = 1;

while r9_it > r8_baseline


    Ja1 = t.^3 .* exp(alphatota(9) .* t) .* sin(omegatota(9) .* t);
    Ja2 = t.^2 .* exp(alphatota(9) .* t) .* cos(omegatota(9) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual9a;

    x8a = x7a - deltaxa;

    model10a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);

    residual10a = y - model10a;

    r9_it = residual10a' * residual10a;



    if r9_it > r8_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x8a(1)];
    omegatota = [omegatota x8a(2)];

if r9_it < r8_baseline
    mu = mu/mu_down;
else
    mu = mu;
```

```
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r9_it];
disp('Iteration 9')
m
mu
r9_it
disp('Next Iteration')
```

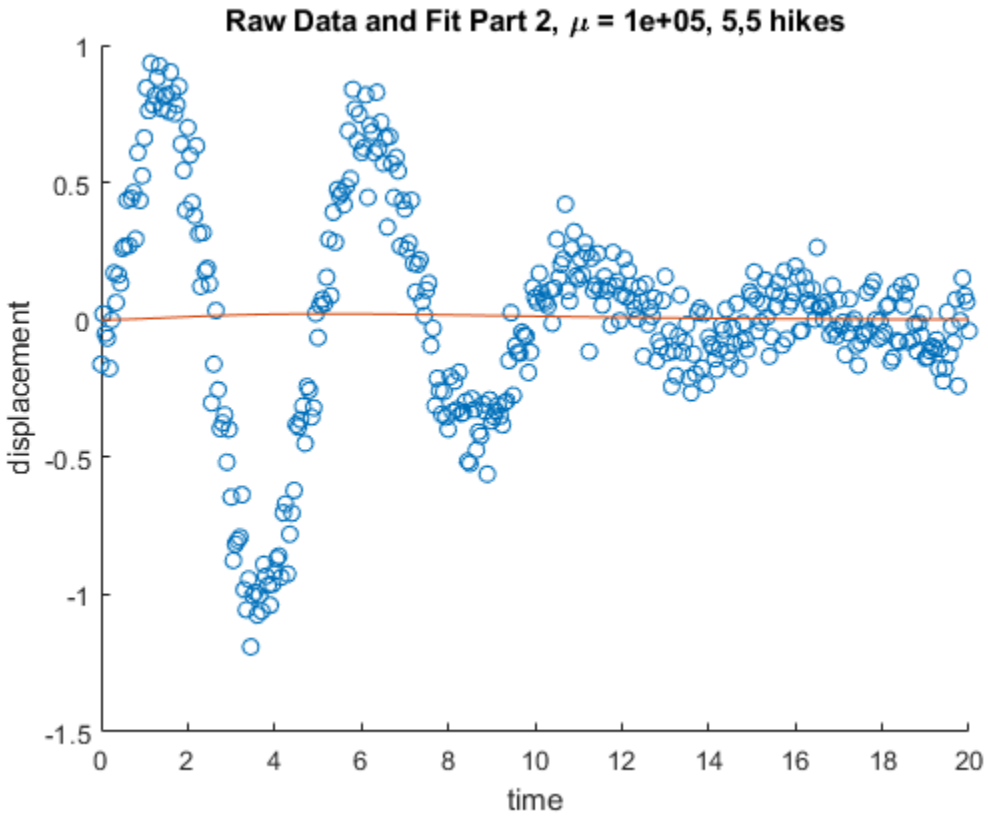
```
m =

     2

Iteration 9

m =

     2


mu =

   5.1200e-09


r9_it =

   62.7030

Next Iteration
```

Iteration 10

```
r10_it = 1000000000000000000;
r9_baseline = r9_it;
m = 1;

while r10_it > r9_baseline


    Ja1 = t.^3 .* exp(alphatota(10) .* t) .* sin(omegatota(10) .* t);
    Ja2 = t.^2 .* exp(alphatota(10) .* t) .* cos(omegatota(10) .* t);
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual10a;

    x9a = x8a - deltaxa;

    model11a = t .* (exp(x8a(1) .* t)) .* (sin(x8a(2)) .* t);
```

```
    residual11a = y - model11a;

    r10_it = residual11a' * residual11a;



    if r10_it > r9_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x9a(1)];
    omegatota = [omegatota x9a(2)];

if r10_it < r9_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
mtot = [mtot m];
rtotv = [rtotv r10_it];
disp('Iteration 10')
m
mu
r10_it
disp('Next Iteration')

