Determine which of the four levels of measurement (nominal, ordinal, interval, ratio) is most appropriate.

1) Amount of fat (in grams) in cookies.
   A) Ratio   B) Interval   C) Ordinal   D) Nominal

Use critical thinking to address the key issue.

2) A researcher wished to gauge public opinion on gun control. He randomly selected 1000 people from among registered voters and asked them the following question: "Do you believe that gun control laws which restrict the ability of Americans to protect their families should be eliminated?" Identify the abuse of statistics and suggest a way the researcher's methods could be improved.

   "Loaded question "I am a gun rights advocate who is upset with the current gun control law. Do you believe that gun control laws should be strengthened, weakened or left in their current form?"

Provide an appropriate response.

3) Jon consulted with an accountant to prepare his tax return. He recommended the accountant to his friend saying that this year the amount he paid in taxes was 150% less than last year. What is wrong with this statement?

   Can't reduce by more than 100%.

4) The frequency distribution below summarizes employee years of service for Alpha Corporation. Determine the width of each class.

<table>
<thead>
<tr>
<th>Years of service</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>5</td>
</tr>
<tr>
<td>6-10</td>
<td>20</td>
</tr>
<tr>
<td>11-15</td>
<td>25</td>
</tr>
<tr>
<td>16-20</td>
<td>10</td>
</tr>
<tr>
<td>21-25</td>
<td>5</td>
</tr>
<tr>
<td>26-30</td>
<td>3</td>
</tr>
</tbody>
</table>

   A) 5   B) 6   C) 4   D) 10
Use the pie chart to solve the problem.

5) A survey of the 9854 vehicles on the campus of State University yielded the following pie chart.

Motorcycles: 36%
Convertibles: 16%
Vans: 7%
Sedans: 3%
Pickups: 29%

Find the number of Hatchbacks. Round your result to the nearest whole number.

\[ n = \frac{36}{100} \times 9854 = 3547.44 \approx 3547 \]

Find the mean for the given sample data. Unless indicated otherwise, round your answer to one more decimal place than is present in the original data values.

6) The students in Hugh Logan's math class took the Scholastic Aptitude Test. Their math scores are shown below. Find the mean score.

\[
\begin{align*}
528 & \quad 505 & \quad 342 & \quad 348 & \quad 492 \\
346 & \quad 349 & \quad 643 & \quad 470 & \quad 482 \\
342 & \quad 643 & \quad 985 & \quad 4925 & \\
\end{align*}
\]

Find the mean for the given sample data. \( 460.5 \)

Find the midrange for the given sample data. \( 492.5 \)

Find the mode(s) for the given sample data. None

Find the median for the given sample data. \( 476 \)

Find the range for the given data. \( 301 \)

Find the variance for the given data. \( 1029.2 \)

Find the standard deviation for the given sample data. \( 101.4 \)

Use the range rule of thumb to estimate the standard deviation. Round results to the nearest tenth.

7) A distribution of data has a maximum value of 64, a median value of 55, and a minimum of 46.

\[
S = \frac{R}{4} = \frac{64 - 46}{4} = \frac{18}{4} = 4.5 \quad S = 4.5
\]
Find the mean of the data summarized in the given frequency distribution.

8) The manager of a bank recorded the amount of time each customer spent waiting in line during peak business hours one Monday. The frequency distribution below summarizes the results. Find the mean waiting time. Round your answer to one decimal place.

<table>
<thead>
<tr>
<th>Waiting time (minutes)</th>
<th>Number of customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>0-3</td>
</tr>
<tr>
<td>5.5</td>
<td>4-7</td>
</tr>
<tr>
<td>4.5</td>
<td>8-11</td>
</tr>
<tr>
<td>12.5</td>
<td>12-15</td>
</tr>
<tr>
<td>17.5</td>
<td>16-19</td>
</tr>
<tr>
<td>21.5</td>
<td>20-23</td>
</tr>
<tr>
<td>25.5</td>
<td>24-27</td>
</tr>
</tbody>
</table>

Find the mean for the given sample data. 8.6

Find the variance for the given data. 38.5

Find the standard deviation for the given sample data. 6.2

Use the empirical rule to solve the problem.

