Statistics Exam

University of Houston Mathematics Contest 2025

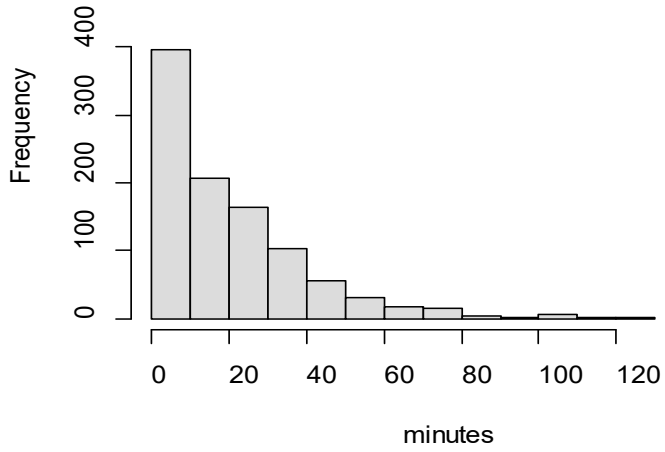
1. Following are data on the populations and number of death row prisoners for several states.

State	Population (in millions)	Death Row Prisoners
Arizona	7.431	116
Florida	22.61	288
Ohio	11.79	117
Nevada	3.09	59
Texas	30.5	180

Which state has the highest number of death row prisoners relative to the size of its population?

a. Arizona
b. Florida
c. Illinois
d. Nevada
e. Texas
f. All are the same

2. The following graph is based on 1000 people waiting for a ride at an amusement park. The variable is the number of minutes that a person waits. Which statement is correct?



a. The mean is less than the median.
b. The mean is 60.
c. The shape of this distribution is skewed left.
d. The shape of this distribution is symmetric.
e. The mean is greater than the median.
f. None of the above

3. Identify the most appropriate test to use for the following situation:

   A national computer retailer believes that the average sales are greater for salespersons with a college degree. A random sample of 14 salespersons with a degree had an average weekly sale of $3542 last year, while 17 salespersons without a college degree averaged $3301 in weekly sales. The standard deviations from the sample were $468 and $642 respectively. Is there evidence to support the retailer's belief?

   a. One sample z-test for means.
   b. One sample t-test for means.
   c. Two sample z-tests for means.
   d. Two sample t-tests for means, assuming the population variances are equal.
   e. Two sample t-tests for means, assuming the population variances are not equal.
   f. None of the above.

4. A random sample of size 32 is taken from a distribution with mean $\mu = 40$ and variance $\sigma^2 = 8$. Determine approximately the probability (round to the nearest 0.001) that the sample mean is between 36.375 and 43.625.

   a. 0.471
   b. 0.796
   c. 0.325
   d. 0.990
   e. 0.010
   f. None of the above.

5. Which list of sample numbers has the highest standard deviation?

   a. 41, 42, 43, 44, 45
   b. 0, 5, 10, 15, 20
   c. 100, 100, 100, 100, 100
   d. 24, 24, 25, 26, 26
   e. 156, 156, 158, 159, 159
   f. All of these have the same standard deviation.

6. Assume that the weight of cereal in a "10-ounce box" is normally distributed. We want to test $H_0: \mu = 10.1$ against $H_a: \mu > 10.1$. A random sample of 16 boxes were selected and observed $\bar{x}$ = 10.4 and *s* = 0.4. Give the test statistic and conclusion of this hypothesis test.

   a. *Z* = 3, the population mean weight is statistically significantly greater than 10.1 ounces.
   b. *T* = 3, the population mean weight is statistically significantly greater than 10.1 ounces.
   c. *Z* = 3, the population mean weight is 10.1 ounces.
   d. *T* = 3, the population mean weight is 10.4 ounces.
   e. *T* = 0.75, there is no evidence that the population mean weight is statistically significantly greater than 10.1 ounces
   f. None of the above.