% disp('Required 10 iterations to find final values')

f2 = figure('Name', 'Part 2 Plot over scatter, mu = 1e+05, 5,5
 hikes');

scatter(t,y)
hold on
plot(t, model10a)
title('Raw Data and Fit Part 2, \mu = 1e+05, 5,5 hikes')
xlabel('time')
ylabel('displacement')


m =

     2

Iteration 10

m =
```

```
     2

mu =

   5.1200e-09

r10_it =

   62.7030

Next Iteration
```



Echoing outputs for diary

```
diary vjprob1pt2_groupD.txt

echo on

mutot
mtot
rtotv
alphatota
omegatota
```

```
echo off

mutot

mutot =

   1.0e+05 *

  Columns 1 through 7

    1.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

  Columns 8 through 11

    0.0000    0.0000    0.0000    0.0000

mtot

mtot =

     1     2     2     2     2     2     2     2     2     2

rtotv

rtotv =

  Columns 1 through 7

  421.8764  412.2513   79.9736   64.3359   62.9533   62.7534   62.7184

  Columns 8 through 11

   62.7103   62.7063   62.7030   62.7030

alphatota

alphatota =

  Columns 1 through 7

   -0.4000   -0.4014   -0.4095   -0.4073   -0.4034   -0.3992   -0.3949

  Columns 8 through 11

   -0.3906   -0.3863   -0.3821   -0.3778

omegatota

omegatota =

  Columns 1 through 7

    0.5000    0.4972    0.1000    0.0249    0.0099    0.0070    0.0064
```

```
  Columns 8 through 11

    0.0062    0.0060    0.0059    0.0057

echo off
```

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Problem 2

```
close all
clear all
[x,y] = textread('Problem2_LogisticData.txt','%f%f','headerlines',1);
%beta 0 is alpha
%beta 1 is omega
alpha = 4;
omega = -4;
xk = [alpha omega]';

J1 = exp(-(alpha + omega .* x) ) ./ (1 + exp(-(alpha + omega .* x))).^2;
J2 = (x .* exp(-(alpha + omega .* x))) ./ (1 + exp(-(alpha + omega .* x))).^2;


J = [J1 J2];

model = 1 ./ (1 + exp(-(alpha + omega.*x)));


residual = y - model;

r2 = residual' * residual;


mu_start = 500;
mu_down = 50;
mu_up = 5;

deltax = inv(J'*J + mu_start.*[1 0; 0 1]) *J' * residual ;
x0 = xk - deltax ;


model2 = 1 ./ (1 + exp(-(x0(1) + x0(2).*x)));
residual2 = y - model2;

r22 = residual2' * residual2;
r22 < r2
```

```
alphatot = [xk(1) x0(1)];
omegatot = [xk(2) x0(2)];


mu = 0.1/50;


mutot = [mu_start mu];
rtotv = [r2 r22];


r2_it = 10000000000000000;
r2_baseline = r22;
m = 1;
while r2_it > r2_baseline


    Ja1 = exp(-(alphatot(2) + omegatot(2) .* x) ) ./ (1 + exp(-(alphatot(2) + omegatot(2) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatot(2) + omegatot(2) .* x))) ./ (1 + exp(-(alphatot(2) + omegatot(2) .*
x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual2;

    x1a = x0 - deltaxa;

    model3a = 1 ./ (1 + exp(-(x1a(1) + x1a(2) .* x)));

    residual3a = y - model3a;

    r2_it = residual3a' * residual3a;




    if r2_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
     if m == 5
        break
    end
end
    alphatota = [alphatot x1a(1)];
    omegatota = [omegatot x1a(2)];

if r2_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
rtotv = [rtotv r2_it];
disp('Iteration 2')
m
mu
r2_it
disp('Next Iteration')
```

```
ans =

  logical

   0


m =

     2


m =

     3


m =

     4


m =

     5

Iteration 2

m =

     5


mu =

    1.2500


r2_it =

   60.8568

Next Iteration
```

Iteration 3

```
r3_it = 1000000000000000;
r2_baseline = r2_it;
m = 1;

while r3_it > r2_baseline || m == 5


    Ja1 = exp(-(alphatota(3) + omegatota(3) .* x) ) ./ (1 + exp(-(alphatota(3) + omegatota(3) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(3) + omegatota(3) .* x))) ./ (1 + exp(-(alphatota(3) + omegatota(3)
.* x))).^2;
```

