Fall 2023 Midterm

ECON 340: Economic Research Methods — Instructor: Div Bhagia

Print Name: _____

This is a closed-book test. You may not use a phone or a computer.

Time allotted: 70 minutes
Total points: 20

Please show sufficient work so that the instructor can follow your work.

I understand and will uphold the ideals of academic honesty as stated in the honor code.

Signature: _____

Question 1: Multiple Choice Questions (1 pt each, total 5 pts)

Choose a single correct response for all questions.

(a) What does the variance of the sample mean signify?

- □ Dispersion in sample data
- □ Sample-to-sample variability
- □ Spread of the population data
- □ Bias in sample mean

(b) We are choosing between two estimators $\hat{\theta}_1$ and $\hat{\theta}_2$ for some population parameter θ, both of which are unbiased i.e. $E(\hat{\theta}_1) = \theta$ and $E(\hat{\theta}_2) = \theta$. But the variance of $\hat{\theta}_1$ is lower than that of $\hat{\theta}_2$ i.e. $Var(\hat{\theta}_1) < Var(\hat{\theta}_2)$. Which of the following is true?

- □ We are indifferent between the two estimators.
- □ We prefer $\hat{\theta}_1$ over $\hat{\theta}_2$.
- □ We prefer $\hat{\theta}_2$ over $\hat{\theta}_1$.
- □ We need more information to reach any conclusion.

(c) If the average score on a math test is 75 with a standard deviation of 10, and your score is 70, then you are:

- □ 1/2 standard deviation over the mean
- □ 1 standard deviation over the mean
- □ 1/2 standard deviation below the mean
- □ 1 standard deviation below the mean

(d) In a scientific study, researchers are analyzing the correlation between the variable X, which represents the age of trees, and Y, which measures the height of those trees in centimeters. The researchers also create a new variable Z that measures the height of the trees in inches. Which of the following is true?

- ☐ $\text{cor}(X, Y) > \text{cor}(X, Z)$
- ☐ $\text{cor}(X, Y) < \text{cor}(X, Z)$
- ☐ $\text{cor}(X, Y) = \text{cor}(X, Z)$
- ☐ None of the above

(e) Which of the following statements correctly explains the concept of p-values in hypothesis testing?

- ☐ The p-value is the probability that the null hypothesis is true.
- ☐ The p-value is the probability of observing the null hypothesis given the sample data.
- ☐ The p-value is the probability of observing the sample data or more extreme values, assuming the null hypothesis is true.
- ☐ The p-value is the probability of observing a statistically significant result in a hypothesis test.

Question 2: Things you can explain. (5 pts)

(a) (2.5 pts) If a study discovers a strong correlation between education level and wealth, can we infer that higher education leads to increased wealth?

(b) (2.5 pts) Imagine a university reports that the average GPA of its student body is 3.4, based on university-wide data. A student organization surveys a random sample of 100 students and finds that the average GPA is 3.2. Should the student organization be concerned that they found a different average GPA than the university? Explain your reasoning, considering factors such as sampling variation and sample size.

Question 3: Investor Behavior (6 pts)

Imagine you're a financial advisor studying two types of investors: *risk-averse* (denoted by $X = 1$) and *risk-taking* (denoted by $X = 2$). You're interested in the amount of money Y they are willing to invest in a new startup: either \$10,000, \$20,000, or \$30,000.

The joint probability distribution table below shows the likelihood of an investor from each risk category investing a particular amount in a new startup:

	Investment Amount (Y)			Total
	\$10,000	\$20,000	\$30,000	
Risk-averse ($X = 1$)	0.35	0.15	0.10	
Risk-taking ($X = 2$)	0.05	0.15	0.20	
Total				

Answer the following questions. *For each question write down the formula you are using if any and show your work clearly.*

(a) (1 pt) What proportion of all investors invest \$10,000?

(b) (1 pt) What is the expected amount of investment across all investors?

(c) (1 pt) What proportion of investors are risk-averse?

(d) (1 pt) What *proportion* of risk-averse investors invest $10,000?

(e) (1 pt) What is the expected amount of investment from a risk-averse investor?

(f) (1 pt) Given your answers above, do you think the investment amount is independent of an individual's risk appetite?

Question 4: Estimating Average Income (4 pts)

In an economics study, researchers are interested in estimating the average monthly income of households in a particular city. They take a random sample of 150 households and find the average monthly income to be \$4,500 with a standard deviation of \$950.

(a) (1.5 pts) Construct a 95% confidence interval for the average monthly income. (Note that: $Pr(Z > 1.96) = 0.025$.)

(b) (1 pt) Interpret the 95% confidence interval you've constructed in part (a). What does it mean in the context of the study?

(c) (1.5 pts) If the researchers wanted to decrease the width of the confidence interval while keeping the confidence level constant, what could they do?