

Econ 311: Midterm I

Monday, October 12

Please do not turn this page over until instructed to do so.

Instructions (Please Read Carefully Before Starting)

- This test has a total of **100 points**. Unless otherwise instructed, you have 1h 50m to solve it, that is, 110 minutes. There are 15 multiple choice questions (each is worth 3 points) and 4 written questions 10, 5, 10, and 30 points respectively).
- Show your work, unless you are explicitly told not to ! No credit will be given for correct answers if you do not justify your argument.
- Please be sure that your handwriting is **legible!**
- We will grade only what is written on your exam sheet. There should be plenty of space for all your answers. **Do not turn in anything aside from your exam sheet.**
- If time is running short, you should try to set up the problem without doing the final calculations.

Name : _____

Signature: _____

Multiple Choice (Just answer writing the letter corresponding to the statement you believe to be correct.)

Question	Answer
1	B
2	C
3	B
4	A
5	B
6	B
7	C
8	C
9	B
10	B
11	B
12	D
13	B
14	C
15	A
Score	

Part I. Multiple Choice (15 questions worth 3 points each).

1. Which of the following is an example of a discrete random variable?

- A) The monthly electric bill for a local business.
- B) The number of people eating at a local café between noon and 2:00 p.m.
- C) The amount of time it takes for a worker to complete a complex task.
- D) The percentage of people living below the poverty level in a Boston.

2. A researcher used a procedure to select a sample of n objects from a population in such a way that each member of the population is chosen strictly by chance, is equally likely to be chosen, and every possible sample of size n has the same chance of selection. The procedure used by the researcher is known as:

- A) descriptive statistics
- B) inferential statistics
- C) simple random sampling
- D) None of the above

3. A summary measure that is computed from a sample to describe a characteristic of the population is known as a(n):

- A) parameter
- B) statistic
- C) population
- D) inferential statistics

4. Which analytical tool is often used to separate the “vital few” from the “trivial many”?

- A) Pareto diagram
- B) Pie chart
- C) Line chart
- D) Histogram

5. Which measures of central location are not affected by extremely small or extremely large values data values?

- A) Arithmetic mean and median
- B) Median and mode
- C) Mode and arithmetic mean
- D) Geometric mean and arithmetic mean

6. Which of the following statements is not true?

- A) Measures of central tendency are numbers that describe typical values in the data.
- B) The coefficient of variation is the least used measure of central tendency.

- C) The mean is the most widely used measure of location.
- D) All of the above.

7. Over the past 10 years, the return on Stock A has averaged 8.4% with a standard deviation of 2.1%. The return on Stock B has averaged 3.6% with a standard deviation of 0.9%. Which of the following statements is true?

- A) Stock A has smaller relative variation than Stock B.
- B) Stock B has smaller relative variation than Stock A.
- C) Both stocks exhibit the same relative variation.
- D) Unable to tell with the given information.

8. Which of the following represents a disadvantage of using the sample range to measure spread or dispersion?

- A) It produces spreads that are too large.
- B) The sample range is not measured in the same units as the data.
- C) The largest or smallest observation (or both) may be an outlier.
- D) None of the above is correct.

9. At a highway checkpoint, the average speed of a passing car was measured at 50 miles per hour with a standard deviation of 5 miles per hour. According to Chebychev's Theorem, what percentage of cars would you expect to be traveling between 42.5 and 57.5 miles per hour?

- A) At least 50%
- B) At least 55.6%
- C) At least 75%
- D) At least 88.9%

10. The set of all possible outcomes from a random experiment is called the:

- A) sample population
- B) sample space
- C) sample probability
- D) sample event

11. Which of the following statements is true for any two events A and B defined on a sample space S?

- A) If the intersection of events A and B is the empty set, then A and B are collectively exhaustive.
- B) If the union of events A and B is the empty set, then each of A and B is the empty set.
- C) If events A and B are collectively exhaustive, then $A \cup B \neq \phi$.
- D) If events A and B are mutually exclusive and collectively exhaustive, then the union of A and B is not necessarily the sample space.

