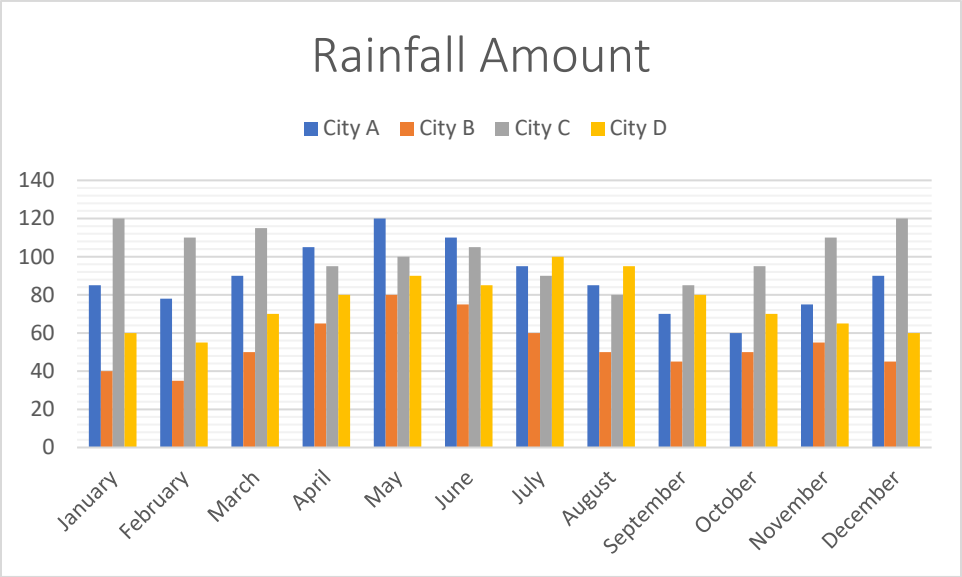
Statistics Exam

University of Houston Mathematics Contest 2026

1. Based on the rainfall patterns shown in the graph, which statement best describes the trends for the four cities?



   a. Cities A, B, and C have the same seasonal trend.
   b. City C shows a lagged seasonal trend, Cities A and B show regular seasonality, City D is irregular.
   c. All cities have random variation.
   d. Cities A and B are negatively correlated.
   e. City D has a seasonal trend identical to City C.
   f. None of the above.

2. A scatter plot compares sleep hours per night and test scores. Most data points show a slight positive trend, but a cluster of students who sleep 4–5 hours have very high scores. What is the most accurate description?
   a. There is a perfect positive correlation.
   b. Sleep hours do not affect test scores.
   c. There is a strong negative correlation.
   d. Data is random with no trend.
   e. There is a weak positive association with outliers.
   f. None of the above.

3. A sports survey taken shows that 48% of the respondents liked soccer, 66% liked basketball and 38% liked hockey. Also, 30% liked soccer and basketball, 22% liked basketball and hockey, and 28% liked soccer and hockey. Finally, 12% liked all three sports. What is the probability that a randomly selected person does not like any of these three sports?
    a. 0.00
    b. 0.16
    c. 0.20
    d. 0.84
    e. 1.00
    f. None of the above.

4. Two independent flights, A and B are going to Houston, TX from two different cities. The probability that flight A is cancelled is 0.05, the probability that flight B is cancelled is 0.1. What is the probability that both flights will arrive in Houston?
    a. 0.005
    b. 0.855
    c. 0.995
    d. 0.000
    e. 1.000
    f. None of the above.

5. The desired true average thickness of lenses used in eyeglasses is 3.20 mm. We assume that the thickness is based on a Normal distribution with σ = 0.34 mm. A sample of 50 lenses yield a sample mean thickness of 3.05. We want to test the hypotheses below with a level of significance α = 0.05.