9) The systolic blood pressure of 18-year-old women is normally distributed with a mean of 120 mmHg and a standard deviation of 12 mmHg. What percentage of 18-year-old women have a systolic blood pressure between 96 mmHg and 144 mmHg?

\[ p = \frac{96 - 92}{12} = 0.33 \]

Find the number of standard deviations from the mean. Round your answer to two decimal places.

10) In one town, the number of pounds of sugar consumed per person per year has a mean of 5 pounds and a standard deviation of 1.3 pounds. Tyler consumed 12 pounds of sugar last year. How many standard deviations from the mean is that?

\[ z = \frac{x - \bar{x}}{s} = \frac{12 - 5}{1.3} = 5.38 \]

Find the z-score corresponding to the given value and use the z-score to determine whether the value is unusual. Consider a score to be unusual if its z-score is less than -2.00 or greater than 2.00. Round the z-score to the nearest tenth if necessary.

11) A test score of 85.0 on a test having a mean of 68 and a standard deviation of 10.

\[ z = \frac{x - \bar{x}}{s} = \frac{85 - 68}{10} = 1.7 \]

Find the percentile for the data value.

12) Data set: 6 14 12 4 10 18 18 22 6 6 18 12 2 18

Data value (14)

\[ \frac{9}{15} = 0.6 \]

Find the percentile for the data value.

P = 0.6 or 60%
Determine which score corresponds to the higher relative position.

13) Which score has a higher relative position, a score of 53.8 on a test for which $\bar{x} = 37$ and $s = 8$, or a score of 375.4 on a test for which $x = 283$ and $s = 44$?

A) A score of 53.8
B) A score of 375.4
C) Both scores have the same relative position.

Calculate and display both z-scores

$$Z = \frac{2.1}{1}$$

$$\bar{z}_1 = \frac{x_1 - \bar{x}}{s_1} = \frac{53.8 - 37}{8}$$

$$Z = \frac{2.1}{1}$$

$$\bar{z}_2 = \frac{375.4 - 283}{44}$$

Construct a boxplot for the given data. Include values of the 5-number summary in all boxplots.

14) The weights (in pounds) of 30 newborn babies are listed below. Construct a boxplot for the data set.

5.5 5.7 5.8 5.9 6.1 6.1 6.3 6.4 6.5 6.6
6.7 6.7 6.7 6.9 7.0 7.0 7.1 7.2 7.2
7.4 7.5 7.7 7.7 7.8 8.0 8.1 8.1 8.3 8.7

A) 

B) 

C) 

D) 

Provide an appropriate response.

15) Suppose that all the values in a data set are converted to z-scores. Which of the statements below is true?

A: The mean of the z-scores will be zero, and the standard deviation of the z-scores will be the same as the standard deviation of the original data values.
B: The mean and standard deviation of the z-scores will be the same as the mean and standard deviation of the original data values.
C: The mean of the z-scores will be 0, and the standard deviation of the z-scores will be 1.
D: The mean and the standard deviation of the z-scores will both be zero.
Statistics 50 SPRING 2010
Test2 Chapters 4-5 Time 8:20 9:40 Name [Key] Seat Letter [ ] Number [ ]

Directions: Circle the correct choice for each response set. If required, show calculations in the blank spaces near the problems.

Answer the question.

✓ 1) In a certain town, 4% of people commute to work by bicycle. If a person is selected randomly from the town, what are the odds against selecting someone who commutes by bicycle?
   A) 1 : 24 B) 24 : 1 C) 1 : 25 D) 24 : 25

Find the indicated probability.

✓ 2) Two 6-sided dice are rolled. What is the probability that the sum of the two numbers on the dice will be 3?
   \[ P = \frac{1}{18} \text{ or } 0.0556 \]

Estimate the probability of the event.

