Problem Set 4 Solution

1. a
% test means (ranksum test: p=.13, t-test: p=.06, kstest: p=.07)

%a. means not significantly different, look at correlation
```
[c1 p1] = corrcoef(x,y1);
[c2 p2] = corrcoef(x,y2);
```
% both correlations significant, reasonable to do
% regression analysis
```
x = [x ; ones(size(x))];
[b1 bint1 r rint stats1] = regress(y1', x', .05);
[b2 bint2 r rint stats2] = regress(y2', x', .05);
```
% b1 = 2.04
% 22.19

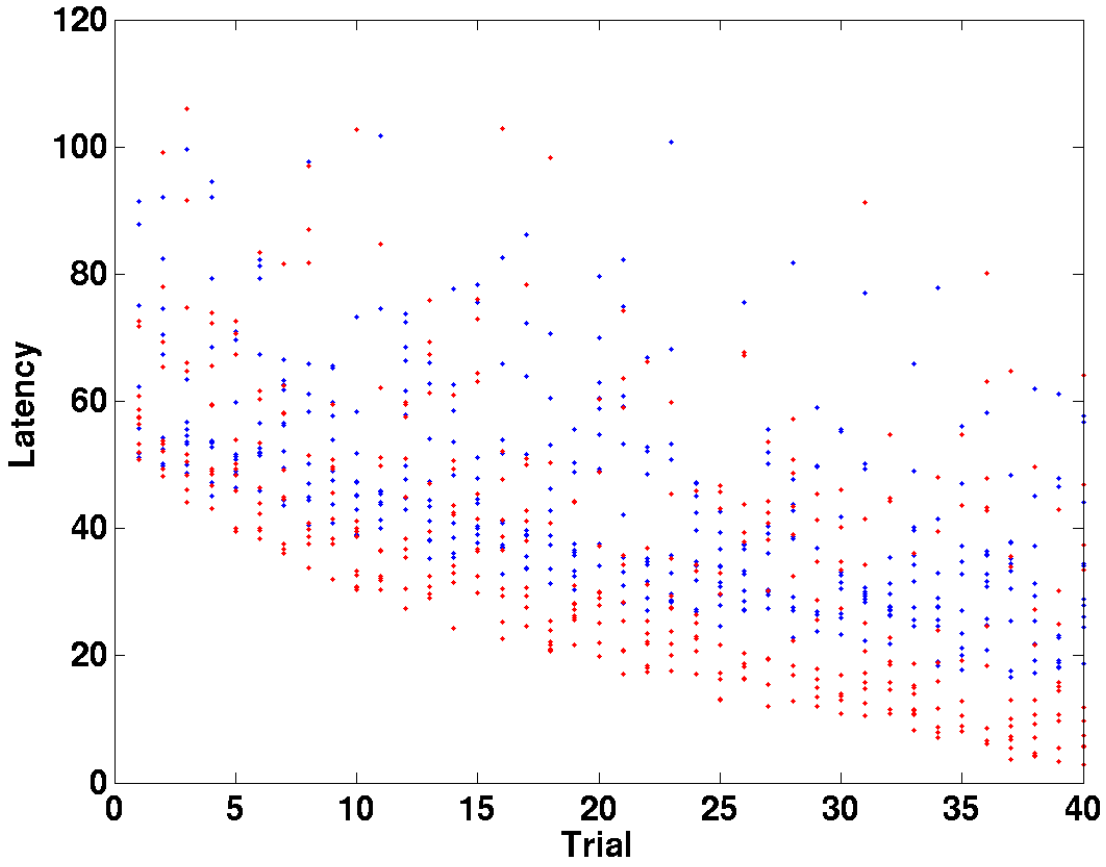
% b2 = 2.84
% 20.22
% bint1 = 1.7007 2.3759
% 20.1371 24.2527
% bint2 = 2.2797 3.4053
% 16.7921 23.6528

% the slopes are significantly different, but the intercepts are not. Thus,
% the two groups are different

