Stat 481
HW #9

Q1 This setup is an experiment because we can manipulate two factors: day of the week & section of newspaper, thus, we can find effects on the number of inquiries that result from ad.

model:

$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$

y_{ijk} = the number of inquiries that result from ad for i-th level of factor A(day) & j-th level of factor B (section) and k-th observation.

μ = mean

α_i = effect of ith level of factor A, shows difference between ith level and day.

β_j = effect of jth level of factor B, shows difference between jth level and section.

$(\alpha\beta)_{ij}$ = Factor A & B together, shows difference of ith level of factor A & j-th level of factor B, compare to what will be expected from main effects.

ϵ_{ijk} = error term

Assumptions:

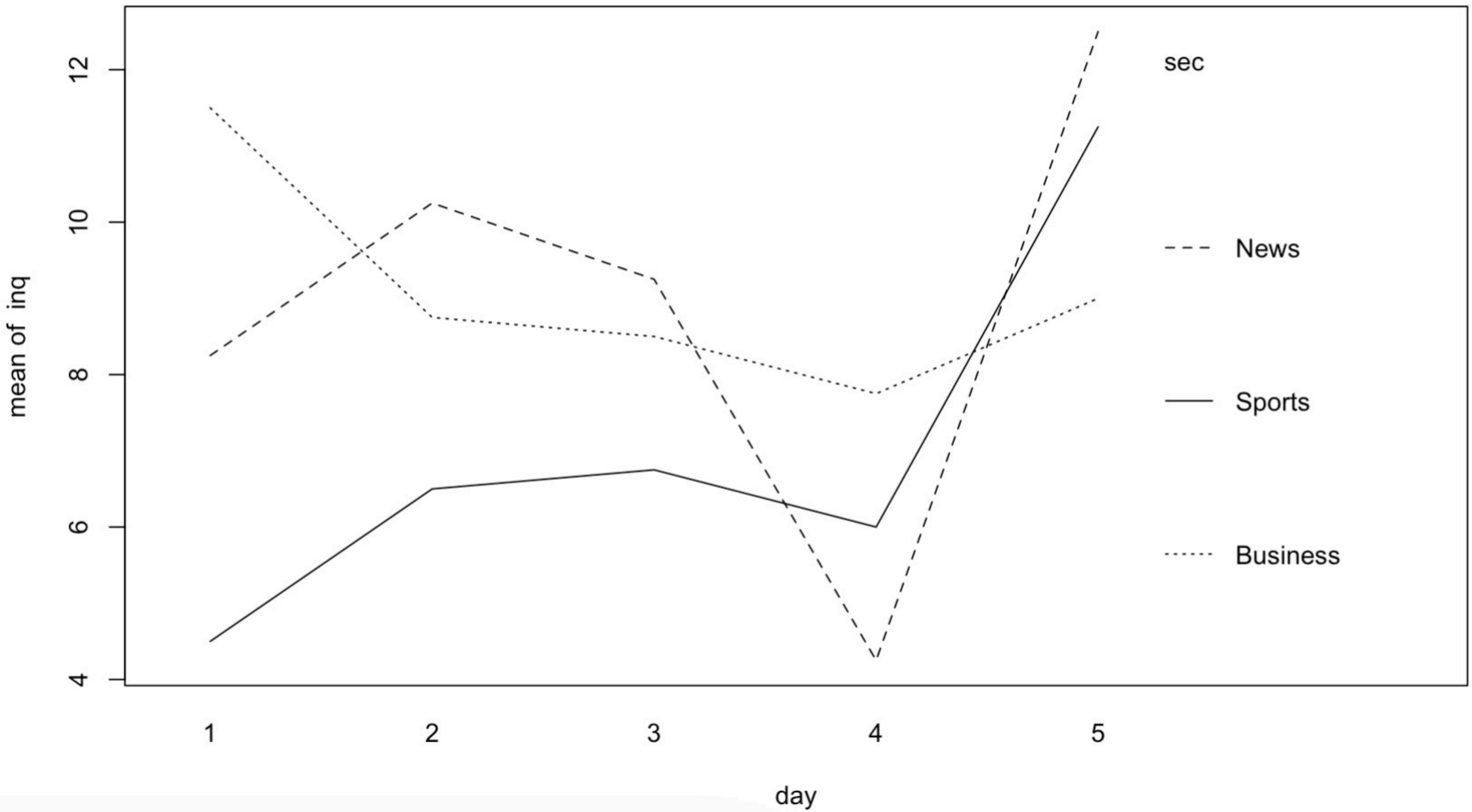
* Relationship between factors should be linear.
* The observations assumed to be independent.
* The response variable is normally distributed.
* The variance of the response variable is equal in all levels of

The cell mean y_{ij} shows the number of inquiries that result from ad for the ith level of Factor A and jth level of factor B, after finding the main effects & interactions of Factors A and B

```
> data <- read.csv("/Users/liza/Desktop/Advertising.csv")
```

```
> inq <- data$Inquiry
> day <- data$Day
> sec <- data$Section
```

```
> tapply(inq, day, mean)
        1         2         3         4         5
 8.083333  8.500000  8.166667  6.000000 10.916667
> tapply(inq, sec, mean)
Business     News   Sports
     9.1      8.9      7.0
> par(mfrow=c(1,1))
> interaction.plot(day, sec, inq)
```


mean of inq
12
10
8
6
4
1
2
3
4
5
day
sec
News
Sports
Business

There might be factor effect between the factor A (Day) and B (section) because the lines are not parallel.

Q3 Let's find ANOVA table

Sourse	SS	df	MS	F
(Day) Factor A	146.83	4	29.37	330.00
(Section) Factor B	53.73	2	26.87	301.91
Factors A & B	135.77	8	16.97	190.67
Error	79	885	0.089	
Total	415.33	899		

$df\ A = 5-1 = 4$

$df\ B = 3-1 = 2$

$df\ AB = (a-1)(b-1) = (5-1)(3-1) = 8$

$df\ Error = ab(n-1) = 5 \cdot 3(60-1) = 885$

$df\ SSTO = abn - 1 = 5 \cdot 3 \cdot 60 - 1 = 899$

$MSA = SSA / df_A = 146.83/4 = 36.70$

$MSB = SSB / df_B = 53.73/2 = 26.87$

$MSAB = SSAB / df_{AB} = 135.77/8 = 16.97$

$MSE = SSE / df_e = 79/885 = 0.089$

$F(A) = MSA/MSE = 330.00$

$F(B) = MSB/MSE = 301.91$

$F(AB) = MSAB/MSE = 190.67$

Q4 $H_0: (\alpha\beta)_{ij} = 0$
$H_1:$ at least one $(\alpha\beta)_{ij} \neq 0$

Reject Ho if $F_{AB} > F_{0.05}(8, 885) = 1.94$
$190.67 > 1.94$, Reject Ho
p-value $= P\{F(8,885) > F_{AB}\} =$
$1.052e^{-186}$
p-value is too small
Reject Ho

There is enough evidence to conclude that the two factors interact at $\alpha = 0.05$

Q5 When interactions are present, we can't look at main effects for the factors. Hypothesis is about the cell mean difference
$H_0: \mu_{ij} = \mu_{i'j'}$
$H_1: \mu_{ij} \neq \mu_{i'j'}$