```
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual3a;

    x2a = x1a - deltaxa;

    model4a = 1 ./ (1 + exp(-(x2a(1) + x2a(2) .* x)));

    residual4a = y - model4a;

    r3_it = residual4a' * residual4a;



    if r3_it > r2_baseline
        mu = mu * mu_up;
    end
     m = m+1
     if m == 5
        break
    end
end
    alphatota = [alphatota x2a(1)];
    omegatota = [omegatota x2a(2)];

if r3_it < r2_baseline
    mu = mu/mu_down;
else
    mu = mu;
end
mutot = [mutot mu];
rtotv = [rtotv r3_it];
disp('Iteration 3')
m
mu
r3_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4


m =

     5

Iteration 3
```

```
m =

     5


mu =

  781.2500


r3_it =

   60.9611

Next Iteration
```

Iteration 4

```
r4_it = 10000000000000000;
r3_baseline = r3_it;
m = 1;

while r4_it > r3_baseline


    Ja1 = exp(-(alphatota(4) + omegatota(4) .* x) ) ./ (1 + exp(-(alphatota(4) + omegatota(4) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(4) + omegatota(4) .* x))) ./ (1 + exp(-(alphatota(4) + omegatota(4)
.* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual4a;

    x3a = x2a - deltaxa;

    model5a = 1 ./ (1 + exp(-(x3a(1) + x3a(2) .* x)));

    residual5a = y - model5a;

    r4_it = residual5a' * residual5a;



    if r4_it > r3_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x3a(1)];
    omegatota = [omegatota x3a(2)];

if r4_it < r3_baseline
    mu = mu/mu_down;
else
    mu = mu;
```

```
end
mutot = [mutot mu];
rtotv = [rtotv r4_it];
disp('Iteration 4')
m
mu
r4_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4


m =

     5

Iteration 4

m =

     5


mu =

   4.8828e+05


r4_it =

   60.9612

Next Iteration
```

Iteration 5

```
r5_it = 1000000000000000;
r4_baseline = r4_it;
m = 1;

while r5_it > r4_baseline


    Ja1 = exp(-(alphatota(5) + omegatota(5) .* x) ) ./ (1 + exp(-(alphatota(5) + omegatota(5) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(5) + omegatota(5) .* x))) ./ (1 + exp(-(alphatota(5) + omegatota(5)
```

```
.* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual5a;

    x4a = x3a - deltaxa;

    model6a = 1 ./ (1 + exp(-(x4a(1) + x4a(2) .* x)));

    residual6a = y - model6a;

    r5_it = residual6a' * residual6a;



    if r5_it > r4_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x4a(1)];
    omegatota = [omegatota x4a(2)];

if r5_it < r4_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
rtotv = [rtotv r5_it];
disp('Iteration 5')
m
mu
r5_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4


m =

     5
```

```
Iteration 5

m =

     5


mu =

   3.0518e+08


r5_it =

   60.9612

Next Iteration
```

Iteration 6

```
r6_it = 10000000000000000;
r5_baseline = r5_it;
m = 1;

while r6_it > r5_baseline


    Ja1 = exp(-(alphatota(6) + omegatota(6) .* x) ) ./ (1 + exp(-(alphatota(6) + omegatota(6) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(6) + omegatota(6) .* x))) ./ (1 + exp(-(alphatota(6) + omegatota(6)
.* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual6a;

    x5a = x4a - deltaxa;

    model7a = 1 ./ (1 + exp(-(x5a(1) + x5a(2) .* x)));

    residual7a = y - model7a;

    r6_it = residual7a' * residual7a;



    if r6_it > r5_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x5a(1)];
    omegatota = [omegatota x5a(2)];

if r6_it < r5_baseline
    mu = mu/mu down;
```

```
else
    mu = mu;
end
mutot = [mutot mu];
rtotv = [rtotv r6_it];
disp('Iteration 6')
m
mu
r6_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4


m =

     5

Iteration 6

m =

     5


mu =

   1.9073e+11


r6_it =

   60.9612

Next Iteration
```

Iteration 7

```
r7_it = 1000000000000000;
r6_baseline = r6_it;
m = 1;

while r7_it > r6_baseline
```

```
    Ja1 = exp(-(alphatota(7) + omegatota(7) .* x) ) ./ (1 + exp(-(alphatota(7) + omegatota(7) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(7) + omegatota(7) .* x))) ./ (1 + exp(-(alphatota(7) + omegatota(7)
.* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual7a;

    x6a = x5a - deltaxa;

    model8a = 1 ./ (1 + exp(-(x6a(1) + x6a(2) .* x)));

    residual8a = y - model8a;

    r7_it = residual8a' * residual8a;



    if r7_it > r6_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x6a(1)];
    omegatota = [omegatota x6a(2)];

if r7_it < r6_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
rtotv = [rtotv r7_it];
disp('Iteration 7')
m
mu
r7_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4
```

