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Ch2: L1 parameter estimates, individual activity

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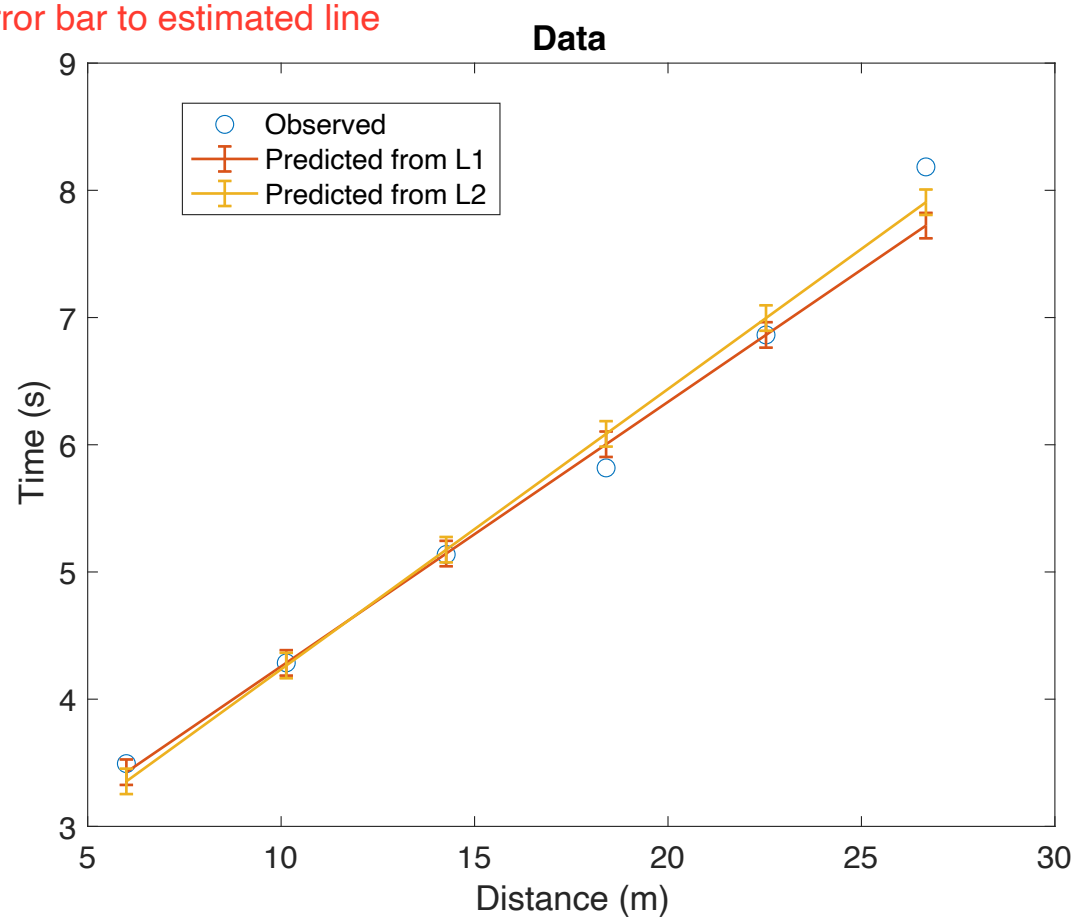
Question 1