$$H_0: \mu = 3.20 \; versus \; H_a: \mu < 3.20$$

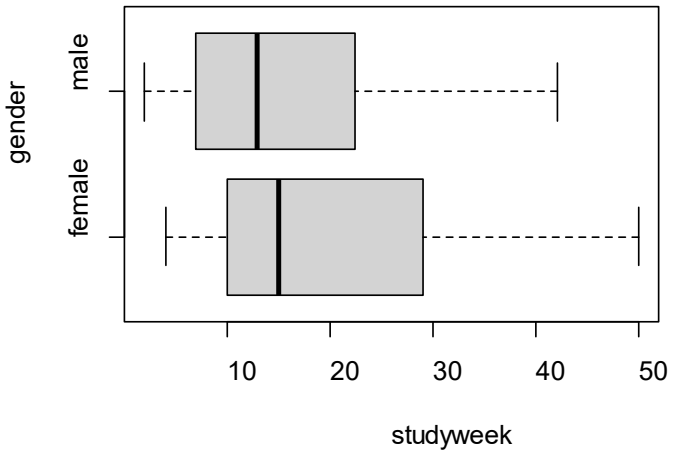
Determine the test statistic (nearest 0.01), p-value (nearest 0.001) and conclusion of this test.
    a. Test statistic: z = -3.12, p-value = 0.001, Conclusion: There is very strong evidence that the average thickness of lenses used in eyeglasses is less than 3.20 mm.
    b. Test statistic: z = -3.12, p-value = 0.001, Conclusion: There is no evidence that the average thickness of lenses used in eyeglasses is less than 3.20 mm.
    c. Test statistic: t = -3.12, p-value = 0.002, Conclusion: There is very strong evidence that the average thickness of lenses used in eyeglasses is more than 3.20 mm.
    d. Test statistic: t = -3.12, p-value = 0.002, Conclusion: There is no evidence that the average thickness of lenses used in eyeglasses is less than 3.20 mm.
    e. Test statistic: z = -3.12, p-value = 0.001, Conclusion: There is very strong evidence that the average thickness of lenses used in eyeglasses is more than 3.20 mm.
    f. We do not have enough information for this test.

6. In a two-tailed hypothesis test situation H_A: $\mu \neq \mu_0$, the test statistic is determined to be t = 2.423. The sample size is 41. Determine the p-value for this test to the nearest 0.01.
    a. -0.01
    b. 0.01
    c. -0.02
    d. 0.02
    e. 0.99
    f. None of the above.

7. It was shown that students with above average scores on the first exam, tend to also get above average scores on the second exam of a certain class. The relationship is only moderately strong. A linear relationship between the first exam and the second exam explains only 36% of the variance of the second exam scores. Based on this information, what is the correlation coefficient between the first and second exam?
    a. $r = 0.36$.
    b. $r = -0.6$.
    c. $r = -0.36$.
    d. $r = 0.13$.
    e. $r = 0.6$.
    f. None of the above.

8. 1,325 students were asked to fill out a survey. They were asked about their height and fastest speed they have ever driven. The following is a least-squares regression line based on their responses where y = speed (mph), and x = height (in inches), $y = -0.7145 + 1.3830x$. Given a student's height is 59 inches, what is the predicted value of the highest speed they have ever driven (to the nearest 0.01)?
    a. 80.88 mph
    b. 81.60 mph
    c. 10.12 mph
    d. 71.45 mph
    e. -8.36 mph
    f. None of the above.

9. The following is a boxplot based on the number of hours a student studies a week by their gender. Based on this plot, which statement is TRUE?



a. There are fewer male students than female students.
b. The median number of hours a male studies per week is less than a female student.
c. The variability for the number of hours a student studies per week is more for male students.
d. The interquartile range for the number of hours a male student studies per week is about 20.
e. The first quartile for the number of hours a female student studies per week is 15.
f. None of the above.

10. Suppose you wish to test if a 6-sided cube is loaded or not. You roll the die 84 times and the following is the count of the number of times each side came up:

Number on Side Up	**1**	**2**	**3**	**4**	**5**	**6**
Count	4	22	23	14	8	13

What is the test statistic, p-value and conclusion (to the nearest 0.001)? Use α = 0.05.

a. $\chi 2$ = 12.595, p-value = 0.02749, there is significant evidence that the die is loaded.
b. $\chi 2$ = 20.143, p-value = 0.001, there is no evidence that the die is loaded.
c. z = 8, p-value = 0.1562, there is no evidence that the die is loaded.
d. $\chi 2$ = 20.143, p-value = 0.001, there is significant evidence that the die is loaded.
e. z = 8, p-value = 0.1562, there is significant evidence that the die is loaded.
f. None of the above.