```
m =

     5

Iteration 7

m =

     5


mu =

   1.1921e+14


r7_it =

   60.9612

Next Iteration
```

Iteration 8

```
r8_it = 1000000000000000;
r7_baseline = r7_it;
m = 1;

while r8_it > r7_baseline


    Ja1 = exp(-(alphatota(8) + omegatota(8) .* x) ) ./ (1 + exp(-(alphatota(8) + omegatota(8) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(8) + omegatota(8) .* x))) ./ (1 + exp(-(alphatota(8) + omegatota(8)
.* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual8a;

    x7a = x6a - deltaxa;

    model9a = 1 ./ (1 + exp(-(x7a(1) + x7a(2) .* x)));

    residual9a = y - model9a;

    r8_it = residual9a' * residual9a;



    if r8_it > r7_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x7a(1)];
```

```
    omegatota = [omegatota x7a(2)];

if r8_it < r7_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
rtotv = [rtotv r8_it];
disp('Iteration 8')
m
mu
r8_it
disp('Next Iteration')
```

```
m =

     2


m =

     3


m =

     4

Iteration 8

m =

     4


mu =

   2.9802e+15


r8_it =

   60.9612

Next Iteration
```

Iteration 9

```
r9_it = 1000000000000000;
r8_baseline = r8_it;
m = 1;

while r9_it > r8_baseline


    Ja1 = exp(-(alphatota(9) + omegatota(9) .* x) ) ./ (1 + exp(-(alphatota(9) + omegatota(9) .*
```

```
x))).^2;
    Ja2 = (x .* exp(-(alphatota(9) + omegatota(9) .* x))) ./ (1 + exp(-(alphatota(9) + omegatota(9)
.* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual9a;

    x8a = x7a - deltaxa;

    model10a = 1 ./ (1 + exp(-(x8a(1) + x8a(2) .* x)));

    residual10a = y - model10a;

    r9_it = residual10a' * residual10a;



    if r9_it > r8_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x8a(1)];
    omegatota = [omegatota x8a(2)];

if r9_it < r8_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
rtotv = [rtotv r9_it];
disp('Iteration 9')
m
mu
r9_it
disp('Next Iteration')
```

```
m =

     2


m =

     3

Iteration 9

m =

     3
```

```
mu =

   1.4901e+16


r9_it =

   60.9612

Next Iteration
```

Iteration 10

```
r10_it = 1000000000000000000;
r9_baseline = r9_it;
m = 1;

while r10_it > r9_baseline


    Ja1 = exp(-(alphatota(10) + omegatota(10) .* x) ) ./ (1 + exp(-(alphatota(10) + omegatota(10) .*
x))).^2;
    Ja2 = (x .* exp(-(alphatota(10) + omegatota(10) .* x))) ./ (1 + exp(-(alphatota(10) +
omegatota(10) .* x))).^2;
    Ja = [Ja1 Ja2];

    deltaxa = inv(J'*J + mu.*[1 0; 0 1]) *J' * residual10a;

    x9a = x8a - deltaxa;

    model11a = 1 ./ (1 + exp(-(x9a(1) + x9a(2) .* x)));

    residual11a = y - model11a;

    r10_it = residual11a' * residual11a;



    if r10_it > r9_baseline
        mu = mu * mu_up;
    end

     m = m+1
    if m == 5
        break
    end
end
    alphatota = [alphatota x9a(1)];
    omegatota = [omegatota x9a(2)];

