DANA 4800 (001)
Homework #5

Due: 11:59 pm on August 3rd, 2025
Submitted to: BrightSpace Homework Folder

Please read these instructions before submitting your homework.

1. **Format**: Please convert all work in Word to PDF.
2. **R Output**: If you have R Output, please copy and paste the output to the corresponding part of the Word document.
3. **Submission**: No email submission will be accepted regardless of the circumstances.
4. **Number of Submission**: You are allowed to submit your homework as many times as you want. But only the latest version of your submission will be marked.
5. **Order of Work**: All work must be submitted in the same order of the questions. It is suggested that you use a brand new page for a different question, especially true for hand-written work.
6. **Filename**: Please name your file in the following format: "DANA4800_Lastname_Firstname_HW#.pdf". For example, my first assignment would have the name "DANA4800_Lo_Michael_HW1.pdf".
7. **Last Advice**: Internet connections do go off, computers do break down, or other unexpected events do occur when they are least expected. The onus is squarely on you to submit it on time. No excuses.

Note: Failure to comply with any of the above will result in loss of marks.

1. A local pizza joint has recently hired additional drivers and claims that its average delivery time for orders is under 25 minutes. A random sample of 20 customer deliveries was examined and the average delivery time was found to be 22.3 minutes with a standard deviation of 5.6 minutes. The delivery time generally follows a Normal distribution.
   Note: Please use t-distribution to complete this question.
   a) Identify the parameter of interest. **[2 marks]**
   b) Set up the null hypothesis and the alternative hypothesis. **[2 marks]**
   c) Calculate the test statistic and find the p-value. **[1+3]**
   d) Draw an appropriate conclusion using 5% significance level. **[2 marks]**

2. What is the effect of concussions on the brain? Researchers measured the brain sizes (hippocampal volume in litre) of 25 college football players with a history of clinically diagnosed concussion and 25 college football players without a history of concussion. Is there evidence of a difference in mean brain size between football players with a history of concussion and those without concussions? It is believed that the brain size follows a Normal distribution and the equal variance assumption is valid in this question. The following table shows the summary statistics.

Group	Sample Size	Sample Mean	Sample S.D.
Concussion	25	5.7	0.65
Non-concussion	25	6.3	0.85

   a) Identify the parameter of interest. Make sure you clearly identify which one is Population 1 and which is Population 2. **[2 marks]**
   b) Set up the null hypothesis and the alternative hypothesis. **[2 marks]**
   c) Calculate the test statistic (with equal variance assumption). **[2 marks]**
   d) Determine the size of the p-value, using the t-table. **[2 marks]**
   e) Use 1% level of significance and draw a conclusion. **[2 marks]**

3. A toothpaste manufacturer claims that children brushing their teeth daily with this company's new toothpaste product will have fewer cavities than children using a competitor's brand. In a carefully supervised study where children were randomly assigned to one of the two brands of toothpaste for a two-year period, the number of cavities for children using the new brand was compared with the number of cavities for children using the competitor brand. You can assume that the number of cavities follows a Normal distribution and the equal variance assumption is not valid. The data set "DANA4800_HW5_Data.xlsx" contains the results and can be downloaded from Brightspace.
   a) Define the parameter of interest. Make sure you clearly identify which one is Population 1 and which is Population 2. **[2 marks]**
   b) Set up the null hypothesis and the alternative hypothesis. **[2 marks]**
   c) Use t.test() in R to find the test statistic and p-value. **[2 marks]**
   d) Identify the sampling distribution of the test statistic. **[2 marks]**
   e) Test the manufacturer's claim using 10% significance level. **[2 marks]**