✓ 3) A polling firm, hired to estimate the likelihood of the passage of an up-coming referendum, obtained the set of survey responses to make its estimate. The encoding system for the data is: 0 = FOR, 1 = AGAINST. If the referendum were held today, estimate the probability that it would pass.
   \[ P = \frac{12}{20} = 0.6 \text{ or } \frac{3}{5} \]

✓ 4) The table below describes the smoking habits of a group of asthma sufferers.

<table>
<thead>
<tr>
<th></th>
<th>Nonsmoker</th>
<th>Occasional smoker</th>
<th>Regular smoker</th>
<th>Heavy smoker</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>394</td>
<td>32</td>
<td>77</td>
<td>46</td>
<td>549</td>
</tr>
<tr>
<td>Women</td>
<td>367</td>
<td>35</td>
<td>75</td>
<td>50</td>
<td>527</td>
</tr>
<tr>
<td>Total</td>
<td>761</td>
<td>67</td>
<td>152</td>
<td>96</td>
<td>1076</td>
</tr>
</tbody>
</table>

If one of the 1076 people is randomly selected, find the probability of getting a regular or heavy smoker.

\[ P = \frac{62}{269} \text{ or } 0.230 \]

Provide a written description of the complement of the given event.

✓ 5) When 100 engines are shipped, all of them are free of defects.
   A) At least one of the engines is defective.
   B) None of the engines are defective.
   C) All of the engines are defective.
   D) At most one of the engines is defective.
Find the indicated probability.

6) A bin contains 63 light bulbs of which 6 are defective. If 4 light bulbs are randomly selected from the bin with replacement, find the probability that all the bulbs selected are good ones. Round to the nearest thousandth if necessary.

\[
P = \frac{6!}{63^4} \times \frac{57!}{53!} = \frac{60 \times 57}{63^4} = 0.663141
\]

7) The following table contains data from a study of two airlines which fly to Small Town, USA.

<table>
<thead>
<tr>
<th>Number of flights which were on time</th>
<th>Number of flights which were late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Podunk Airlines</td>
<td>33</td>
</tr>
<tr>
<td>Upstate Airlines</td>
<td>43</td>
</tr>
</tbody>
</table>

If one of the 87 flights is randomly selected, find the probability that the flight selected is an Upstate Airlines flight which was on time.

\[
P = \frac{43}{87} = 0.49425
\]

Evaluate the expression.

\[
5^2_4 = \frac{5!}{(5-4)!} = \frac{5!}{1!} = 5 \times 4 \times 3 \times 2 \times 1 = 120
\]

Solve the problem.

9) The library is to be given 3 books as a gift. The books will be selected from a list of 18 titles. If each book selected must have a different title, how many possible selections are there?

\[
18^3 = \frac{18 \times 17 \times 16}{3 \times 2} = 816
\]

10) A tourist in France wants to visit 6 different cities. If the route is randomly selected, what is the probability that she will visit the cities in alphabetical order?

\[
P = \frac{1}{6!} = \frac{1}{720} = 0.0013888
\]
Find the mean of the given probability distribution.

11) A police department reports that the probabilities that 0, 1, 2, and 3 burglaries will be reported in a given day are 0.49, 0.44, 0.06, and 0.01, respectively.

\[
\begin{align*}
x & | P(x) \\
0 & | 0.49 \\
1 & | 0.44 \\
2 & | 0.06 \\
3 & | 0.01 \\
\end{align*}
\]

\[\bar{x} = 0 \cdot 0.49 + 1 \cdot 0.44 + 2 \cdot 0.06 + 3 \cdot 0.01 = 0.59\]

\[\mu = \Sigma x \cdot P(x) = 0.59\]

\[\sigma = \sqrt{\Sigma (x - \mu)^2 \cdot P(x)} = 0.6\]

Assume that a researcher randomly selects 14 newborn babies and counts the number of girls selected, x. The probabilities corresponding to the 14 possible values of x are summarized in the given table. Answer the question using the table.

