MASSACHUSETTS INSTITUTE OF TECHNOLOGY

6.S098 IAP 2024
Session 1 exercises Jan 8

NAME: **MIT ID:**

Directions: Please state hypotheses in words and variables, show your work or describe your code briefly for calculations, and interpret your results. Code does not need to be submitted. If additional pages are used, please note in the provided space and write your name on all pages.

Learning objectives:

- Practice formulating null and alternative hypotheses
- Compute an exact p-value for a hypothesis test
- Perform a one-sample t-test

Problem 1. [5 pts] Is my die fair?
Let's test whether a 4-sided tetrahedral die is fair.

(a) [1 pts] Formulate the null and alternative hypotheses in terms of distributions.

(b) [2 pts] We observe the following data: $4\boxdot, 1\boxdot, 1\boxdot, 0\boxdot$. What is the set of outcomes that are as extreme or more extreme than what was observed if the null hypothesis were true? Compute the probability of each outcome in the set.

(c) [2 pts] Suppose we reject the null hypothesis at significance level $\alpha = 0.05$. Compute the p-value and interpret your result.

Name: _____

Problem 2. [5 pts] California water usage.
In 2022, California issued restrictions on outdoor water usage in residential areas. We will assess whether these restrictions were effective at reducing per capita water usage in California cities from July 2021 to July 2022.

(a) [1 pt] Let μ be the average change in per capita water usage from July 2021 to July 2022. Formulate the null and alternative hypotheses.

(b) [2 pts] Using the data provided for 184 California cities in `water_usage.csv`, compute the t-statistic. Hint: First take the difference between the columns for July 2021 and July 2022 to compute the reduction for each city.

(c) [2 pts] Compute and interpret the p-value.