ECON 0150 | Fall 2025 | Homework 3.4

Due: Friday, Feb 28, 5PM

Homework is designed to both test your knowledge and challenge you to apply familiar concepts in new applications. Answer clearly and completely. You are welcomed and encouraged to work in groups so long as your work is your own. Use the provided datasets to answer the following questions. Then submit your figures and answers to Gradescope.

Q1. Hypothesis Testing

A researcher conducts a hypothesis test and reports a p-value of 0.032. *(Note: We use α to denote roughly our willingness to be wrong. So if we want to be 95% confident, then we would use an α of 0.05.)*

a) What does this p-value mean?
b) If the researcher used a significance level of $\alpha = 0.05$, what would their conclusion be?
c) Would their conclusion change if they used $\alpha = 0.01$ instead? Explain.

Q2. True or False?

Explain your reasoning for each.

a) A p-value of 0.10 means there is a 10% chance that the null hypothesis is true.
b) If we fail to reject the null hypothesis, we have proven that it is true.
c) A small p-value indicates that our observed result would be unlikely if the null hypothesis were true.

Q3. Coffee Shop Wait Times

A coffee shop owner claims that the average wait time for coffee is 4 minutes. As a data analyst, you collected wait times (in minutes) for 25 randomly selected customers to test this claim.

```
wait_times = [3.8, 4.2, 5.1, 3.9, 4.7, 5.2, 4.3, 4.6, 3.7, 5.0,
              4.9, 4.5, 4.8, 4.1, 3.6, 5.3, 4.2, 4.0, 4.4, 5.1,
              3.8, 4.6, 4.7, 4.3, 4.0]
```

a) Use python to calculate the *(sample)* mean, standard deviation, sample size, and standard error of the wait times.

```
xbar = np.mean(wait_times)
s = np.std(wait_times, ddof=1)
n = len(wait_times)
se = s / np.sqrt(n)
```

b) State the null hypothesis.

c) Construct a 95% confidence interval for the mean wait time. Does this interval include the claimed value of 4 minutes?

```
stats.t.interval(0.95, n-1, loc=xbar, scale=se)
```

d) Use python to find the probability of seeing a sample mean as extreme as ours given the null hypothesis.

```
stats.t.cdf(some_value, loc=xbar, scale=se) # Use this code as reference
```

e) Which option best describes the meaning of a p-value?

- The probability that the coffee shop owner's claim of 4 minutes is true
- The probability of observing a sample mean at least as far from 4 minutes as what we calculated, if the true population mean is actually 4 minutes
- The probability that our sample mean occurred by random chance
- The percentage of coffee wait times that equal exactly 4 minutes
- The probability that we should accept the coffee shop owner's claim

f) Would you reject the null hypothesis with a 95% confidence level?