if r10_it < r9_baseline
    mu = mu/mu_down;
else
    mu = mu;
end

mutot = [mutot mu];
rtotv = [rtotv r10_it];
disp('Iteration 10')
```

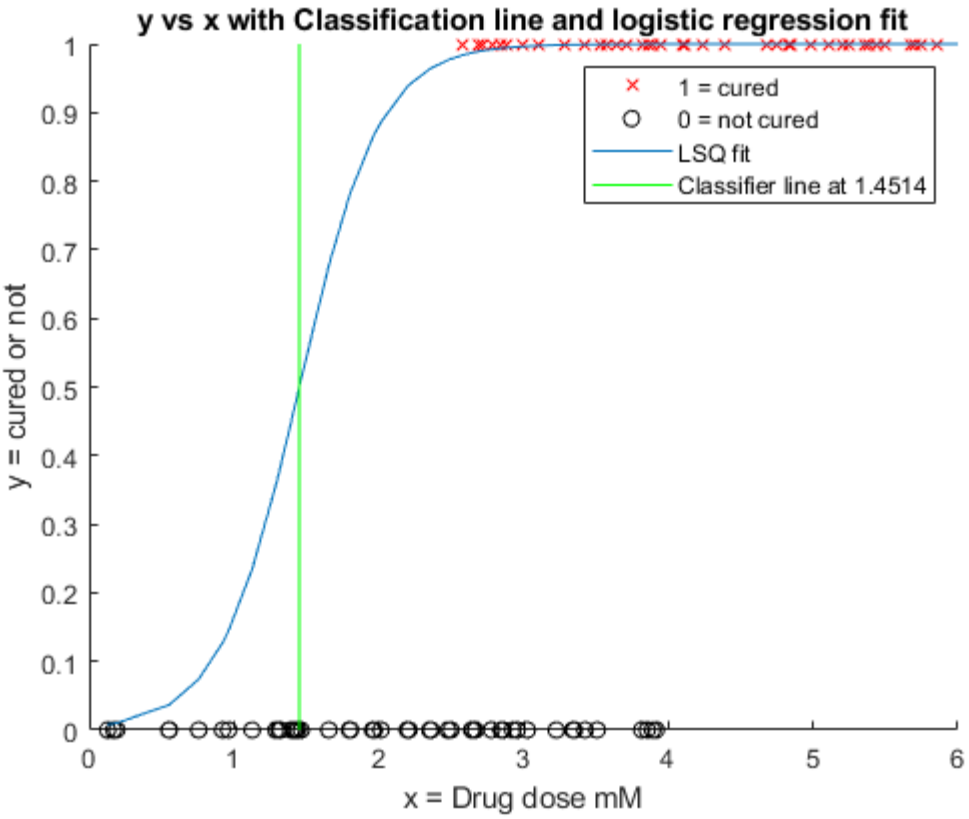
```
m
mu
r10_it
disp('Next Iteration')

% disp('Required 10 iterations to find final values')
```

```
m =

     2

Iteration 10

m =

     2


mu =

   1.4901e+16


r10_it =

   60.9612

Next Iteration
```

Plotting

```
vertx = -alphatota(9)/omegatota(9)

yind = find(y>0,100);
yind2 = find(y<1, 100);

scatter(x(yind), y(yind),'r', 'x'); %all ones
hold on
scatter(x(yind2),y(yind2),'k', 'o');

hold on


fp = flip(model9a);
plot(x,-model9a+1)



hold on


line([vertx vertx], [0 1], 'Color', 'g')

title('y vs x with Classification line and logistic regression fit');
xlabel('x = Drug dose mM');
ylabel('y = cured or not');
legend('1 = cured', '0 = not cured', 'LSQ fit', 'Classifier line at 1.4514')
xlim([0 6])
```

```
vertx =

    1.4514
```



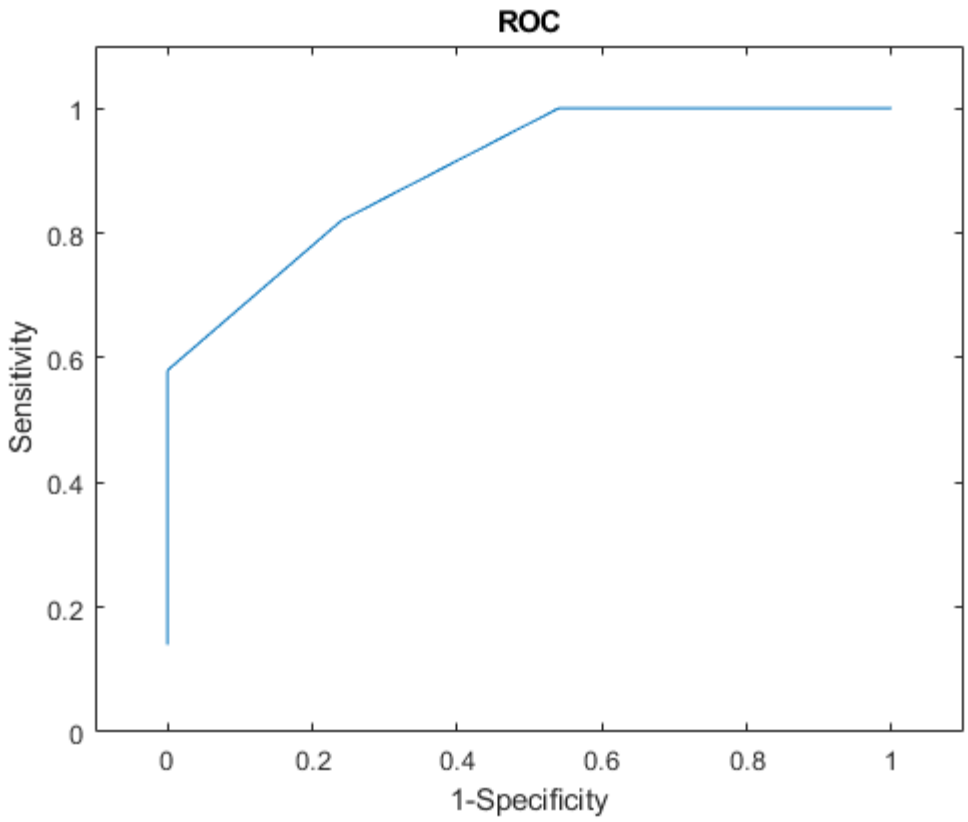
Sensitivity and specificity

