STAT 2002 - Probability and Statistics II, Summer 2024
Homework 3 - Hypothesis Testing
100 points total.

This homework is due **Beijing Time 11:59pm Thursday, July 2rd, 2024** on BlackBoard. No late homework accepted.

Please make sure to **SHOW ALL WORK** in order to receive full credit.

1. (20 points) Recent Gallup Poll estimates that 88% Americans believe that cloning humans is morally unacceptable. Results are based on telephone interviews with a randomly selected national sample of $n = 1000$ adults, aged 18 and older, conducted May 2-4, 2004.

   (a) Find 95% confidence interval for the true proportion? Does 0.9 fall in the interval?

   (b) Pretend that you want to replicate Gallup's inquiry in the Shenzhen area. What sample size is needed so that the **length** of a 95% confidence interval for the unknown proportion of people in the area who believe that cloning humans is morally unacceptable does not exceed 0.02?

2. (30 points) **Find α and β and p-value.**

   A manufacturer is interested in the output voltage of a power supply used in a PC. Output voltage is assumed to be normally distributed, with standard deviation 0.25 volt, and the manufacturer wishes to test $H_0 : \mu = 5$ volts against $H_1 : \mu \neq 5$ volts, using $n = 8$ units. Suppose we set the acceptance region to be $4.85 \leq \bar{x} \leq 5.15$.

   (a) Find the Type I error (α) of the test.

   (b) Find the Type-II error (β) of the test for detecting a true mean output voltage of 5.1 volts.

   (c) Find the p-value when the observed statistic is (i) $\bar{x} = 5.2$ and (ii) $\bar{x} = 4.7$, respectively.

3. (20 points) **Hypothesis testing and confidence interval for sample proportion.**

   An article in the British Medical Journal *"Comparison of Treatment of Renal Calculi by Operative Surgery, Percutaneous Nephrolithotomy, and Extra-Corporeal Shock Wave Lithotrips," (1986, Vol. 292, pp. 879–882)* found that percutaneous nephrolithotomy (PN) had a success rate in removing kidney stones of 289 out of 350 patients. The traditional method was 78% effective.

   (a) Is there evidence that the success rate for PN is greater than the historical success rate? Find the p-value.

   (b) Explain how the question in part (a) could be answered with a confidence interval.

4. (30 points) **Hypothesis testing for sample mean difference.** A computer scientist is investigating the usefulness of two different design languages in improving programming tasks. Twelve expert programmers, familiar with both languages, are asked to code a standard function in both languages, and the time (in minutes) is recorded. The data follow:

	Time	
Programmer	Design Language 1	Design Language 2
1	17	18
2	16	14
3	21	19
4	14	11
5	18	23
6	24	21
7	16	10
8	14	13
9	21	19
10	23	24
11	13	15
12	18	20

(a) Find a 95% confidence interval on the difference in mean coding times. Is there any indication that one design language is preferable?

(b) If hypothesis test is performed to answer the above question: whether one design language is preferable or not. Write down the null and alternative hypothesis. Report the p-value and draw a conclusion (either accept or reject H_0) under significance level 0.05.