7. A drug manufacturer recently stopped testing a promising new drug to treat depression. It turned out that in a randomized, double-blind trial a dummy pill did almost as well as the new drug. The fact that many people respond to a dummy treatment is called

   a. Confounding
   b. Nonresponse
   c. Comparison
   d. The placebo effect
   e. The explanatory variable
   f. None of the above.

8. Given a random variable, *X*, is from a normal distribution with mean $\mu = 650$ and standard deviation $\sigma = 25$. Determine a constant $c > 0$ (to the nearest .01) such that $P(|X - 650| \leq c) = 0.94$.

   a. 697.02
   b. 688.87
   c. 602.98
   d. 1.88
   e. 47.02
   f. None of the above.

9. The following is an output predicting price of an automobile by $1,000 based on mpg from a sample of 75 automobiles.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -16.78222    1.23778  -13.56   <2e-16 ***
mpg.x         1.92253    0.03645   52.74   <2e-16 ***
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.318 on 73 degrees of freedom
Multiple R-squared:  0.9744,    Adjusted R-squared:  0.9741
F-statistic:  2781 on 1 and 73 DF,  p-value: < 2.2e-16
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   Give a 95% confidence interval value (to the nearest .0001) for the slope.

   a. (1.8860, 1.9590)
   b. (1.8510, 1.9940)
   c. (1.8260, 2.0190)
   d. (1.8499, 1.9952)
   e. (1.8620, 1.9830)
   f. None of the above.

10. A vendor sells low-fat dairy products. In order to determine the fat content of the product, both the company and vendor take a different sample from each lot and test it for fat content in percent. Five sets of test results are shown below.

Lot Number	1	2	3	4	5
Company Test Results	1.25	0.74	1.14	0.75	0.80
Vendor Test Results	0.77	0.72	0.82	0.72	0.91

Give the null hypothesis test and the test statistic (to the nearest .001) to determine if there is a significant difference in the test results between the company and the vendor.

a. $H_0: \mu_D = 0,$ T = 1.305
b. $H_0: \mu_D = 0,$ T = 1.360
c. $H_0: \mu_1 - \mu_2 = 0,$ T = 1.305
d. $H_0: \mu_1 - \mu_2 = 0,$ T = 1.360
e. $H_0: \mu_1 - \mu_2 = 0,$ T = 0.148
f. None of the above.

11. Given a random variable *X* with mean $\mu_x = 35$ and standard deviation $\sigma_x = 15$. Suppose that *Y* = 10 +2*X* is a random variable based on a linear combination of *X*. Determine the mean and variance of *Y*.

a. $\mu_y = 35,\ \sigma_y^2 = 15$
b. $\mu_y = 35,\ \sigma_y^2 = 225$
c. $\mu_y = 80,\ \sigma_y^2 = 900$
d. $\mu_y = 80,\ \sigma_y^2 = 910$
e. $\mu_y = 75,\ \sigma_y^2 = 450$
f. None of the above.

12. Fill in the blanks of the following statements in order.

Blank 1 try to gather data without influencing the responses. **Blank 2**, on the other hand, impose some **Blank 3** in order to observe the response.

a. 1-Experiments, 2-Observational Studies, 3-Randomization
b. 1-Randomization, 2-Experiments, 3-Treatments
c. 1-Observational studies, 2-Sample Surveys, 3-Response variable
d. 1-Observational studies, 2-Experiments, 3-Treatment
e. 1-Matched pair designs, 2-Explanatory variables, 3-Response variable
f. None of the above.

13. Suppose that many of the households who are asked to state their income by the Census Bureau give an answer that is too low because they fear that their answer will go to the Internal Revenue Service. What type of error is this?
    a. This is a sampling error that causes bias.
    b. This is a sampling error that increases variability.
    c. This is a non-sampling error that causes bias.
    d. This is a non-sampling error that increases variability.
    e. This is a sample error that decreases variability.
    f. There is no error.