```
%we know that there are 50 positives, 50 neg

xind1 = find(x(yind) > vertx, 50);
tp = length(xind1);
xind4 = find(x(yind) < vertx, 50);
fn = length(xind4);
xind2 = find(x(yind2) < vertx, 50);
tf = length(xind2);
xind3 = find(x(yind2) > vertx, 50);
fp = length(xind3);

sensitivity = tp/(tp + fn);
specificity = tf/(tf + fp);
```

ROC

```
%do the above for the model with x* from 0 to 6 (0 1 2 3 4 5 6)
yinda = find(y>0,100);
yind2a = find(y<1, 100);
sense = [];
spec = [];
```

```
for i = 0:6
    xind1a = find(x(yinda) > i, 50);
    tpa = length(xind1a);
    xind2a = find(x(yind2a) < i, 50);
    tfa = length(xind2a);
    xind3a = find(x(yind2a) > i, 50);
    fpa = length(xind3a);
    xind4a = find(x(yinda) < i, 50);
    fna = length(xind4a);

    ss = tpa/(tpa + fna);
    sp = 1 - (tfa/(tfa + fpa));
    sense = [sense ss];
    spec = [spec sp];
end

figure;
plot(spec, sense)
title('ROC')
xlabel('1-Specificity');
ylabel('Sensitivity');
ylim([0 1.1]);
xlim([-0.1 1.1]);
```



Echoing Results to Diary

```
diary vjprob2.txt

echo on

mutot
rtotv
```

```
beta_o = alphatota
beta_one = omegatota
sensitivity
specificity
echo off
```

```
mutot

mutot =

   1.0e+16 *

  Columns 1 through 7

    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

  Columns 8 through 11

    0.0119    0.2980    1.4901    1.4901

rtotv

rtotv =

  Columns 1 through 7

   55.9632   55.9721   60.8568   60.9611   60.9612   60.9612   60.9612

  Columns 8 through 11

   60.9612   60.9612   60.9612   60.9612

beta_o = alphatota

beta_o =

  Columns 1 through 7

    4.0000    4.0022    5.2663    5.2790    5.2790    5.2790    5.2790

  Columns 8 through 11

    5.2790    5.2790    5.2790    5.2790

beta_one = omegatota

beta_one =

  Columns 1 through 7

   -4.0000   -3.9980   -3.6501   -3.6371   -3.6371   -3.6371   -3.6371

  Columns 8 through 11

   -3.6371   -3.6371   -3.6371   -3.6371

sensitivity

sensitivity =
```

```
     1

specificity

specificity =

    0.3400

echo off
```

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Problem 3

```
clear all
close all

day1 = [1.7 1.72 1.73 2.30 2.40 2.50 2.55 2.6]';
day15 = [3.8 3.95 4.00 4.3 4.4 4.5 4.7 4.9 5 5.10]';
day29 = [4.2 4.3 4.4 4.45 4.50 4.51 4.70 4.75 4.80 4.85]';
day36 = [4.9 5.1 5.73 5.75 5.77 5.78 5.82 5.85]';
convplctrl = [2.5 4.2 4.25 4.4 4.6 4.8 5 5.2 5.6 5.8 5.9 6 6.2 6.3 6.4
 6.5]';
totvec = [day1' day15' day29' day36' convplctrl'];
totvecl = {'d1', 'd1', 'd1', 'd1', 'd1', 'd1', 'd1', 'd1',...

  'd15', 'd15', 'd15', 'd15', 'd15', 'd15', 'd15', 'd15', 'd15', 'd15',...

  'd29', 'd29', 'd29', 'd29', 'd29', 'd29', 'd29', 'd29', 'd29', 'd29', ...
    'd36', 'd36', 'd36', 'd36', 'd36', 'd36', 'd36', 'd36', ...

  'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', ...

  'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl', 'cptrl'};


d1m = mean(day1);
d15m = mean(day15);
d29m = mean(day29);
d36m = mean(day36);
convplm = mean(convplctrl);
totvecm = mean(totvec);

figure;

day1ones = ones(length(day1),1);
h = scatter(day1ones,day1,'r');

hold on

day15ones = 15*ones(length(day15),1);
h1 = scatter(day15ones,day15, 'g');
hold on

day29ones = 29*ones(length(day29),1);
h2 = scatter(day29ones,day29, 'b');
hold on

day36ones = 36*ones(length(day36),1);
h3 = scatter(day36ones,day36,'y');
hold on

convones = 60*ones(length(convplctrl),1);
h4 = scatter(convones, convplctrl, 'm');
```

```
ylim([0 7])
xlim([0 62])

hl0 = line([0:3], [d1m d1m d1m d1m], 'Color', 'r');
hl1 = line([12:18], [d15m d15m d15m d15m d15m d15m
 d15m], 'Color', 'g');
hl2 = line([26:32], [d29m d29m d29m d29m d29m d29m
 d29m], 'Color', 'b', 'LineWidth', 3);
hl3 = line([33:39], [d36m d36m d36m d36m d36m d36m
 d36m], 'Color', 'y');
hl4 = line([57:63], [convplm convplm convplm convplm convplm convplm
 convplm], 'Color', 'm');
ll = [1:60];
hl5 = line(ll,
 totvecm*ones(length(ll),1)', 'Color', 'k', 'LineStyle', '--');

title('S-2P')
ylabel('Reciprocal Enpdpoint Titer (log-scale)')
xlabel('Study Day')
set(gca,'XTickLabel',{'0','10','20','30','40','50','Convalescent'});

hold off


dtot = totvec' - totvecm*ones(length(totvec),1);
SStot = dtot'*dtot;
doftot = length(totvec)-1;

%do it for each each group


%take variable
SSerror = sscalc(day1) + sscalc(day15) + sscalc(day29) + sscalc(day36)
 + sscalc(convplctrl);
groupdof = doftot - 4;

SSgroup = length(day1)*(d1m - totvecm) + length(day15)*(d15m -
 totvecm) + length(day29)*(d29m - totvecm) + length(day36)*(d36m -
 totvecm) +...
    length(convplctrl)*(convplm - totvecm); %odd not sure why this
 didn't work

SSgroup_real = SStot-SSerror;
groupodof = 4;

groupvar = SSgroup_real/groupodof;
errorvar = SSerror/groupdof;
F = groupvar/errorvar;


DOF = [groupodof groupdof doftot]';
% xx = ['Days (Categorical)';'Error';'Total'];
SS = [SSgroup_real, SSerror, SStot]';
```

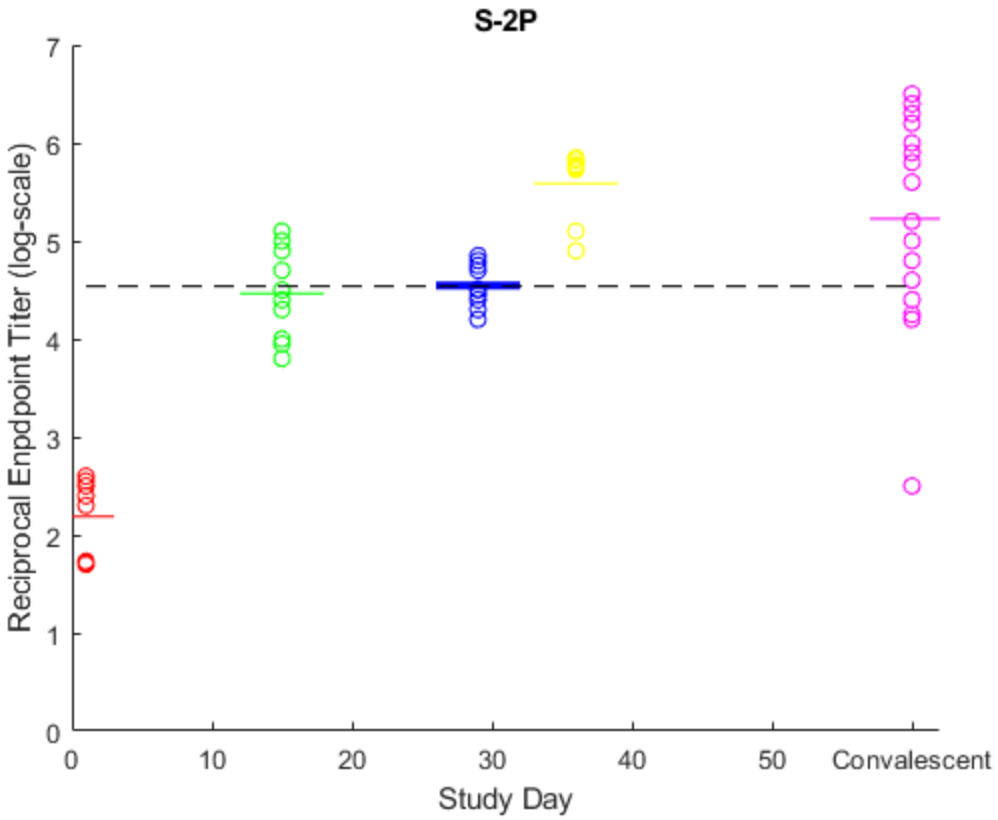
```
MS = [groupvar, errorvar, NaN]';
FF = [F, NaN, NaN]';
pp = [1, NaN, NaN]';
Fcrit = [2.5695, NaN, NaN]';
tfields = { 'DOF'
            'SS'
            'MS'
            'F'
            'Fcrit'
            'isp' };

