Due date: Friday, December 4th at 11:59pm

Researchers are interested in investigating whether different dosages of a new medication influence reductions in systolic blood pressure. To investigate this relationship, researchers conduct an experiment in which 50 subjects are randomly assigned to one of five treatment groups:

- Control (placebo)
- Low dosage (5 mg)
- Medium dosage (10 mg)
- High dosage (15 mg)
- Very high dosage (20 mg)

Each treatment group receives 10 subjects. After a specified treatment period, researchers measure the reduction in systolic blood pressure (mmHg) for each subject. Larger reductions indicate a greater response to the medication.

Part 1: Experimental Design and ANOVA

Suppose the researchers collect data from the experiment described above.

1. Identify the experimental design used in this study. Write the statistical model for a one-way ANOVA in terms of Y_{ij}, expressing the model using the treatment means (μ_i). Define all parameters in your model and state the model assumptions.
2. Researchers are particularly interested in comparing the control group against the average response of the four dosage groups. Write the linear contrast for this comparison in terms of the treatment means and provide the corresponding contrast coefficients.

Suppose the following partial ANOVA table is obtained from the experiment.

Source	DF	Sums of Squares	Mean Square	F	Pr(>F)
Treatment		240			
Error		360			
Total					

3. Fill in the missing values of the ANOVA table. Recall that not every position in the table will contain a value.
4. State the null and alternative hypotheses represented by the treatment p-value in the ANOVA table.
5. Write an appropriate conclusion in the context of the research question using the p-value. Use a significance level of $\alpha = 0.05$.

Part 2: One-Way ANOVA

Researchers conduct a second experiment to investigate the effects of medication dosage on reductions in systolic blood pressure. The following data represent the observed reductions (mmHg) for 10 subjects in each treatment group.

Control	Low	Medium	High	VeryHigh
1.81	3.88	10.55	8.65	8.02
2.27	4.66	6.59	10.17	11.27
1.49	1.30	7.94	9.76	12.50
-0.16	5.62	8.69	9.58	10.53
3.46	3.85	8.47	10.02	8.48
3.87	7.16	11.09	11.59	10.50
2.61	7.72	8.31	11.00	10.15
2.49	2.89	6.75	10.89	11.23
0.28	6.93	9.14	8.55	11.60
3.62	5.89	7.55	9.11	9.45

6. Fit a one-way ANOVA model to the data and produce an ANOVA table. Briefly interpret the output in the context of the research question.

7. Using the `emmeans` package, conduct a hypothesis test for the contrast comparing the control group against the average of the four dosage groups. Report the estimated contrast, standard error, test statistic, and p-value. Write a brief conclusion in the context of the research question.

8. Perform all pairwise comparisons among the five treatment groups using the following two appropriate p-value adjustments:

   - Bonferroni adjustment
   - Tukey adjustment

   Report the results of both procedures. Using the Tukey-adjusted results, identify which treatment groups differ significantly from one another. Interpret your findings in the context of the research question.

Part 3: Simple Linear Regression

Researchers are also interested in investigating whether medication dosage has a linear relationship with reductions in systolic blood pressure.

9. Fit a simple linear regression model to investigate the relationship between medication dosage and reductions in systolic blood pressure.

10. Write the statistical model for the simple linear regression in terms of Y_i. Define all parameters in your model.

11. Conduct a hypothesis test to determine whether there is a significant linear relationship between medication dosage and reductions in systolic blood pressure. State the null and alternative hypotheses, report the test statistic and p-value, and write a conclusion in the context of the research question using a significance level of $\alpha = 0.05$. (Hint: you can use either a t-test or F-test)