11. Given the following statistics below for a person's height, which would be the best value for standard deviation?

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
52.00	63.00	66.00	66.13	69.00	82.00

    a. 30
    b. 20
    c. 10
    d. 4
    e. 1
    f. We do not have enough information.

12. Which condition is necessary for performing a **one-sample t-test** for a population mean?
    a. The population must be normally distributed
    b. The sample must be randomly selected
    c. The sample size must be greater than 100
    d. The population standard deviation must be known
    e. Both a) and b) are necessary.
    f. None of the above.

13. Researchers want to compare the mean cholesterol levels of adults who exercise regularly and those who do not. Two independent random samples are taken from each group. Which procedure is most appropriate?
    a. One-sample z-test
    b. Paired t-test
    c. One-sample t-test
    d. Two-sample t-test
    e. Chi-square test for independence
    f. None of the above.

14. A study examines the relationship between caffeine intake and reaction time. Participants choose whether or not to consume caffeine before testing. Which conclusion is most appropriate?
    a. Caffeine causes changes in reaction time
    b. Reaction time causes caffeine consumption
    c. Caffeine and reaction time are independent
    d. A cause-and-effect relationship can be established
    e. An association may exist, but causation cannot be concluded
    f. None of the above.

15. A random sample of 35 students reports an average study time of 2.4 hours per day with a standard deviation of 0.8 hours. Which condition must be checked before constructing a confidence interval for the mean study time?
    a. The population standard deviation is known
    b. The sample size is greater than 100
    c. The sampling distribution of the mean is approximately normal
    d. There is no nonresponse bias
    e. The population is larger than the sample
    f. All of these above.

16. A researcher conducts many hypothesis tests at the 0.05 significance level using the same data set. What is a likely consequence?
    a. The probability of a Type II error increases
    b. The probability of a Type I error increases
    c. The sampling distribution becomes skewed
    d. The confidence level increases
    e. The null hypothesis becomes true
    f. None of the above.

17. A 95% confidence interval for the mean difference in test scores between two teaching methods is as follows:

$$2.1 < \mu_A - \mu_B < 6.4$$

    Which conclusion is best supported?
    a. There is a 95% probability that the true mean difference is between 2.1 and 6.4 points
    b. Students taught with Method A scored between 2.1 and 6.4 points higher than students taught with Method B
    c. The data provide convincing evidence that the mean test score for Method A is higher than for Method B
    d. There is no statistically significant difference between the two methods
    e. The probability that Method A is better than Method B is 0.95
    f. None of the above.

18. A weight-loss program is tested on 6 participants. The following are the weights in kilograms before and after the weight-loss program. Assume that the weight is normally distributed.

Participant	1	2	3	4	5	6
Before (kg)	85	90	88	92	87	89
After (kg)	80	86	84	88	83	85

Perform a hypothesis test to determine if the program significantly reduces weight at $\alpha = 0.05$ significance level.

a. The p-value is less than 0.05, thus there is evidence that the program is effective.
b. The p-value is greater than 0.05, thus there is no evidence that the program is effective.
c. There is a 5% chance that the program reduces weight.
d. Weight increased significantly.
e. Cannot perform a t-test on this data.
f. The results are inconclusive.

19. In a study of 100 patients:

- Drug A: 40 out of 50 patients improved
- Drug B: 30 out of 50 patients improved

Test if Drug A is significantly better than Drug B (α=0.05).

a. P-value ≈ 0.09 → no significant difference.
b. P-value < 0.05 → Drug A significantly better.
c. Drug B is significantly better.
d. Cannot test with these data.
e. Both drugs are equally effective.
f. The difference in improvement rates is clinically meaningful, not just statistically significant.

20. A researcher conducts a one-sample t-test and fails to reject the null hypothesis. Which explanation is valid?
    a. The null hypothesis is true
    b. There is no difference in the population
    c. There is insufficient evidence to support the alternative hypothesis
    d. The sample mean equals the population mean
    e. A Type I error has occurred
    f. None of the above.