1.b.
%c1 = .786, so r^2 = .6179
%c2 = .7286, so r^2 = .5309

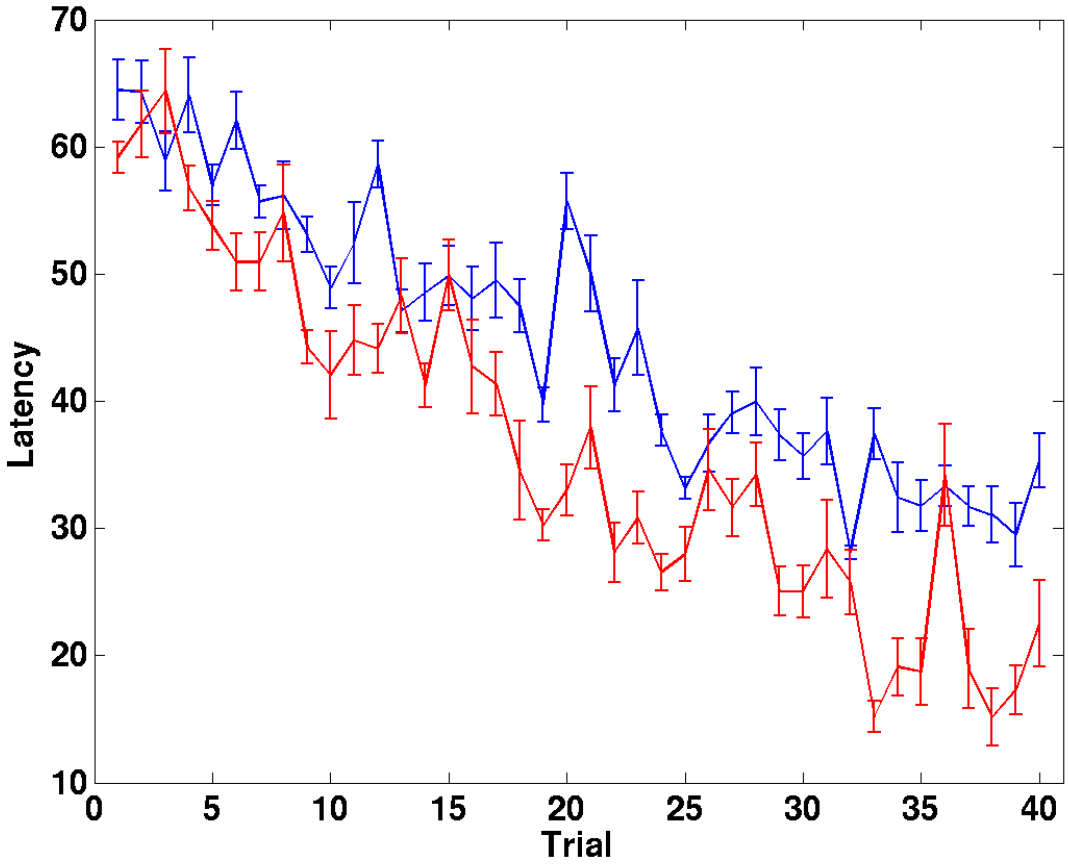
% 61 and 53 % of the variance can be explained by contrast.

2. Water maze simulation
```
load ps5_problem2
```
% a. plot data
```
x = 1:40;
plot(x, g1, 'b.');
hold on
plot(x, g2, 'r.');
xlabel('Trial', 'FontSize', 18);
ylabel('Latency', 'FontSize', 18);
set(gca, 'FontSize', 18);
```



