Homework 4

STAT 212, Section 501
Spring 2025

Instructions

- The homework is due on **Mar. 21, 2025**, 11:59 pm.
- The homework should be submited electronically via Canvas.
- Please upload a single PDF containing the solutions in the correct order. If you include scanned images, make sure that they are organized and easy to read.

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1. (100 points) (Problems 6, on page 359 of textbook, Section 10.2; Problems 4, on page 368 of textbook, Section 10.3) Porous carbon materials are used commercially in several industrial applications, including gas separation, membrane separation, and fuel cell applications. For the purpose of gas separation, the pore size is important. To compare the mean pore size of carbon made at temperatures of 300, 400, 500, and 600, an experiment uses 5 measurements at each temperature setting (PorousCarbon.txt). Is there any difference in the average pore size of carbon made at the different temperatures?

   (a) State the relevant null and alternative hypotheses for answering this question, and use hand calculations to conduct the ANOVA F test at level $\alpha = 0.05$, stating any assumptions needed for its validity. (Hint. You may use the following summary statistics: $\overline{X}_1 = 7.43$, $\overline{X}_2 = 7.24$, $\overline{X}_3 = 6.66$, $\overline{X}_4 = 6.24$, $S_1^2 = 0.2245$, $S_2^2 = 0.143$, $S_3^2 = 0.083$, $S_4^2 = 0.068$.)

   (b) Use R commands to import the data into the R data frame pc and to conduct the ANOVA F test. Report the value of the test statistic, the p-value, and whether or not the null hypothesis is rejected at level $\alpha = 0.05$.

   (c) Use R commands to test the assumptions of equal variances and normality. Report the p-values from the two tests and the conclusions reached. Next, construct a boxplot and the normal Q-Q plot for the residuals from fitting the model, and comment on the validity of the normality assumption on the basis of these plots.

   (d) Use R commands or hand calculations to compute Tukey's 95% simultaneous CIs, and perform Tukey's multiple comparisons at experiment-wise level of significance $\alpha = 0.05$.

   (e) For each analysis performed in the last sub-problem, summarize your results by arranging the means in increasing order and underlining the ones that do not differ significantly.