14. Suppose a company manufactures electronic components, and each component can either be defective or non-defective. The probability of a component being defective depends on which of two factories produces it. Factory A produces 60% of the components, and Factory B produces the rest of the components. The probability that a component is defective from Factory A is 0.05, while the probability that a component is defective from Factory B is 0.02. A component is selected at random, and it turns out to be defective. What is the probability (to the nearest 0.0001) that it was produced by Factory A?
    a. 0.7895
    b. 0.6000
    c. 0.0380
    d. 0.0080
    e. 0.0380
    f. None of the above.

15. A factory produces light bulbs, and each light bulb has a 5% chance of being defective. The factory produces 1000 light bulbs per day. Let X be the random variable representing the number of defective light bulbs in a sample of 100 light bulbs randomly selected from the day's production. What is the probability (to the nearest 0.001) that at least 5 light bulbs were found to be defective?
    a. 0.050
    b. 0.950
    c. 0.180
    d. 0.616
    e. 0.564
    f. None of the above.

16. A random number generator is used to select 20 students from a statistics class to rate a statistics video. These 20 students are
    a. The sampling frame
    b. The population
    c. A simple random sample of the class
    d. A census
    e. A voluntary response sample
    f. None of the above.

17. A basketball player is practicing free throws. The probability that the player makes a successful free throw is $p = 0.75$, and the probability of missing a free throw is $1 - p = 0.25$. Let *X* represent the number of free throws the player needs to make before they make their first successful free throw. What is the probability (to the nearest .001) that the player makes their first successful free throw on the 3rd attempt?

    a. 0.422
    b. 0.047
    c. 0.012
    d. 0.016
    e. 0.953
    f. None of the above.

18. We divide a class into two groups: first year students and others. We then take random samples from each group. This is an example of

    a. Simple random sampling
    b. Clustered sampling
    c. Multistage sampling
    d. Stratified random sampling
    e. Systematic random sampling
    f. None of the above.

19. The margin of error for a poll is 4%. Based on a 95% confidence interval. This means that

    a. 4% of those samples did not answer the question asked.
    b. We have 95% confidence that the sample statistic is within 4% of the population parameter.
    c. 4% of those sampled gave the wrong answer to the question asked.
    d. 4% of the population were in the sample.
    e. The confidence we have in the statistic is 4%.
    f. None of the above.

20. A call center receives phone calls, and the probability that a customer call is answered within 2 minutes is $p = 0.4$. Let X be the random variable representing the number of calls the call center receives until the first call that is answered within 2 minutes. What is the expected number of calls the call center receives until the first one is answered within 2 minutes?

    a. 0
    b. 0.5
    c. 1.5
    d. 2
    e. 2.5
    f. None of the above.

21. The following is a five-number summary of the distribution of scores for a statistics exam.

    18 39 62 76 100

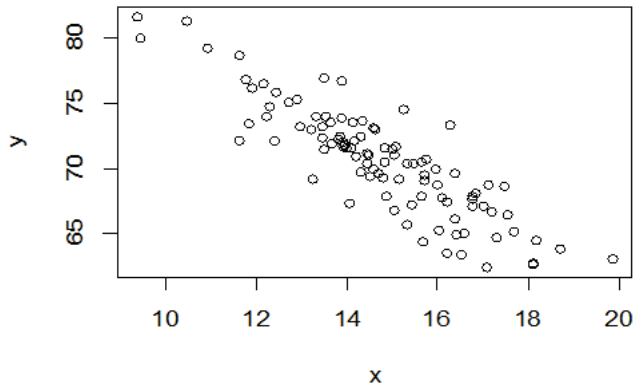
    A total of 416 students took the exam. About how many students had a score above 39?

    a. 416
    b. 312
    c. 104
    d. 400
    e. 208
    f. None of the above.

22. Suppose the mean of a list of numbers (data points) is 16.7 and the standard deviation is 0. Which statement is correct?

    a. There must have been an arithmetic mistake.
    b. All of the numbers on the list are equal to 16.7.
    c. All of the numbers on the list are the same, but their common values can be anything.
    d. 68% of the numbers on the list are between -16.7 and +16.7.
    e. 68% of the numbers on the list are between 0 and 33.4.
    f. None of the above.