%b. means and standard errors

```
figure;
m1 = mean(g1);
m2 = mean(g2);
s1 = stderr(g1);
s2 = stderr(g2);
errorbar2(x, m1, s1, .5);
hold on
errorbar2(x, m2, s2, .5, 'r');
xlabel('Trial', 'FontSize', 18);
ylabel('Latency', 'FontSize', 18);
set(gca, 'FontSize', 18);
```




```
%c. anova
y = [];
group = [];
time = [];
for i = 1:10
    y = [y g1(i,:)];
    group = [group ones(size(g1(i,:)))];
    time = [time 1:40];
    y = [y g2(i,:)];
    group = [group 2*ones(size(g1(i,:)))];
    time = [time 1:40];
end

[p atab stats] = anovan(y, {time group}, 3, 3, strvcat('group',
'time'));
[comp m h] = multcompare(stats, .05, 'off','tukey-kramer',[] ,[1 2]);
% the interesting differences are the groups with the same time, which are
% group indeces separated by 40
sig = find((sign(comp(:,3)) == sign(comp(:,5))) & (comp(:,1) ==
comp(:,2) - 40));
% sig is empty, so none of the times are different
```

Note that ideally this would be mixed anova with one within and one between subject variable, but anovan doesn't handle that.

2d. linear regression

```
g1row = reshape(g1, 400, 1);
g2row = reshape(g2, 400, 1);
x = [];
for i = 1:40
    x = [x ; ones(10,1) * i ones(10,1)];
end
[b1 bint1 r rint stats1] = regress(g1row, x, .05);
[b2 bint2 r rint stats2] = regress(g2row, x, .05);
```