<table>
<thead>
<tr>
<th>Girls</th>
<th>P(x)</th>
<th>x(girls)</th>
<th>P(x)</th>
<th>x(girls)</th>
<th>P(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000</td>
<td>5</td>
<td>0.122</td>
<td>10</td>
<td>0.061</td>
</tr>
<tr>
<td>1</td>
<td>0.001</td>
<td>6</td>
<td>0.183</td>
<td>11</td>
<td>0.022</td>
</tr>
<tr>
<td>2</td>
<td>0.006</td>
<td>7</td>
<td>0.209</td>
<td>12</td>
<td>0.006</td>
</tr>
<tr>
<td>3</td>
<td>0.022</td>
<td>8</td>
<td>0.183</td>
<td>13</td>
<td>0.001</td>
</tr>
<tr>
<td>4</td>
<td>0.061</td>
<td>9</td>
<td>0.122</td>
<td>14</td>
<td>0.000</td>
</tr>
</tbody>
</table>

or \[1 - \text{binomcdf}(n, p, x)\]

\[1 - \text{binomcdf}(14, 0.5, 8) = 0.213\text{ or } 0.212\]

or \[1 - \text{binomcdf}(14, 0.5, 8) = 0.213\text{ or } 0.212\]

12) Find the probability of selecting 9 or more girls.

Determine whether the given procedure results in a binomial distribution. If not, state the reason why.

13) Choosing 7 marbles from a box of 40 marbles (20 purple, 12 red, and 8 green) one at a time with replacement, keeping track of the number of red marbles chosen.

A) Not binomial: the trials are not independent.
B) Procedure results in a binomial distribution.
C) Not binomial: there are too many trials.
D) Not binomial: there are more than two outcomes for each trial.

Find the indicated probability. Round to three decimal places.

14) The participants in a television quiz show are picked from a large pool of applicants with approximately equal numbers of men and women. Among the last 10 participants there have been only 2 women. If participants are picked randomly, what is the probability of getting 2 or fewer women when 10 people are picked?

A) 0.055
B) 0.044
C) 0.011
D) 0.054

\[P(2-) = \text{binomcdf}(10, 0.5, 2) = 0.0546875\]
Find the standard deviation, $\sigma$, for the binomial distribution which has the stated values of $n$ and $p$. Round your answer to the nearest hundredth.

15) $n = 50; p = 0.4$
- $\sigma = 3.46$  
- $\sigma = 7.58$
- $\sigma = 6.73$
- $\sigma = 1.05$

Find the mean, $\mu$, for the binomial distribution
\[ \mu = np = (50)(0.4) = 20 \]
\[ \sigma = \sqrt{np(1-p)} = \sqrt{(50)(0.4)(0.6)} \approx 3.464 \]

Use the Poisson Distribution to find the indicated probability.

16) The town of Fastville has been experiencing a mean of 64.1 car accidents per year. Find the probability that on a given day the number of car accidents in Fastville is 0. (Assume 365 days in a year.)
- $\text{A) 0.109}$
- $\text{B) 0.982}$
- $\text{C) 0.738}$
- $\text{D) 0.839}$

\[ \text{Poisson} (\mu, x) = (\frac{64.1}{365}, 0) \approx 0.839397 \]
Statistics 50  SPRING 2010  Test3 Chapters 6-7  Time 8:20  9:40  Name  Key  Seat Letter  Number

Find the area of the shaded region. The graph depicts the standard normal distribution with mean 0 and standard deviation 1.

\[ P = \text{NormalCDF}(L, R) \]
\[ (-1.18, 1.59) \]
\[ = 0.60340 \]

Provide an appropriate response.

2) Find the indicated IQ score. The graph depicts IQ scores of adults, and those scores are normally distributed with a mean of 100 and a standard deviation of 15 (as on the Wechsler test).

\[ X = \text{invnorm}(0.5675, 100, 15) \]
\[ 102.55 \]

The shaded area under the curve is 0.5675.

Solve the problem. Round to the nearest tenth unless indicated otherwise.