21. A random variable, *X*, has the probability distribution shown below:

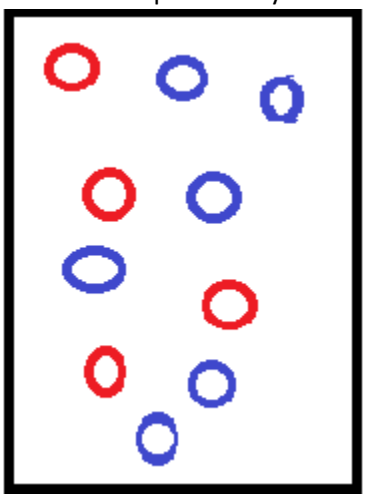
X	-10	0	5	10
P(X = *x*)	0.1	0.3	?	0.2

Which of the following is the expected value of *X*?

a. 0.4
b. 0
c. 1
d. 5
e. 3
f. None of the above

22. A researcher uses a simulation to estimate the probability that a randomly selected sample of size 50 will produce a sample mean within 2 units of the population mean. Which principle justifies using repeated simulation trials?
    a. Law of Diminishing Returns
    b. Central Limit Theorem
    c. Law of Large Numbers
    d. Empirical Rule
    e. Independence Condition
    f. None of the above.

23. The following drawing is a bag that contains some marbles that are red and blue. Two marbles are drawn without replacement. What is the probability that both marbles are red?



a. $\frac{1}{10}$
b. $\frac{2}{15}$
c. $\frac{2}{10}$
d. $\frac{2}{9}$
e. $\frac{4}{9}$
f. None of the above.

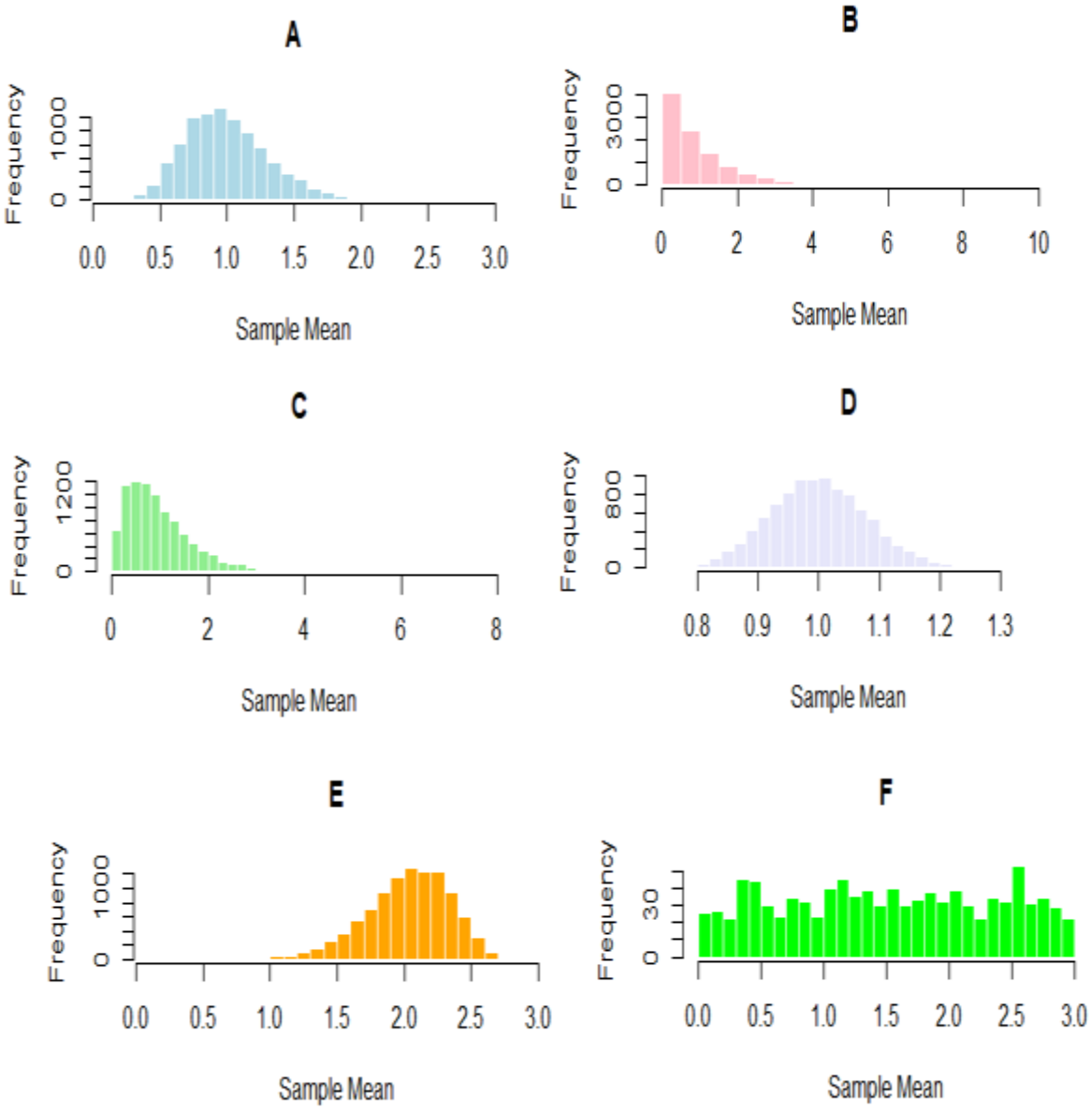
24. Two events *A* and *B* satisfy $P(A) = 0.3$, $P(B) = 0.4$ and $P(A \cup B) = 0.6$. Which statement is correct?
    a. Events A and B are independent.
    b. Events A and B are disjoint.
    c. Events A and B are both independent and disjoint.
    d. Events A and B are the entire sample space.
    e. Events A and B are the same.
    f. None of the above.

