Show your work to receive full credit.

Problem 1 Part 1

In a clinical study, 1000 subjects were vaccinated with a vaccine manufactured with a new ingredient. Over a period of roughly 28 weeks, 6 of these subjects developed the flu.

a) Find the point estimate of the population proportion that were vaccinated but still developed the flu. Specify its value and statistical notation for this estimate.

b) Show set up (formula with numbers plugged in) and verify that the standard error of this estimate is 0.0024. Briefly explain what this number means.

c) What is the value of z-multiplier $z_{\alpha/2}$ for a 98% confidence interval? Find the margin of error for a 98% confidence interval. Round your margin of error to the nearest four decimal number.

Problem 1 Part 2

d) Use your answers from Problem 1 Part 1 and construct a 98% confidence interval. **Interpret.**

e) Based on your confidence interval, is it plausible that less than 1% of all people vaccinated with the vaccine will develop the flu? Explain.

Problem 2

Refer to the Problem 1.
Does the information provided in Problem 1 satisfy conditions (assumptions) of the large number confidence interval for p? State two assumptions and determine whether each is met or not. (Hint: See lecture notes on page 106. There are two assumptions.)

Problem 3

An election is expected to be close. Pollsters planning an exit poll want their estimates be to within ± 0.02 with 90% confidence. How large should be the sample size if they have no prior information?

Problem 4 Part 1

The 2012 General Social Survey asked, "What do you think is the ideal number of children for a family to have?". The 590 females who gave a numeric response from 0 to 6 had a median of 2, mean of 2.56, and standard deviation of 0.84.

a) What is the point estimate of the population mean? Specify its value and statistical notation for this estimate.

b) Find the standard error of of this estimate. Round your answer to the nearest four decimal number. Explain what this number means.

c) What is the value of t-multiplier $t_{\alpha/2, n-1}$ for a 99% confidence interval? Find the margin of error for a 99% confidence interval. Round your margin of error to the nearest two decimal number.

Problem 4 Part 2

d) 99% confidence interval is (2.47, 2.65). Interpret the interval in context.

e) Is it plausible that the population mean of females' ideal number of children is greater than 2?

Problem 5

Refer to Problem 4. State assumptions of confidence interval for population mean. Determine whether each assumption is met based on Problem 4 description. Explain.

Problem 6: Multiple Choice Question

The following interprets the 99% confidence interval for population mean of females' ideal number of children from Problem 4 part d) (2.47, 2.65). Which of the following is correct?

(A) In the entire population, 99% of females' ideal number of children fall within 2.47 and 2.65.

(B) We are 99% confident the sample mean of females' ideal number of children falls between 2.47 and 2.65.

(C) If we repeatedly sample 590 females randomly and construct 99% confidence intervals, then in the long run, 99% of those intervals contain the population mean of females' idea number of children.

(D) There is 99% probability population mean is between 2.47 and 2.65.

R Problem

In this problem, we will use the class survey data set. We will assume that the population of interest is *all students at the University of Minnesota* and the variable of interest is average weekday sleep hours. Assume that *the survey data represents a random sample of 391 students at the University of Minnesota.*

Use the following R code to import data from the survey data.

```
survey_f22<-read.csv("http://users.stat.umn.edu/~parky/Fall2022Survey.csv", header=TRUE)
```

a) Construct a histogram and Q-Q plot of students' weekday sleep hours. Include both plots in your submission. Describe the shape of the distribution.

b) (Multiple Choice Question) The histogram from the previous part is :
   (i) a population distribution
   (ii) a data distribution (sample distribution)
   (iii) a sampling distribution
   Briefly explain.

c) State the assumptions of confidence interval for mean. Determine whether our sample satisfy this assumption.

d) Use `t.test()` command to construct a 90% confidence interval to estimate the population mean weekday sleep hours. Submit R command and output. Interpret the interval.