b1 =

  -0.8694
  62.9827

b2 =

  -1.0890
  58.9789

bint1 =

  -0.9866 -0.7522
  60.2251 65.7403

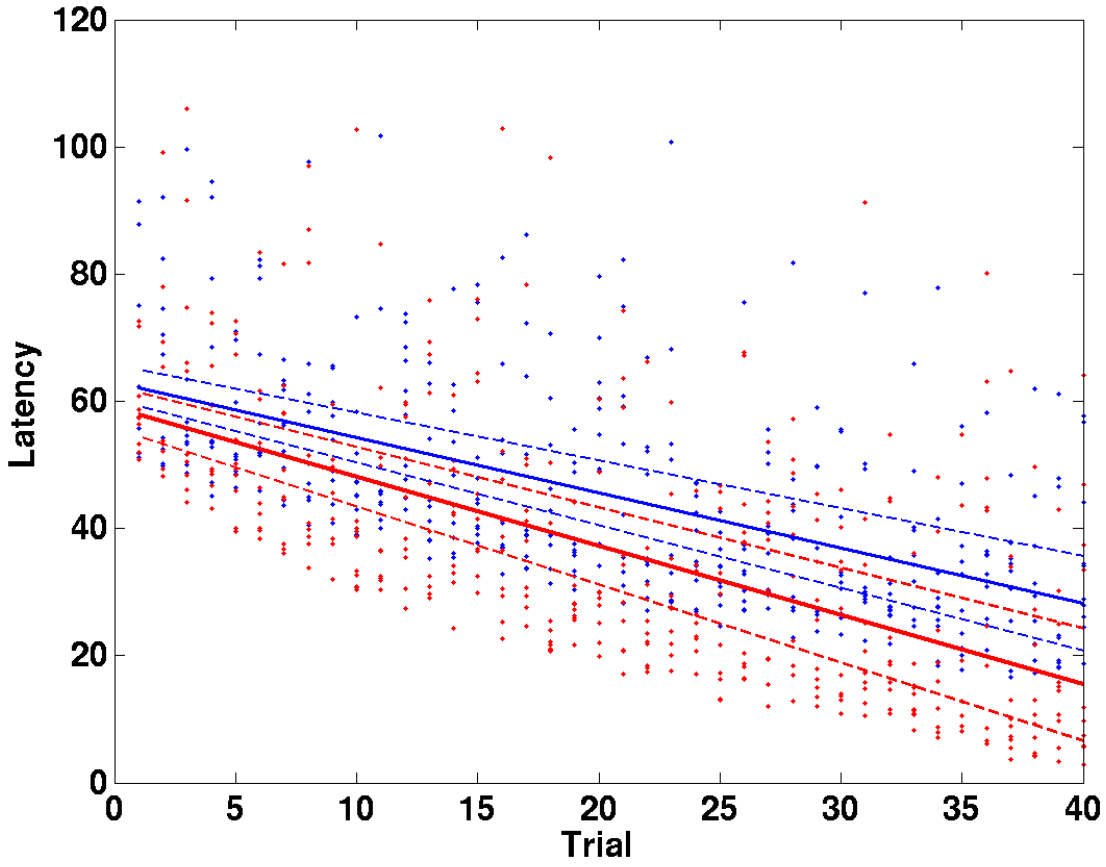
bint2 =

  -1.2285 -0.9495
  55.6967 62.2610

%plot:

```
t = 1:40;
plot(t, g1, 'b.');
hold on
plot(t, g2, 'r.');
xlabel('Trial', 'FontSize', 18);
ylabel('Latency', 'FontSize', 18);
set(gca, 'FontSize', 18);

%regression lines:
endpoints = [t(1) t(end)];
plot(endpoints, b1(1) * endpoints + b1(2), 'b', 'LineWidth', 2);
plot(endpoints, bint1(1,1) * endpoints + bint1(2,1), 'b--',
'LineWidth', 1);
plot(endpoints, bint1(1,2) * endpoints + bint1(2,2), 'b--',
'LineWidth', 1);
plot(endpoints, b2(1) * endpoints + b2(2), 'r', 'LineWidth', 2);
```

```
plot(endpoints, bint2(1,1) * endpoints + bint2(2,1), 'r--',
'LineWidth', 1);
plot(endpoints, bint2(1,2) * endpoints + bint2(2,2), 'r--',
'LineWidth', 1);
```

