MTH 324, Homework #8, Fall 2022 Name _____

Instructions: Show work or attach R code used to perform calculations (or any other technology used). Be sure to answer all parts of each problem as completely as possible, and attach work to this cover sheet with a staple.

1. Consider a large population of families in which each family has exactly three children. If the genders of the three children in any family are independent of one another, then number of male children in a randomly selected family will have a binomial distribution based on three trials.
   a. Suppose a random sample of 160 families yields the following results. Test the relevant hypotheses.

Number of Male Children	**0**	**1**	**2**	**3**
Frequency	14	66	64	16

   b. Suppose a random sample of families in a nonhuman population resulting in observed frequencies shown in the table below. Would the chi-squared test be based on the same number of degrees of freedom? Conduct the test.

Number of Male Children	**0**	**1**	**2**	**3**
Frequency	15	20	12	3

2. The accompanying data on degree of spirituality for samples of natural and social scientists at research universities as well as for a sample of non-academics with graduate degrees

Degree of Spirituality

	Very	Moderate	Slightly	Not at all
Natural Science	56	162	198	211
Social Science	56	223	243	239
Graduate Degree	109	164	74	28

   a. Is there substantial evidence for concluding that the three types of individuals are not homogeneous with respect to their degree of spirituality? State and test the appropriate hypotheses.
   b. Considering just the natural scientists and social scientists, is there evidence for non-homogeneity? Base your conclusion on a P-value.

3. An article reported the following frequencies with which ethnic characters appeared in recorded commercials that aired on Philadelphia television stations.

Ethnicity	**African American**	**Asian**	**Caucasian**	**Hispanic**
Frequency	57	11	330	6

   The 2000 census proportions for these four ethnic groups are 0.177, 0.032, 0.734 and 0.057 respectively. Does the data suggest the proportions in commercials are different from the census proportions? Carry out a test of appropriate hypotheses using a significance level of 0.01, and also say as much as you can about the P-value.

4. In a genetics experiment, investigators looked at 300 chromones of a particular type and counted the number of sister-chromatid exchanges on each. A Poisson model was hypothesized for the distribution of the number of exchanges. Test the fit of a Poisson distribution to the data by first estimating μ and then combining the counts for $x = 8$ and $x = 9$ into one cell.

$x =$ **Number of Exchanges**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Observed Counts	6	24	42	59	62	44	41	14	6	2

5. A sample of test scores is shown in the table below. Create 1000 bootstrap samples of n=20.

92	90	76	82	81	88	72	80	98	77

   a. Plot the bootstrap means in a histogram.
   b. What is the mean of the sample means? How does it compare to the mean of the original data?
   c. What is the standard deviation of the bootstrap sample means? How does this compare to the standard error (assuming the data is approximately randomly distributed, calculate the standard error of the original sample from the standard deviation and the sample size.)
   d. What is an approximate 95% confidence interval for your mean based on your bootstrap samples?

6. A study of learning techniques was conducted on two groups of students to determine which teaching method was better. Students were randomly assigned to the two groups and their tests scores at the end were compared. The data is shown in the table below.

Method 1	**87**	**92**	**77**	**80**	**66**	**91**	**75**	**67**	**83**	**88**
Method 2	94	81	81	78	76	87	73	83	81	94

   a. Conduct a traditional t-test to determine if teaching method 2 is an improvement over teaching method 1.
   b. Conduct a permutation test of this data. Estimate the p-value of the original data from your permutations and use it to conduct a hypothesis test of the methods (is method 2 better than method 1?).
   c. Compare the results of the two tests.

7. Shown to the right is a contingency table on technical writing skills from different disciplines taken from a research article. Conduct a Fisher Exact Test on the data to determine if field impacts level of technical writing ability.

Major	**Level of Technical Writing Expertise**			
	None	**Beginner**	**Intermedi-ate**	**Expert**
STEM	8	7	11	39
Soc.Sci.	11	41	13	9
HUM	9	11	25	19
Interdis-ciplinary	15	9	21	14