3) Scores on a test are normally distributed with a mean of 65.3 and a standard deviation of 10.3. Find \( P_{51} \), which separates the bottom 81% from the top 19%.

\[ P_{51} = \text{invnorm}(0.81, 65.3, 10.3) \]
\[ 74.3 \text{ or } 74.4 \]

Solve the problem.

4) The annual precipitation amounts in a certain mountain range are normally distributed with a mean of 91 inches, and a standard deviation of 14 inches. What is the probability that the mean annual precipitation during 49 randomly picked years will be less than 93.8 inches?

\[ X = 91 \]
\[ \sigma = 14 \]
\[ n = 49 \]

\[ P = \text{NormalCDF}(L, R, X, \frac{\sigma}{\sqrt{n}}) \]
\[ (0, 93.8, 91, \frac{14}{\sqrt{49}}) \]
\[ = 0.91924 \]
Estimate the indicated probability by using the binomial distribution.

5) A product is manufactured in batches of 120 and the overall rate of defects is 5%.
Estimate the probability that a randomly selected batch contains more than 6 defects.
\[
P = 0.05 \\
N = 120 \\
P(X > 6) = P(X^+ = 1 - P(X^-) = 1 - \binom{120}{6} p^6 (1-p)^{120-6}
\]
\[p = 3.9366\]

Solve the problem.

6) A normal quantile plot is given below for the weekly incomes (in dollars) of a sample of engineers in one town. Use the plot to assess the normality of the incomes of engineers in this town. Explain your reasoning.

Since the normal quantile plot displays curvature, it appears that the incomes of engineers in this town are probably not normally distributed.

Express the confidence interval using the indicated format.

7) Express the confidence interval 0.35 < p < 0.63 in the form of \( \hat{p} \pm E \).

\[
\hat{p} = 0.35 \\
\hat{p} + E = 0.63 \\
\hat{p} + E = 0.63 - (0.63 - 0.35)
\]
\[\hat{p} \pm E = 0.49 \pm 0.14\]
Statistics 50 Test 3 Chapters 6-7  Spring 2010 Page 3.

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion $p$.

8) $n = 72, x = 27; 95\%$ confidence

\[ \hat{p} = \frac{x}{n} = \frac{27}{72} = 0.375 \]

\[ 0.375 - 0.12 < p < 0.375 + 0.12 \]

\[ 0.263 < p < 0.487 \]

Find the indicated critical $z$ value.

9) Find the critical value $z_{\alpha/2}$ that corresponds to a $91\%$ confidence level.

\[ z_{0.05} = 1.645 \quad \text{or} \quad 1.70 \]

Use the given data to find the minimum sample size required to estimate the population proportion.

10) Margin of error: 0.04; confidence level: 95%; from a prior study, $\hat{p}$ is estimated by the decimal equivalent of 94%.

\[ E = 0.04 \]

\[ \alpha = 0.05 \]

\[ \hat{p} = 0.94 \]

\[ n = \frac{Z_{\alpha/2}^2 \hat{p} \left( 1 - \hat{p} \right)}{E^2} = \frac{(1.96)^2 (0.94)(0.06)}{(0.04)^2} = 136.4164 \]

Use the confidence level and sample data to find a confidence interval for estimating the population $\mu$. Round your answer to the same number of decimal places as the sample mean.

11) Test scores: $n = 76, \bar{x} = 53.0, \sigma = 5.5; 95\%$ confidence

\[ \bar{x} - E < \mu < \bar{x} + E \]

\[ 53.0 - 1.6 < \mu < 53 + 1.6 \]

\[ E = \frac{z_{\alpha/2} \sigma}{\sqrt{n}} = \frac{(2.326)(5.5)}{\sqrt{76}} = 1.574 \]

\[ 51.4 < \mu < 54.6 \]
Statistics 50 Test 3 Chapters 6-7 Spring 2010 Page 4.

Solve the problem.

12) Find the critical value $\chi^2_R$ corresponding to a sample size of 13 and a confidence level of 95 percent.

\[ n = 13 \]

\[ \chi^2_{0.05} = 23.337 \]

Find the appropriate minimum sample size.