25. A student wants to estimate the probability that a randomly selected sample of 40 adults from a large population will have a mean height greater than 68 inches. The population distribution of heights is unknown. The student performs a simulation by repeatedly selecting random samples of size 40 from the population data and recording the sample mean each time. Which of the following best justifies using the simulation results to estimate the probability?
    a. The population distribution is normal.
    b. The number of simulation repetitions eliminates sampling variability.
    c. The sampling distribution of the sample mean is approximately normal.
    d. The simulation guarantees the exact probability.
    e. The population mean is known.
    f. None of the above.

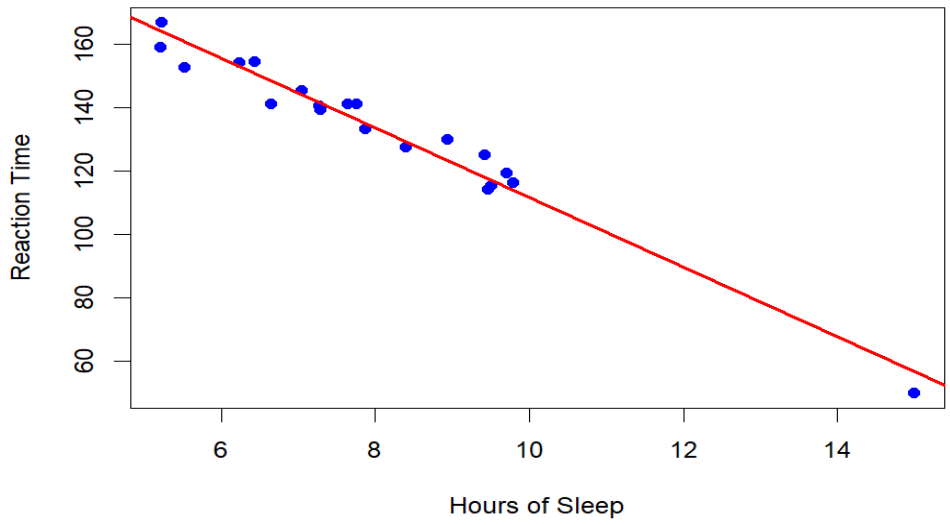
26. A simulation-based hypothesis test produced a distribution of sample proportions assuming the null hypothesis is true. Out of 10,000 simulated samples, 180 resulted in proportions at least as extreme as the observed sample proportion. What is the best estimate of the p-value?
    a. 0.0018
    b. 0.018
    c. 0.18
    d. 0.82
    e. 1.00
    f. Cannot be determined.