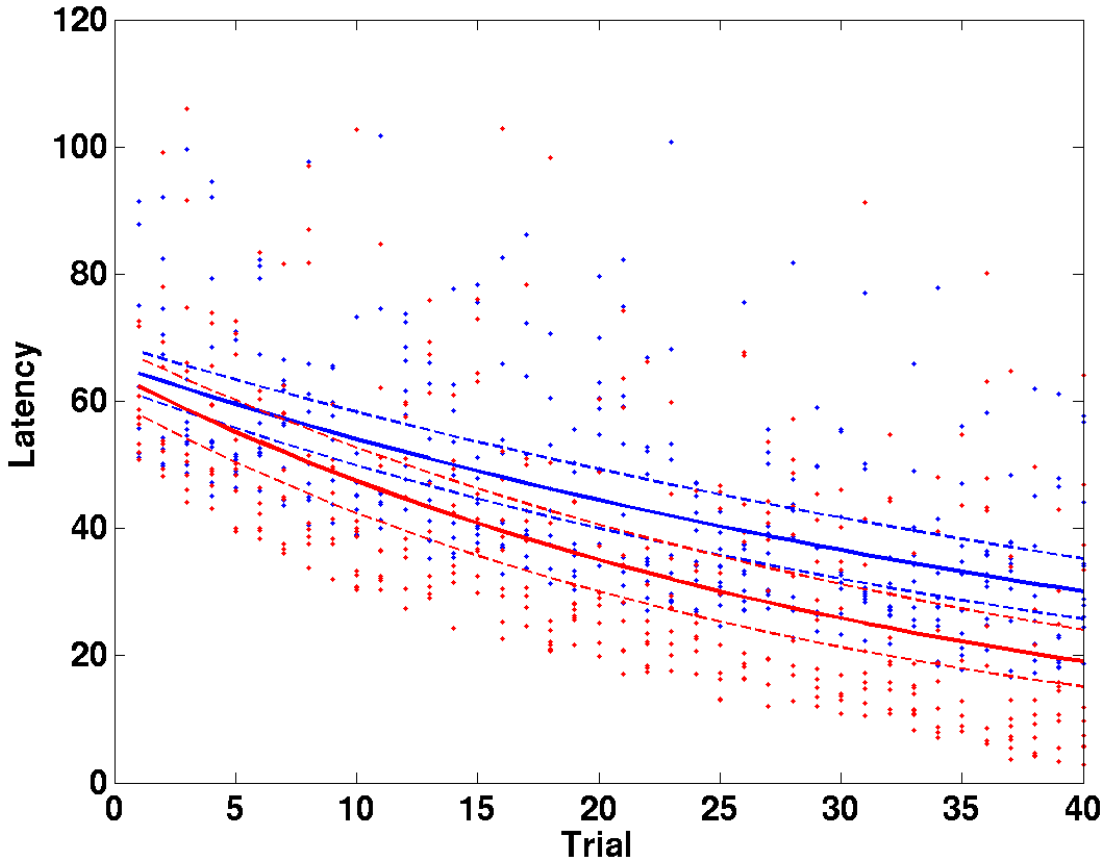


The solid lines lie outside of each others' 95% confidence intervals, so the two fits indicate a significant difference.

2e. Non-linear regression, y = Aexp(-Bx)

```
% function [y] = expfn(beta, x)
% y = beta(1) * exp(-beta(2) * x);
x = x(:,1);
[beta1 r j] = nlinfit(x, g1row, @expfn, [50 1]);
bint1 = nlparci(beta1, r, j);

[beta2 r j] = nlinfit(x, g2row, @expfn, [50 1]);
bint2 = nlparci(beta2, r, j);

beta1 =
  65.6128    0.0194

beta2 =
```

```
   64.2558    0.0303


bint1 =
   62.2808   68.9423
    0.0168    0.0221

bint2 =
   59.9057   68.6063
    0.0262    0.0344

% overlapping intercepts but different time constants

% plot data
x = 1:40;
plot(x, g1, 'b.');
hold on
plot(x, g2, 'r.');
y1 = beta1(1) * exp(-beta1(2) * x);
y1lower = bint1(1,1) * exp(-bint1(2,2) * x);
y1upper = bint1(1,2) * exp(-bint1(2,1) * x);
plot(x,y1, 'b', 'LineWidth', 2);
plot(x,y1lower, 'b--');
plot(x,y1upper, 'b--');


y2 = beta2(1) * exp(-beta2(2) * x);
y2lower = bint2(1,1) * exp(-bint2(2,2) * x);
y2upper = bint2(1,2) * exp(-bint2(2,1) * x);
plot(x,y2, 'r', 'LineWidth', 2);
plot(x,y2lower, 'r--');
plot(x,y2upper, 'r--');
xlabel('Trial', 'FontSize', 18);
ylabel('Latency', 'FontSize', 18);
set(gca, 'FontSize', 18);
```