13) You want to be 99% confident that the sample standard deviation $s$ is within 5% of the population standard deviation.

\[ \text{Table look up } P_{0.01} \]

\[ n = 1336 \]

Use the given degree of confidence and sample data to find a confidence interval for the population standard deviation $\sigma$. Assume that the population has a normal distribution. Round the confidence interval limits to one more decimal place than is used for the original set of data.

14) The football coach randomly selected ten players and timed how long each player took to perform a certain drill. The times (in minutes) were:

13 14 11 13 14
6 10 13 13 8

Find a 95% confidence interval for the population standard deviation $\sigma$.

\[ \frac{(n-1)s^2}{X_L^2} < \sigma < \frac{(n-1)s^2}{X_R^2} \]

\[ \frac{9(7.38)}{19.023} < \sigma < \frac{9(7.38)}{2.700} \]

\[ 1.86969... < \sigma < 4.9618... \]

\[ 1.9 < \sigma < 5.0 \]
Provide an appropriate response.

1) Suppose the claim is in the alternate hypothesis. What form does your conclusion take?
Suppose the claim is in the null hypothesis. What form does your conclusion take?
Alternate: The sample data supports or does not support the claim. Conclusion: 3 or 4
Null: The sample evidence warrants rejection or does not warrant rejection of the claim. Conclusion: 1 or 2

Express the null hypothesis and the alternative hypothesis in symbolic form. Use the correct symbol (μ, p, σ) for the indicated parameter.

2) Carter Motor Company claims that its new sedan, the Libra, will average better than 30 miles per gallon in the city. Use μ, the true average mileage of the Libra.
   A) H₀: μ > 30
   H₁: μ ≤ 30
   B) H₀: μ < 30
   H₁: μ > 30
   C) H₀: μ = 30
   H₁: μ < 30
   D) H₀: μ = 30
   H₁: μ > 30

Find the value of the test statistic z

3) A claim is made that the proportion of children who play sports is less than 0.5 and the sample statistics include n = 1200 subjects with 40% saying that they play a sport.
   H₀: p = 0.5
   H₁: p < 0.5
   n = 1200
   p̂ = 0.4

Find the value of the test statistic z

TS: \( z = -6.93 \)
CV: \( z = -1.645 \)
P: \( z = 2.14 \geq -12 \)
Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

4) The principal of a senior high school claims that test scores of the eleventh-graders at his school vary less than the test scores of the eleventh-graders at a neighboring school, which have variation described by $\sigma = 12.8$. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.

A) There is not sufficient evidence to support the claim that the standard deviation is less than 12.8.
B) There is not sufficient evidence to support the claim that the standard deviation is greater than 12.8.
C) There is sufficient evidence to support the claim that the standard deviation is less than 12.8.
D) There is sufficient evidence to support the claim that the standard deviation is greater than 12.8.

Identify the null hypothesis, alternative hypothesis, test statistic, $P$-value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

5) A supplier of digital memory cards claims that no more than 1% of the cards are defective. In a random sample of 600 memory cards, it is found that 3% are defective, but the supplier claims that this is only a sample fluctuation. At the 0.01 level of significance, test the supplier's claim that no more than 1% are defective.

$H_0 : P = .01$ (orig)

$H_1 : P > .01$

TS: $Z = 4.92$

CV: $Z = 2.326$

$P : 4.2533 \times 10^{-7}$

Treat $H_0$: Reject $H_0$

Conclusion: There is sufficient evidence to reject the claim that no more than 1% are defective.

Find the critical value or values of $\chi^2$ based on the given information.

6) $H_0 : \sigma = 8.0$

$n = 10$

$\alpha = 0.01$

$H_1 : \sigma \neq 8.0$

$t$-tail df $9$

$1.735, 23.589$
Test the given claim. Use the P-value method or the traditional method as indicated. Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) or P-value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

7) The mean resting pulse rate for men is 72 beats per minute. A simple random sample of men who regularly work out at Mitch's Gym is obtained and their resting pulse rates (in beats per minute) are listed below. Use a 0.05 significance level to test the claim that these sample pulse rates come from a population with a mean less than 72 beats per minute. Assume that the standard deviation of the resting pulse rates of all men who work out at Mitch's Gym is known to be 6.8 beats per minute. Use the traditional method of testing hypotheses.