27. A 95% confidence interval for a population proportion is constructed using simulation. Which interpretation is correct?
    a. 95% of the data fall within the interval.
    b. There is a 95% probability the true proportion is in the interval.
    c. The interval contains 95% of all possible proportions.
    d. About 95% of the intervals made this way capture the true proportion.
    e. The true proportion changes with each sample.
    f. None of these above.

28. A simulation is produced from a right-skewed population. Random samples of size 10 are taken and the mean of each sample is recorded. This process is repeated 10,000 times. Which histogram best represents the distribution of the sample means?



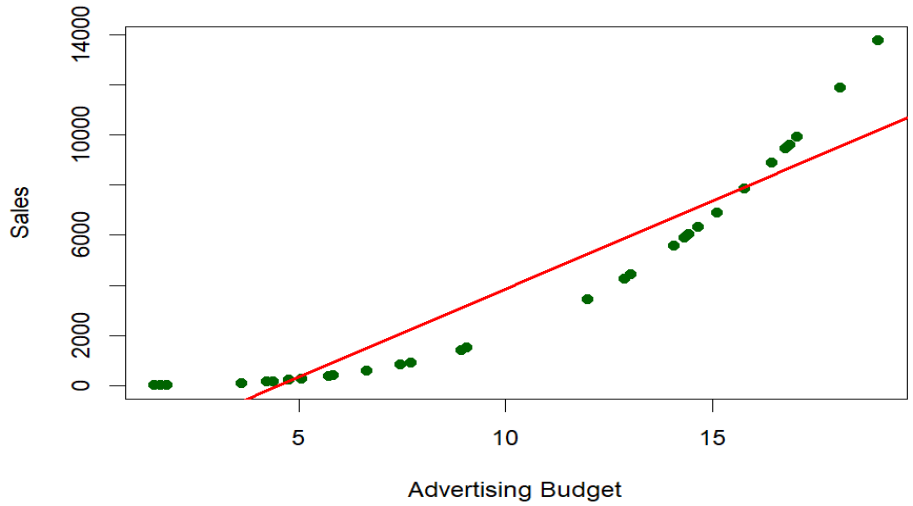
29. A researcher studies the relationship between hours of sleep (x) and reaction time (y). The scatterplot below shows 20 data points with a least-squares regression line.



Which of the following statements is **most accurate**?

a. The outlier at (15,50) has little effect on the slope of the regression line.
b. Removing the outlier will likely change the magnitude of the slope.
c. The correlation between x and y would not change if the outlier were removed.
d. The residual for the outlier is approximately 0.
e. The intercept is not affected by outliers.
f. None of the above.

30. A company studies advertising budget (x, in thousands) vs. sales (y, in thousands). The scatterplot shows a pattern in residuals from a fitted linear regression line.



Which statement about the regression model is most appropriate?

a. The linear model is appropriate; residuals show no pattern.
b. The linear model underestimates sales for low budgets and overestimates for high budgets.
c. A stronger linear correlation could be obtained by removing the largest x values.
d. Residual standard deviation is irrelevant in this case.
e. The intercept should be ignored because it is negative.
f. The linear model is not appropriate.

31. A teacher collected data on the number of hours students studied (x) and their exam scores (y) in a statistics class with 25 students. The following is an output of least-squares regression line predicting exam score from hours studied.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	49.2713	1.6951	29.07	<2e-16
hours_studied	4.8140	0.2649	18.17	<2e-16

Which of the following is closets to a 95% confidence interval for the slope of exam score on hours studied (to the nearest 0.001)?

a. 4.814 ± 0.265
b. 4.814 ± 0.519
c. 49.271 ± 0.265
d. 4.814 ± 0.548
e. 4.815 ± 4.815
f. None of the above.