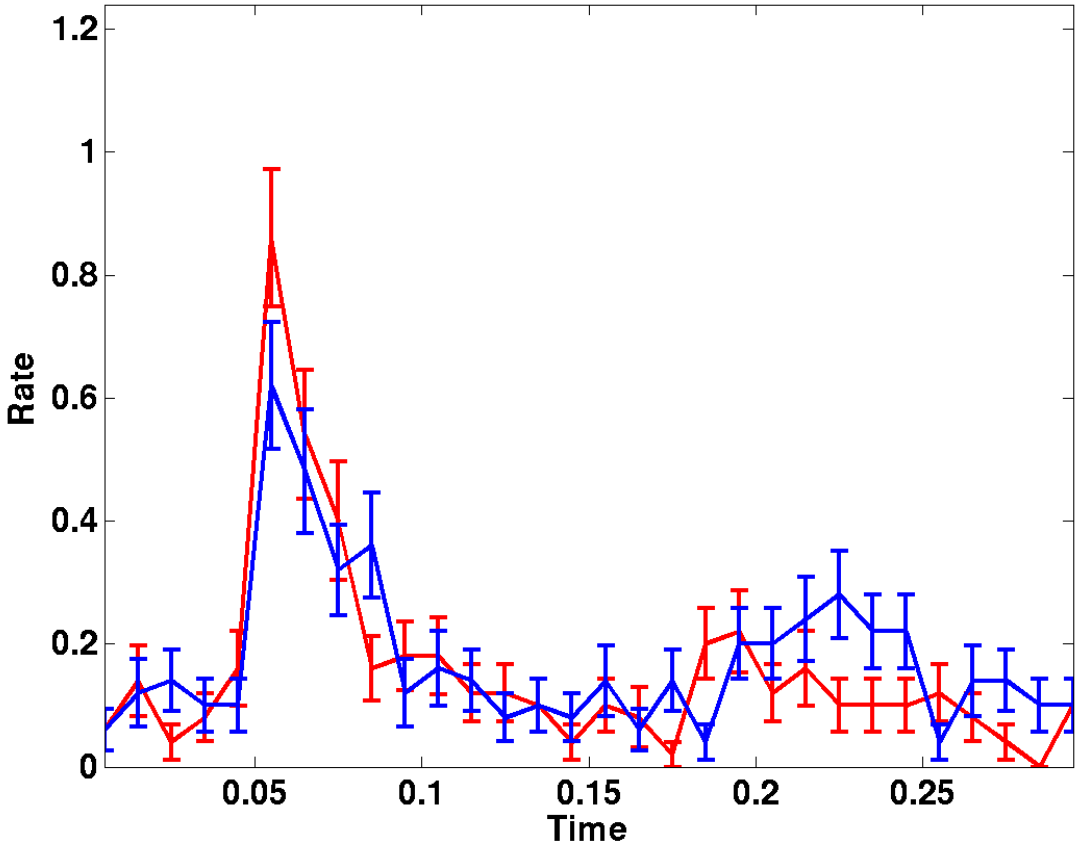
3.

```
load ps5_problem3

b = 0:.01:.3;
r1 = zeros(length(spiketimes1), length(b)-1);
r2 = zeros(length(spiketimes2), length(b)-1);
for i = 1:50
    [r1(i,:) btmp] = hist(spiketimes1{i}, b);
    [r2(i,:) btmp] = hist(spiketimes2{i}, b);
end
```

a. means and standard errors

```
h = errorbar2(btmp, mean(r1), std(r1)./sqrt(49), .005);
set(h, 'Color', [1 0 0], 'LineWidth', 2);
hold on
h = errorbar2(btmp, mean(r2), std(r2)./sqrt(49), .005);
set(h, 'Color', [0 0 1], 'LineWidth', 2);
```

```
xlabel('Time', 'FontSize', 18);
ylabel('Rate', 'FontSize', 18);
set(gca, 'FontSize', 18);
set(gca, 'YLim', [0 max(mean(r2)) * 2]);
```




```
%b.
t1 = [];
t2 = [];
for i = 1:50
    t1(i) = length(spiketimes1{i}) / .3;
    t2(i) = length(spiketimes2{i}) / .3;
end
t = [t1 t2];
y = [zeros(size(t1))'; ones(size(t2))'];
% add on a column of 1's to y
y = [y ones(size(y))];

[b dev stats] = glmfit(t, y, 'binomial');

stats.p=
```

```
    0.3203
    0.2729

% no signficant effect



% c. bins
clear b1 b2 s1 s2 r1 r2
for i = 1:50
    b1(i) = length(find(spiketimes1{i} < .05)) / .3;
    b2(i) = length(find(spiketimes2{i} < .05)) / .3;
    s1(i) = length(find((spiketimes1{i} > .05) & (spiketimes1{i} <
0.1))) / .3;
    s2(i) = length(find((spiketimes2{i} > .05) & (spiketimes2{i} <
0.1))) / .3;
    r1(i) = length(find(spiketimes1{i} > .1)) / .3;
    r2(i) = length(find(spiketimes2{i} > .1)) / .3;
end

x1 = [b1';  b2'];
x2 = [s1';  s2'];
x3 = [r1';  r2'];
x = [x1 x2 x3];


[b dev stats] = glmfit(x, y, 'binomial');
```
significant effect only in last interval

```
stats.p =      0.2069
               0.9171
               0.6678
               0.0306
```

d. No effect of baseline period before apparent