

HOMework #3

Read:

The R tutorial on “One-way ANOVA”
The “ANOVA” chapter posted on Courseworks.
The “Multiple Comparisons” chapter posted on Courseworks.

R Assignment:

1. The safety of cars was studied by crashing them into a fixed barrier at 35 mi/h with a crash test dummy placed in the driver’s seat. Data was collected on the amount of head injury on the dummies measured in hic (a standard head injury criterion). The researchers were primarily interested in determining whether there was a difference in the amount of head injury between small, medium and large sized cars. A total of 10 cars of each type were tested. The results can be found at

www.stat.columbia.edu/~martin/W2024/Data/HeadInjury.txt

- (a) Make a side-by-side boxplot showing the distribution of head injuries for the different types of cars. Comment on the results.
 - (b) State the appropriate null and alternative hypotheses.
 - (c) Perform an ANOVA on these data. What can you conclude?
 - (d) If the results of the ANOVA indicate that the means are significantly different, perform a multiple comparisons test to determine which types of cars differ in terms of mean head injury.
2. To see how much of a difference the time of day made on the speed at which he could download files, a college student performed an experiment. He placed a file on a remote server and proceeded to download it at three different time periods of the day. He downloaded the file 48 times in all, 16 times in each time period. The data can be found at:

www.stat.columbia.edu/~martin/W2024/Data/download.txt

- (a) Make a side-by-side boxplot showing the distribution of download times for the different times of day. Comment on the results.
- (b) State the appropriate null and alternative hypotheses.
- (c) Perform an ANOVA on these data. What can you conclude?
- (d) If the results of the ANOVA indicate that the means are significantly different, perform a multiple comparisons test to determine which times of the day differ in terms of mean download time.

3. A researcher compared four different preservatives to be used in freezing strawberries. The researcher randomly divided strawberries into four equal groups. Within each group they treated the strawberries with the appropriate preservative and packaged them into eight small plastic bags for freezing. Six months later, the contents of the bags were allowed to thaw and then rated on a scale from 1 to 10 points for discoloration (a low score indicates little discoloration). The ratings are given below:

Group I	10	8.5	7	7.5	8.5	9	7.5	7.5
Group II	6	7.5	8	7	5.5	6	5	5.5
Group III	3	3.5	4	4.5	3	3.5	4	4.5
Group IV	2	1	2.5	3	4	3.5	2	2

- Make a side-by-side boxplot showing the distribution of discoloration ratings for the four different groups.
 - State the appropriate null and alternative hypotheses.
 - Perform an ANOVA on these data. What can you conclude?
 - If the results of the ANOVA indicate that the means are significantly different, perform a multiple comparisons test to determine which groups differ in terms of discoloration rating.
4. A researcher wanted to determine the impact that smoking has on resting heart rate. She randomly selected seven individuals from each of three categories: nonsmokers, light smokers (<10 cigarettes/day) and heavy smokers (>10 cigarettes/day) and obtained the following resting heart rate data (in beats/minute):

Nonsmoker	56	53	53	65	70	58	51
Light smoker	78	62	70	73	67	75	65
Heavy smoker	77	86	65	83	79	80	77

- Make a side-by-side boxplot showing the distribution of resting heart rate for the three different groups.
- State the appropriate null and alternative hypotheses to test whether the mean heart rate differs between the three groups.
- Perform ANOVA on the data. What can you conclude?
- If the results of the ANOVA indicate that the means are significantly different, perform a multiple comparisons test to determine which groups differ in terms of mean resting heart rate.

Hand in your R code and output file for Questions 1-4, as well as answers to all questions.