32. A researcher performs a two-tailed hypothesis test and obtains a p-value of 0.03. Which statement is correct?

    a. There is a 3% chance that the null hypothesis is true.
    b. There is a 3% probability of observing a test statistic as extreme or more extreme than the one observed if the null hypothesis is true.
    c. The null hypothesis should always be rejected because 0.03 < 0.05.
    d. The alternative hypothesis is true with probability 0.97.
    e. The p-value is equal to the Type II error.
    f. None of the above.

33. A sample of 16 students has a mean test score of 78. The population standard deviation is unknown. Assume the population is approximately normal. We want to test if the population mean is 75 at α=0.01. The sample standard deviation is 6. Give the alternative hypothesis, test statistic and p-value for this test (to the nearest 0.001).
    a. H_A: $\mu > 78$, t = 2, p-value = 0.032.
    b. H_A: $\mu > 75$, z = 2, p-value = 0.022.
    c. H_A: $\mu < 78$, t = -2, p-value = 0.032.
    d. H_A: $\mu \neq 75$, z = -2, p-value = 0.044.
    e. H_A: $\mu \neq 75$, t = 2, p-value = 0.064
    f. None of the above.

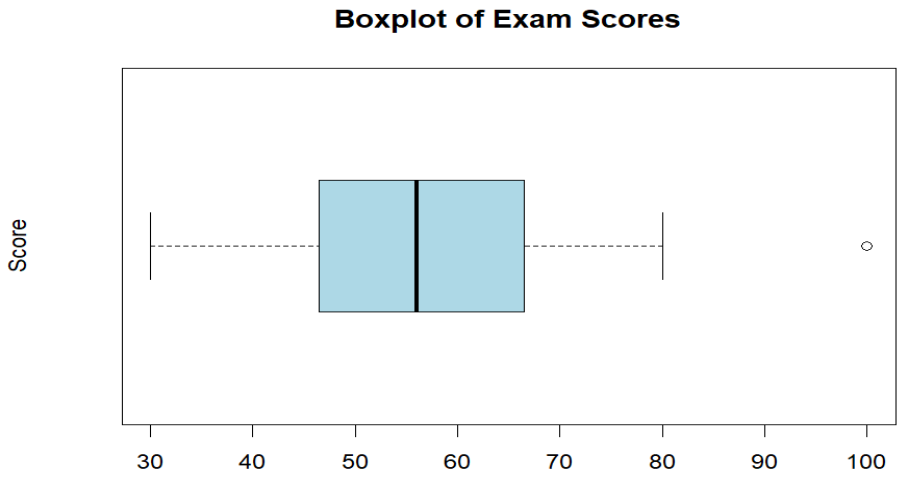
34. A study tests whether a coin is fair (H_0: p =0.5) using 100 flips. Researchers choose α = 0.01. Which statement is true?
    a. Decreasing α increases the probability of a Type I error.
    b. Increasing sample size increases the power of the test.
    c. A p-value of 0.02 would lead to rejecting H_0.
    d. Power is the probability of making a Type I error.
    e. Type II error probability does not depend on sample size.
    f. None of the above.

35. Researchers want to study whether drinking coffee affects reaction time. Which design would best allow them to determine causation?
    a. Surveying 100 people about their coffee habits and reaction times.
    b. Observing reaction times in a coffee shop.
    c. Randomly assigning participants to drink coffee or not, then measuring reaction time.
    d. Collecting reaction time data from social media posts.
    e. Asking friends how fast they respond to a quiz after drinking coffee.
    f. None of the above.

36. A pollster wants to measure opinions about a new city ordinance. She only interviews people standing outside city hall. What kind of bias is most likely present?
    a. Response bias.
    b. Nonresponse bias.
    c. Sampling bias.
    d. Measurement bias.
    e. Random sampling error.
    f. No bias exists in this sample.

37. A company reports the annual salaries (in thousands) of 50 employees: most earn between $40k–$60k, but 3 executives earn over $500k. Which is the best measure of central tendency?
    a. Mean, because it accounts for all values.
    b. Median, because it is resistant to extreme values.
    c. Mode, because salaries cluster around $40–$60k.
    d. Range, because it measures spread.
    e. Standard deviation, because it measures variability.
    f. None of the above.

