Statistical Methods in Education Research
Vanderbilt University
Prof. Sean P. Corcoran

Due November 11, 2021
45 total points

Problem Set 9

Instructions: Answer the following questions in their entirety in a separate document. Submit your completed problem set as a PDF document via email to `sean.corcoran@vanderbilt.edu`. Use your last name and problem set number as the filename. Working together is encouraged, but it is expected that all submitted work be that of the individual student.

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1. The table below summarizes the number of hours spent in housework per week by gender, based on a 2002 survey. (**10 points**)

		Housework Hours	
Gender	Sample size	Mean	SD
Men	292	8.4	9.5
Women	391	12.8	11.6

NOTE: you can use the Stata t-test calculator to check your answer to the questions below, but please show your work. (I need to see that you understand the calculation).

   (a) What is the estimated difference in the mean hours spent in housework per week between men and women, and what is its standard error? Assume equal variances and use the pooled variance estimator. Provide a written interpretation of the standard error. (**5 points**)

   (b) Find the 99% confidence interval for the population difference in mean hours spent in housework per week. (Use $n_1 + n_2 - 2$ for the degrees of freedom). (**3 points**)

   (c) Using the information in part (b), test the null hypothesis that women and men in the population on average spend an equal number of hours per week doing housework. (Use the 1% significance level). Briefly explain your answer. (**2 pts**)

2. Men are considered overweight if their body mass index is greater than 27.8. In the 1980 *National Health and Nutrition Examination Survey*, 130 of 750 randomly surveyed men aged 20-24 were found to be overweight, while in the 1994 version of the survey, 160 of the 700 randomly surveyed men were overweight. Test the hypothesis that the proportion overweight is the same in 1994 as it was in 1980. (**5 points**)

   NOTE: you can use the Stata t-test calculator to check your answer to the question above, but please show your work. (I need to see that you understand the calculation).

3. The table below summarizes the number of hours per day spent watching TV, by gender, based on the 2006 General Social Survey. (**9 points**)

		TV Hours	
Group	N	Mean	SD
Men	870	2.86	2.22
Women	1,117	2.99	2.34

NOTE: you can use the Stata t-test calculator to check your answer to the questions below, but please show your work. (I need to see that you understand the calculation).

(a) Conduct a significance test to analyze whether the population means differ for females and males. Write down the null and alternative hypotheses, test statistic, p-value, and conclusion. (Let $\alpha = 0.05$). Assume equal variances and use the pooled variance estimator. (**5 points**)

(b) If you were to construct a 95% confidence interval comparing the means, would it contain 0? Answer based on your results in (a). (**2 points**)

(c) Do you think the distribution of TV watching is approximately normal? Why or why not? Does this affect the validity of your inferences here? (**2 points**)

4. In Stata, open the NELS.dta dataset from class. As you know, this extract from the larger National Education Longitudinal Study of 1988 contains data for 500 students followed from 8th through 12th grade. For this problem you will be asking the following question: Among the population of college-bound students, do students whose families owned a computer in 8th grade (*computer*) score differently in 12th grade math (*achmat12*), on average, than those whose families did not own a computer? Use the variable *edexpect* to select the subset of students who are college-bound. (**16 points**)

(a) Are the two samples being compared here independent or dependent? Briefly explain your answer. (**1 point**)

(b) For this hypothesis test to be valid, does the distribution of math achievement in these two populations have to be normal? Briefly explain why or why not. (**1 pt**)

(c) Write down the null and alternative hypotheses for a t-test to assess whether 12th grade math achievement for students whose families owned a computer in 8th grade differs, on average, from that of students whose families did not own a computer. (**2 points**)

(d) Using the appropriate Stata command, what is the test statistic and p-value associated with this test? (**2 points**)

(e) Use the p-value to determine whether or not H_0 can be rejected in favor of the alternative. Use a significance level of $\alpha = 0.05$. (**2 points**)

(f) Provide a 95% confidence interval for the mean difference in 12th grade math achievement between students whose families owned a computer in 8th grade and students whose families did not. (**2 points**)

(g) Use the confidence interval found in part (f) to conduct the test in parts (c)-(e). Are the results consistent? (**2 points**)

(h) Now provide a 99% confidence interval for the mean difference in 12th grade math achievement. Does your conclusion change at the $\alpha = 0.01$ level of significance? (**2 points**)

(i) Finally, calculate the Cohen's d as a measure of effect size. Would you consider the observed effect practically significant? Explain why or why not. (**2 points**)

5. Consider again Question #2 from Problem Set 8. In that problem, you were interested in the effect of charter school attendance on student math achievement. Suppose now you have the opportunity to randomly assign a group of students to either attend a charter or traditional public school. At the end of the year, you will administer a math test to your study students. Based on prior evidence, you still believe the standard deviation in math achievement is 84. You consider a meaningful difference in math achievement to be +21 points. How many students (in total) will you need to randomly assign in order to correctly reject the null hypothesis of no effect in 80% of random samples? Use $\alpha = 0.05$ and assume that students will be assigned in equal numbers to the treatment and control groups. Hint: use Stata to answer this question. (**5 points**)