12. If A and B are independent events with $P(A) = 0.60$ and $P(A|B) = 0.60$, then $P(B)$ is:

- A) 1.20

- B) 0.60
- C) 0.36
- D) Cannot be determined with the information given.

13. If $P(A) = 0.20$, $P(B) = 0.40$ and $P(A \cap B) = 0.08$, then A and B are said to be

- A) dependent events
- B) independent events
- C) mutually exclusive events
- D) complementary events

14. Which of the following best describes the multiplication rule of probabilities?

- A) $P(A|B) = P(A)P(B)$
- B) $P(A|B) = P(A \cap B)P(B)$
- C) $P(A \cap B) = P(A|B)P(B)$
- D) $P(A \cap B) = P(A|B)P(A)$

15. If two events A and B are mutually exclusive, what does the special rule of addition state?

- A) $P(A \cup B) = P(A) + P(B)$
- B) $P(A \cap B) = P(A) + P(B)$
- C) $P(A|B) = P(A)$
- D) $P(A|B) = P(A) - P(B)$

Part II. Written Questions.

Question 1.(10pts) Rising Hills Manufacturing Inc. wishes to study the relationship between the number of workers, X and the number of tables, Y , produced in its Redwoods Falls plant. It has obtained a random sample of 3 hours of production. The following (x, y) combinations of points were obtained: $(3,6)$, $(6,9)$, $(9,12)$. Compute the covariance and correlation coefficient. (Hint: $s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$, $cov(x, y) = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$.)

Note that $\bar{X} = 6$ and $\bar{Y} = 9$. So, $Cov(X, Y) = \frac{(3-6)(6-9)+(6-6)(9-9)+(9-6)(12-9)}{3-1} = 9$.

The correlation coefficient = $\frac{Cov(X, Y)}{S_X S_Y} = \frac{9}{3 \times 3} = 1$ since $S_X = 3$ and $S_Y = 3$

Question 2.(5pts) In general, which of the covariance and the sample correlation coefficient is a more useful measure of the relationship between the two variables? Explain why.

The sample correlation coefficient is generally a more useful measure, as it provides both the direction and the strength of the relationship.

Question.3 (10pts) Consider the following sample data: 153, 178, 203, 410, 310, 231, 190, and 225. Compute the mean and median. Is the distribution of these numbers skewed to the right, skewed to the left or symmetric? Why?

Mean = 237.5, median = $(203+225)/2 = 214$. Since mean > median, the distribution of these numbers is skewed to the right.

Question 4. (30 pts) Three airlines serve a small town in Indiana. Airline A has 60% of all the scheduled flights, airline B has 30%, and airline C has the remaining 10%. Their on-time rates are 80%, 60%, and 49% respectively. Define event D as an airline arrives on time.

a.(5pts) Calculate $P(A \cap D)$.

$$P(A \cap D) = P(D|A)P(A) = (0.80)(0.60) = 0.48$$

b.(5pts) Calculate $P(B \cap D)$.

$$P(B \cap D) = P(D|B)P(B) = (0.60)(0.30) = 0.18$$

c.(5pts) Calculate $P(C \cap D)$.

$$P(C \cap D) = P(D|C)P(C) = (0.49)(0.10) = 0.049$$

d.(5pts) Calculate the probability that a plane leaves on time.

$$P(D) = P(A \cap D) + P(B \cap D) + P(C \cap D) = 0.48 + 0.18 + 0.049 = 0.709$$

e.(5pts) If a plane has just left on time, what is the probability that it was airline A?

$$P(A|D) = P(A \cap D)/P(D) = 0.48/0.709 = 0.677$$

f.(5pts) If a plane has just left 40 minutes late, what is the probability that it was airline A?

$$P(A|\bar{D}) = P(A \cap \bar{D})/P(\bar{D}) = (0.12)/0.291 = 0.412 \text{ Note that } P(\bar{D}) = 1 - P(D) = 1 - 0.709 = 0.291 \text{ and } P(A \cap \bar{D}) = P(A) - P(A \cap D) = 0.6 - 0.48 = 0.12$$