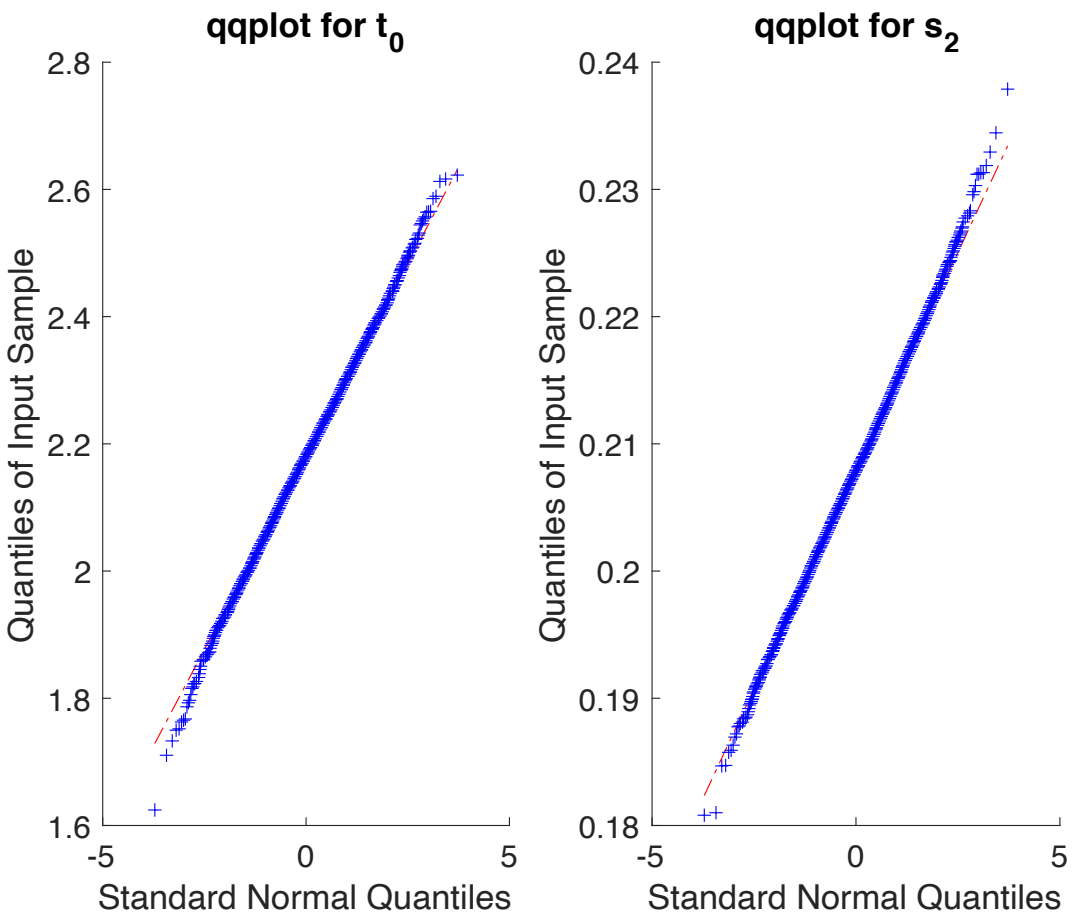
The parameter estimated from L1 algorithm is $t_0 = 2.1786$ and $s_2 = 0.2079$. The data and the fitted model are plotted at figure below. Comparison between the estimation from L1 and L2, we can find that L1 estimation is closer to the general trend and away from the outliers (e.g., the rightest point in the figure).

-1, I add the error bar to estimated line



Question 2

I use $q = 5000$ in this problem and the qq plot for the two parameters are shown in figure below. We can find the variables are almost fit in a straight line, which means they are close to normal distribution.



Question 3

(a) From the sort operation, I found the 95% confidence interval for t_0 is 0.2506 and for s_2 is the 0.0138. The range is $t_0 = 2.1786 \pm 0.2506$ and

-0

$s_2 = 0.2079 \pm 0.0138$

(b) The covariance matrix from L1 estimation is $\begin{matrix} 0.01546 & -0.00081 \\ -0.00081 & 4.9197e-5 \end{matrix}$

The confidence interval = 1.96*sqrt(diag(cov)) = 0.2477 and 0.0138
The range is $t_0 = 2.1786 \pm 0.2477$ and

-0

$s_2 = 0.2079 \pm 0.0138$

The confidence interval from L2 estimation is 0.2017 and 0.0113 respectively. We can find that the uncertainty from sort and covariance are almost the same but uncertainty from L2 is smaller.

Codes

```
clear

clear
t = [3.4935;4.2853;5.1374;5.8181;6.8632;8.1841];
x = [6;10.1333;14.2667;18.4;22.5333;26.6667];

% organize G

G = [ones(6,1),x];

% L1 estimate
s_l1 = irls(G, t, 1e-3, 1e-3, 1, 20)

t_pred = G*s_l1;


% least square estimate s2
s2 = inv(G'*G)*G'*t;

t_pred2 = G*s2;


% plot the data and the fitted model, and the residuals.

figure(1)

plot(x,t,'o','MarkerSize',8)
hold on
errorbar(x,t_pred,0.1*ones(size(t_pred)),'LineWidth',1.2)
hold on
errorbar(x,t_pred2,0.1*ones(size(t_pred)),'LineWidth',1.2)
xlabel('Distance (m)')
legend('Observed','Predicted from L1','Predicted from L2')
ylabel('Time (s)')
xlim([5,30])
set(gca,'fontsize',14)
title('Data')

%% question 2
q = 5000;

for i =1:q
    M (:,i)= irls(G, t_pred + 0.1*randn(size(t_pred)), 1e-3, 1e-3, 1, 50);
end

std(t_pred2-t)


figure
subplot(1,2,1)
qqplot(M(1,:))
title('qqplot for t_0')
set(gca,'fontsize',14)
```

```
subplot(1,2,2)
qqplot(M(2,:))
title('qqplot for s_2')
set(gca,'fontsize',14)
%% question 3
%(a)
t0sort = sort(abs(s_l1(1)-M(1,:)));
t0_in = t0sort(q*0.95)

s2sort = sort(abs(s_l1(2)-M(2,:)));
s2_in = s2sort(q*0.95)

%(b)
A = M - s_l1;
cov = A*A'/q

1.96*sqrt(diag(cov))

CI = [s_l1-1.96*sqrt(diag(cov)), s_l1 + 1.96*sqrt(diag(cov))]
```