HOMEWORK #8

Read:

- Chapter 5 in 'Regression Analysis by Example'.
- The "Two-way ANOVA" chapter posted on Courseworks.

R Assignment:

Solve the following questions using R. Hand in your R code and output file for Questions 1-3, as well as answers to all questions.

1. In a psychology experiment, researchers asked participants to respond to various stimuli and measured their reaction time. Participants were randomly assigned to one of three treatment groups. Subjects in group 1 were required to respond as quickly as possible to any stimulus that was presented. Subjects in group 2 were required to respond to a particular stimulus while disregarding other types of stimuli. Finally, subjects in group 3 were required to respond differently depending on the stimuli presented. The researcher felt that age may be a factor in determining the reaction time, so she organized the subjects by age and obtained the following data:

	Group 1	Group 2	Group 3
18-24 years old	0.384	0.338	0.586
	0.248	0.495	0.509
	0.191	0.631	0.364
25-34 years old	0.203	0.485	0.626
	0.331	0.389	0.858
	0.438	0.629	0.529
35 and older	0.494	0.585	0.52
	0.467	0.782	0.854
	0.302	0.529	0.7

   (a) Fit a two-way ANOVA model with interactions.
   (b) Is there a significant interaction effect between group and age?
   (c) Draw an interaction plot to support the result of (b).
   (d) Refit the model without the interaction term.
   (e) What are the null and alternative hypotheses for the two main effects?
   (f) How many degrees of freedom does the sum of square error have?
   (g) Is there a significant difference in the mean reaction time between the three stimulus groups?
   (h) Is there a significant difference in the mean reaction time between the three age groups?
   (i) Make a residual plot. Do the assumptions of ANOVA appear to be valid?

2. A company wanted to determine if age or gender significantly affects the time required to learn an assembly line task. They select 4 males and 4 females in each of three different age groups sand measured the amount of time required to perform a certain task. The data is shown below:

	20-34 years	35-49 years	50-64 years
Male	5.2	4.8	5.2
	5.1	5.8	4.3
	5.7	5.0	5.5
	6.1	4.8	4.7
Female	5.3	5.0	4.9
	5.5	5.4	5.5
	4.9	5.6	5.5
	5.6	5.1	5.0

(a) Fit a two-way ANOVA model with interactions.
(b) Is there a significant interaction effect between gender and age?
(c) Draw an interaction plot to support the result of (b).
(d) Refit the model without the interaction term.
(e) What are the null and alternative hypotheses for the two main effects?
(f) How many degrees of freedom do the sums of squares corresponding to the two main factors have?
(g) Is there a significant difference in the means between the three age groups?
(h) Is there a significant difference in the means between males and females?
(i) Make a residual plot. Do the assumptions of ANOVA appear to be valid?

3. A researcher wants to determine if the mean score on a standardized math test is different among three groups of school children ranging in age from 12 to 18. The scores, as well as the ages, for each student are shown below:

Group A		Group B		Group C	
Math Score	Age	Math Score	Age	Math Score	Age
90	16	92	18	97	18
88	15	88	13	92	17
72	12	76	12	88	16
82	14	78	14	92	17
65	12	90	17	99	17
74	13	68	12	82	14

(a) Fit a one-way ANOVA comparing the mean math scores between the three-groups. Is there is significant difference in scores between the groups?
(b) Make a scatter plot of score against age using a separate symbol for each group. Do the linearity assumptions required for performing ANCOVA appear to hold?
(c) Perform an ANCOVA comparing the math scores among the three groups, while controlling for age. Is there a significant difference in scores between the groups?