23. Based on the scatter plot of the two quantitative variables below, what would be the most appropriate value for the correlation coefficient (to the nearest 0.001)?



    a. -0.875
    b. 0.875
    c. 0.005
    d. -0.005
    e. 1.000
    f. 0.000

24. Let *A* and *B* be two events such that *P*(*A*) = 0.4, *P*(*B*) = 0.4, and $P(A \cap B) = 0.2$. Which statement is true?

    a. Events *A* and *B* are independent.
    b. Events *A* and *B* are mutually exclusive (disjoint events).
    c. Events *A* and *B* are the entire sample space.
    d. Events *A* and *B* are both mutually exclusive and independent.
    e. Events *A* and *B* are not possible because of the probabilities.
    f. None of the above.

25. The table below is a table between the class and if the passengers survived on the Titanic. Given that the person is a crew member, what percent survived (to the nearest 0.01)?

	Survived	
Class	No	Yes
1st	122	203
2nd	167	118
3rd	528	178
Crew	673	212

    a. 9.63%
    b. 23.95%
    c. 29.82%
    d. 40.21%
    e. 32.30%
    f. None of the above.

26. The following is a list of the highest six values of a data set, 3, 4, 4, 6, 9, 10. The five number summary of the data is: 0, 0, 2, 3.5, 10. Using the 1.5IQR rule, are there any values that are considered outliers?

    a. 6, 9, and 10
    b. 9 and 10
    c. Only 9
    d. Only 10
    e. All of these are considered outliers
    f. No values are considered outliers

27. For two events, *A* and *B*, if P(*A*) = 0.4, and P(*B*) = 0.5, and $P(A \cup B) = 0.8$, find $P(A \cap B^C)$.

    a. 0.3
    b. 0.4
    c. 0.5
    d. 0.8
    e. 0.1
    f. None of the above.

28. Hospital records show that 12% of all patients are admitted for heart disease, 20% are admitted for cancer (oncology) treatment, and 8% receive both coronary and oncology care. What is the probability that a randomly selected patient is admitted for coronary care, oncology or both? (Note that heart disease is a coronary care issue.)

    a. 0.68
    b. 0.40
    c. 0.32
    d. 0.24
    e. 0.16
    f. None of the above.

29. Let a random variable *X* have the following probability distribution (one probability intentionally left blank):

X	-10	**0**	**5**
P(*X*)	0.5	0.3	

    What is the expected value of this random variable *X*?

    a. -5
    b. -4
    c. 0
    d. 1
    e. 5
    f. None of the above.

30. An electrical firm manufactures light bulbs that have a length of life that is approximately normally distributed with a standard deviation of 60 hours. How large a sample is needed if we wish to be 97% confident that we will be within 10 hours of the true mean?

    a. 14
    b. 28
    c. 125
    d. 170
    e. 187
    f. None of the above.

31. A random sample of 100 observations produced a sample proportion of 0.25. An approximate 95% confidence interval for the population proportion p is between (to the nearest 0.001)

    a. (0.165, 0.335)
    b. (0.165, 0.321)
    c. (0.179, 0.321)
    d. (0.207, 0.293)
    e. (0.152, 0.348)
    f. None of the above.

32. The weight of a bag of mints from a candy producer is normally distributed with a mean of 20.37 grams and standard deviation of 0.4 grams. Suppose we take a random sample of 16 bags, what is the probability that the sample mean weight is more than 20.4 grams (to the nearest 0.0001)?

    a. 0.4701
    b. 0.5299
    c. 0.3821
    d. 0.6179
    e. 0.5120
    f. None of the above.