fulltable = table(DOF, SS, MS, FF, Fcrit, pp, 'VariableNames',
 tfields);

%tukey test
DGM = zeros(5,5);
DGM(2,1) = d1m - d15m;
DGM(3,1) = d1m - d29m;
DGM(4,1) = d1m - d36m;
DGM(5,1) = d1m - convplm;
DGM(3,2) = d15m - d29m;
DGM(4,2) = d15m - d36m;
DGM(5,2) = d15m - convplm;
DGM(4,3) = d29m - d36m;
DGM(5,3) = d29m - convplm;
DGM(5,4) = d36m - convplm;
% DGM
% abs(DGM)
% HSD
q = 4.011;
mse = errorvar;
HSD = zeros(5,5);
HSD(2,1) = 4.011 * ((mse/2)*(1/8 + 1/10))^0.5;
HSD(3,1) = 4.011 * ((mse/2)*(1/8 + 1/10))^0.5;
HSD(4,1) = 4.011 * ((mse/2)*(1/8 + 1/8))^0.5;
HSD(5,1) = 4.011 * ((mse/2)*(1/8 + 1/16))^0.5;
HSD(3,2) = 4.011 * ((mse/2)*(1/10 + 1/10))^0.5;
HSD(4,2) = 4.011 * ((mse/2)*(1/10 + 1/8))^0.5;
HSD(5,2) = 4.011 * ((mse/2)*(1/16 + 1/10))^0.5;
HSD(4,3) = 4.011 * ((mse/2)*(1/8 + 1/10))^0.5;
HSD(5,3) = 4.011 * ((mse/2)*(1/16 + 1/10))^0.5;
HSD(5,4) = 4.011 * ((mse/2)*(1/16 + 1/8))^0.5;
% HSD

% DGM - HSD

diary VJprob3.txt
echo on

fulltable
disp('Since F is greater than critical value, p is less than alpha and
 thus we can reject the null hypothesis.')
disp('Group 1 is statistically dissimilar to all the rest. Group 4 and
 5 are statistically the same, thus are the higher titer.')
```

```
disp('According to abs(DGM) - HSD, group 2 and 3 are statistically
 similar.')
disp('Day 15 and 36 are statistically dissimilar.')
disp('Group 2 and 5 are statistically similar.')
disp('Group 3 and 4 are statistically dissimilar.')

echo off
```

```
fulltable
```

```
fulltable =

  3×6 table

    DOF      SS        MS         F       Fcrit     isp
    ___    _____    _______    _____    ______    ___

     4     60.685     15.171    32.754    2.5695     1
    47     21.769    0.46318       NaN       NaN    NaN
    51     82.454        NaN       NaN       NaN    NaN
```

```
disp('Since F is greater than critical value, p is less than alpha and
 thus we can reject the null hypothesis.')
Since F is greater than critical value, p is less than alpha and thus
 we can reject the null hypothesis.
disp('Group 1 is statistically dissimilar to all the rest. Group 4 and
 5 are statistically the same, thus are the higher titer.')
Group 1 is statistically dissimilar to all the rest. Group 4 and 5 are
 statistically the same, thus are the higher titer.
disp('According to abs(DGM) - HSD, group 2 and 3 are statistically
 similar.')
According to abs(DGM) - HSD, group 2 and 3 are statistically similar.
disp('Day 15 and 36 are statistically dissimilar.')
Day 15 and 36 are statistically dissimilar.
disp('Group 2 and 5 are statistically similar.')
Group 2 and 5 are statistically similar.
disp('Group 3 and 4 are statistically dissimilar.')
Group 3 and 4 are statistically dissimilar.

echo off
```



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