ASSIGNMENT 3 — Omnibus Tests I

For all questions below, provide all programming code and plots in the report. Unless stated otherwise, assume $\alpha = 0.05$

1-Way ANOVA

1. In a study of the relationship between smoking and serum concentrations of high-density lipoprotein cholesterol (HDL-C), the following data (coded for ease of calculation) were collected from samples of adult males who were nonsmokers, light smokers, moderate smokers, and heavy smokers. We wish to know if these data provide sufficient evidence to indicate that the four populations differ with respect to mean serum concentration of HDL-C. (15 marks).

Smoking Status			
Nonsmokers	**Light**	**Moderate**	**Heavy**
12	9	5	3
10	8	4	2
11	5	7	1
13	9	9	5
9	9	5	4
9	10	7	6
12	8	6	2

a. Plot the data. (2 mark)

b. Find the F-statistic. (1 mark)

c. Report the p-value for the main effect of Smoking status. (1 mark)

d. Is normality violated? (2 marks)

e. Is homogeneity of variance violated? (2 marks)

f. Report the effect size ω^2 for the main effect. (1 mark)

g. Perform follow up mean comparisons (two-tailed) (2 mark)

h. Perform a Holm-Bonferroni correction (1 mark)

i. Report the effect size for each followup mean comparison. (1 mark)

j. Interpret the findings. (1 mark)

k. What is the result of a Kruskal Wallis test? (1 mark)

2. We wish to know if 4 new diet fads influence body weight. Based on pilot data, we find that the average body weight for each fad diet is 79, 82, 81, and 88 kg. You have found a sample within-group standard deviation of 10 kg (4 Marks).

a. How many participants per group are needed to be sufficiently powered? (2 mark)

b. What are the limitations of this approach? (1 mark)

c. What would be an alternative approach (1 mark)

3. You want to determine the influence of three drugs (Drug X, Drug Y, and Drug Z) and Biofeedback (Present vs Absent) on blood pressure. Use a Normal distribution to simulate each of the 6 groups: Drug X + Biofeedback ($\mu = 170, \sigma = 12.91, n = 20$), Drug Y + Biofeedback ($\mu = 203, \sigma = 13.91, n = 20$), Drug Z + Biofeedback ($\mu = 188, \sigma = 13.84, n = 20$), Drug X + No Biofeedback ($\mu = 186, \sigma = 11.84, n = 20$), Drug Y + No Biofeedback ($\mu = 201, \sigma = 11.93, n = 20$), Drug Z + No Biofeedback ($\mu = 210, \sigma = 12.81, n = 20$). 10 Marks.

a. Simulate then plot the data. (1 mark)

b. Report the p-values from the 2-way ANOVA. (1 mark)

c. Is normality violated? (1 marks)

d. Is homogeneity of variance violated? (1 marks)

e. Report the effect size ω_p^2 for significant main effects and interactions. (1 mark)

f. Perform follow up mean comparisons (two-tailed). If there is a significant interaction, compare the three drugs to one another. (1 mark)

g. Perform a Holm-Bonferroni correction. (1 mark)

h. Report the effect size for each significant mean comparison. (1 mark)

i. Interpret the findings (based on one of the simulation runs). (1 mark)

j. How many participants should there be per group to obtain 90% power, with $\alpha = 0.05$ and $f = 0.1$? (1 mark)

4. We are interested whether an anti-cough medication is effective. At three time points (T1,T2,T3) we record the number of coughs per day (dependent variable). 13 Marks.

	Assay		
Subject	**T1**	**T2**	**T3**
S1	745	764	774
S2	777	786	788
S3	734	733	763
S4	779	801	797
S5	756	786	785
S6	721	732	740

a. Plot the data. (1 mark)

b. Report the GG corrected p-values and F-scores from the 1-way within ANOVA. (2 mark)

c. Is sphericity violated? (1 mark)

d. Is there a main effect with using the multivariate approach? (1 mark)

e. Is there a main effect using the Friedman test? (1 mark)

f. Is normality violated? (1 mark)

g. Report the effect size ω_p^2 for the main effect of Time. (1 mark)

h. Perform follow up mean comparisons with t-tests (two-tailed). (1 mark)

i. Perform a Holm-Bonferroni correction. (1 mark)

j. Report the effect size (cohen's d) for each significant mean comparison. (1 mark)

k. Interpret the findings. (1 mark)

l. How many participants should there be per group to obtain 80% power, with $\alpha = 0.05$, $f = 0.4$, and 0.8 sphericity? (1 mark)