38. Which statement is correct about the following boxplot for exam scores?



    a. The distribution is perfectly symmetric.
    b. The IQR is 70.
    c. The mean is 55.
    d. There are no outliers.
    e. The maximum value is 80.
    f. None of the above.

39. The following is data about plant growth (cm) from 10 plants that received new fertilizer:

12, 13, 14, 14, 15, 16, 16, 17 ,18, 25

Which statement is correct?

a. Median = 15.5, outlier = 25
b. Mean = 16, outlier = 12
c. Median = 16.5, no outliers
d. Distribution is left-skewed
e. IQR = 20
f. None of the above.

40. The following are exam scores from two classes on the same exam:

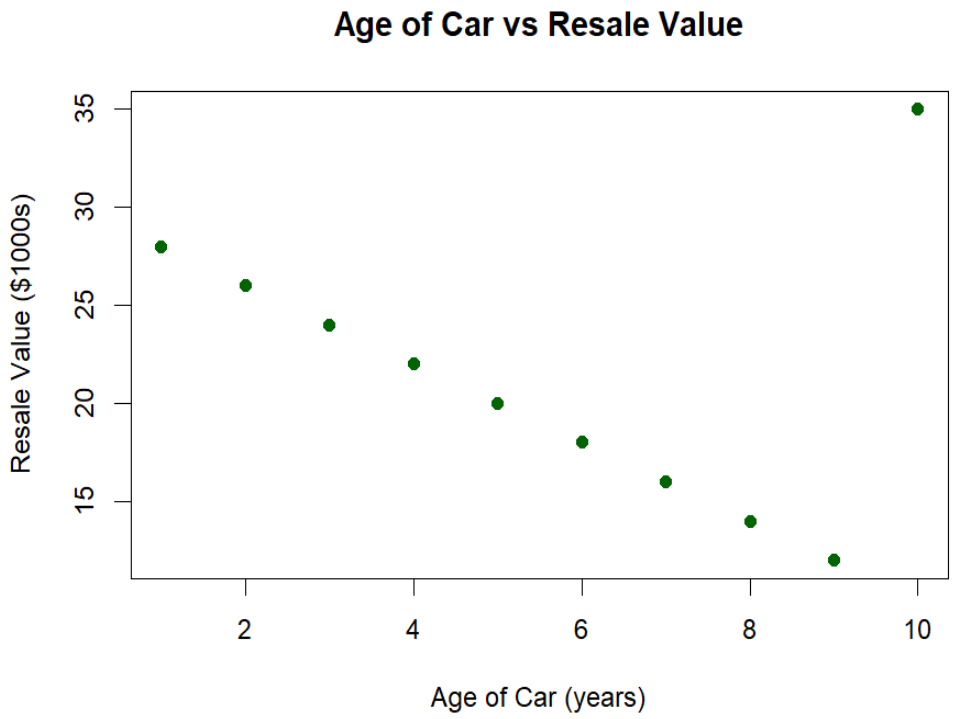
Class A: 70, 72, 73, 75, 76, 78, 80

Class B: 60, 65, 70, 75, 80, 85, 90

Which statement is correct?

a. Class A has more variability than Class B.
b. Both Classes have the same variability.
c. Class B has more variability than Class A.
d. Variability cannot be determined.
e. Class A and Class B have the same median.
f. None of the above.

41. A city planner collected data on the age of a car (in years) and its resale value (in thousands of dollars) for 10 vehicles. The following is a plot of the data.



Which statement about the correlation between age of the car and resale value is most accurate?

a. The correlation is close to −1 because resale value generally decreases as age increases.
b. Removing the 10-year-old car would likely increase the magnitude of the correlation.
c. The correlation is zero because one point does not follow the trend.
d. The correlation is positive because resale value increases at age 10.
e. The correlation would change if resale value were recorded in dollars instead of thousands of dollars.
f. None of the above.

42. The following table shows paired data. What is the correlation coefficient, r?

X	**1**	**2**	**3**	**4**	**5**
Y	2	4	6	8	10

a. -1
b. -0.5
c. 0
d. 0.5
e. 1
f. None of the above.