33. A researcher asks a group of students to complete a survey that measures maturity. She wanted to test if the mean scores for males and females are the same versus if the female mean scores are higher than for male scores. She finds that the mean score for girls is higher than the mean score for boys, with a p-value of 0.03. What should she conclude from this p-value?

    a. The chance that she concludes that the score for girls is higher for boys when it really is not is 3%.
    b. The chance that we observe the girls score higher, given that the score should be the same is 3%.
    c. There is a 3% chance that the girls scores are higher. There is a 3% chance that the girls and boys scores are equal.
    d. The chance of a girl getting a higher score than a boy is 97%.
    e. The chance of a boy getting a higher score is 97%.
    f. Cannot be concluded by the information we have.

34. What error describes a decision to NOT reject the null hypothesis when in fact it should be rejected?

    a. Type I error
    b. Type II error
    c. Type III error
    d. Probability error
    e. Power
    f. Statistical hypothesis error

35. A potato chip company calculated that there is a mean of 75.2 broken potato chips in each production run with a standard deviation of 5.4. If the distribution is approximately normal, find the probability (to the nearest 0.001) that there will be fewer than 67 broken chips in a run.

    a. 0.364
    b. 0.064
    c. 0.314
    d. 0.038
    e. 0.936
    f. None of the above.

36. Imagine a researcher conducts a survey asking people of different age groups which coffee brand they prefer: Brand A, Brand B, or Brand C. The goal of the study is to find out whether age group has any effect on coffee brand preference. The following table shows data from 3 different age groups (e.g., 18-30, 31-45, and 46+):

Age Group	Brand A	Brand B	Brand C
18 – 30	40	50	30
31 – 45	35	60	25
46+	30	40	50

The researcher wants to test if there is no relationship between age group and coffee brand preference. Determine the test statistic and the conclusion of the test.

a. $\chi^2 = 15.429$, there is a significant relationship between age group and coffee brand preference.
b. $\chi^2 = 15.429$, there is no relationship between age group and coffee brand preference.
c. $\chi^2 = 26.25$, there is a significant relationship between age group and coffee brand preference.
d. $\chi^2 = 26.25$, there is no relationship between age group and coffee brand preference.
e. T = 2.6186, there is a significant relationship between age group and coffee brand preference.
f. None of the above.

37. The following is a stem-and-leaf plot of the cost of a combo meal at 25 different fast-food restaurants. Determine the median cost.

```
The decimal point is at the |

11 | 8
12 | 478
13 | 02
14 | 17899
15 | 1447
16 | 222568
17 | 159
18 | 0
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a. 15.0
b. 15.4
c. 14.1
d. 151
e. 154
f. None of the above.

38. Which of the following would be the most appropriate test of significance for the following situation? Do M&M's Peanut candies really weigh 1.92 oz., as labeled on the package? 20 UH students scattered about town to collect a bag of M&M's Peanuts at randomly selected stores to test this hypothesis.

    a. Matched pairs T test
    b. One Sample Proportion Z Test
    c. One Sample Mean T Test
    d. Two Sample Proportion Z Test
    e. Chi-square Test
    f. None of the above.

39. Each year a company selects a number of employees for a management training program. On average, 70% of those sent complete the program. Out of the 30 people sent, what is the probability (to the nearest 0.001) that exactly 20 complete the program?

    a. 0.1416
    b. 0.4112
    c. 0.0352
    d. 0.5888
    e. 0.0001
    f. None of the above.

40. Costs for standard veterinary services at a local animal hospital follow a Normal distribution with a mean of $77 and a standard deviation of $22. What is the probability (to the nearest 0.001) that one bill for veterinary services costs between $50 and $103?

    a. 0.005
    b. 0.7715
    c. 0.7798
    d. 0.0010
    e. 0.8814
    f. None of the above.

41. A shipment of 17 television sets contains 7 defective sets. A hotel purchases 6 of these television sets. What is the probability (to the nearest 0.0001) that the hotel receives at least one of the defective sets?

    a. 0.0068
    b. 0.0170
    c. 0.9830
    d. 0.1425
    e. 0.8575
    f. None of the above.