54 60 66 84 74 64 69
70 66 80 59 71 76 63

\[ H_0 : \mu = 72 \]
\[ H_1 : \mu < 72 \text{ (original)} \]

\[ z = -2.04 \]
\[ TS : z = -1.668 \]
\[ CV : z = 1.771 \]

\[ z = -1.645 \]

Conclusion: #4. There is not sufficient sample evidence to support the claim that these sample pulse rates come from a population with a mean less than 72 beats per minute.

Use the traditional method to test the given hypothesis. Assume that the population is normally distributed and that the sample has been randomly selected.

8) When 12 bolts are tested for hardness, their indexes have a standard deviation of 41.7.

Test the claim that the standard deviation of the hardness indexes for all such bolts is greater than 30.0. Use a 0.025 level of significance.

\[ H_0 : \sigma = 30 \]
\[ H_1 : \sigma > 30 \text{ (original)} \]

\[ x^2 = 21.253 \]

Conclusion: #4. There is not sufficient sample evidence to support the claim that the standard deviation of the hardness indexes for all such bolts is greater than 30.0.
Find the number of successes \( x \) suggested by the given statement.

1) Among 880 people selected randomly from among the eligible voters in one city, 52.3% were homeowners.

\[
P = \frac{x}{n} \quad x = nP = (880)(0.523) = 460.24 \approx 460
\]

n = 460

Assume that you plan to use a significance level of \( \alpha = 0.05 \) to test the claim that \( p_1 = p_2 \). Use the given sample sizes and numbers of successes to find the \( z \) test statistic for the hypothesis test.

2) A report on the nightly news broadcast stated that 10 out of 145 households with pet dogs were burglarized and 23 out of 187 without pet dogs were burglarized.

\[
\hat{p}_1 = \frac{x_1}{n_1} = \frac{10}{145} = 0.069
\]

\[
\hat{p}_2 = \frac{x_2}{n_2} = \frac{23}{187} = 0.123
\]

\[
z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = -1.63
\]

\[
P = 0.10269
\]

Test the indicated claim about the means of two populations. Assume that the two samples are independent simple random samples selected from normally distributed populations. Do not assume that the population standard deviations are equal. Use the traditional method or \( P \)-value method as indicated.

3) A researcher wishes to determine whether people with high blood pressure can reduce their blood pressure, measured in mm Hg, by following a particular diet. Use a significance level of 0.01 to test the claim that the treatment group is from a population with a smaller mean than the control group. Use the traditional method of hypothesis testing.

\[
H_0 : \mu_1 = \mu_2
\]

\[
H_1 : \mu_1 < \mu_2 \quad \text{(original)}
\]

\[
\bar{x}_1 = 120.5 \quad s_1 = 17.4
\]

\[
\bar{x}_2 = 149.3 \quad s_2 = 30.2
\]

\[
\text{Diff.} = 167 \quad \text{or} \quad |t| = 100
\]

\[
t = -8.426 \quad \text{or} \quad t = -2.345
\]

\[
CV : t = \pm 2.364
\]

\[
\text{or anything between}
\]

\[
\alpha = 0.01
\]

\[
P = 0.0092
\]

\[
\bar{X} = 120.5 - 22.05 = -38.55
\]

\[
-38.55 < \mu_1 - \mu_2 < -22.05
\]
Use the computer display to solve the problem.

4) When testing for a difference between the means of a treatment group and a placebo group, the computer display below is obtained. Using a 0.05 significance level, is there sufficient evidence to support the claim that the treatment group (variable 1) comes from a population with a mean that is different from the mean for the placebo population?

\[ H_0: \mu_1 = \mu_2 \]
\[ H_1: \mu_1 \neq \mu_2 \text{ (original)} \]
\[ \alpha = 0.05 \]
\[ t = -1.77 \]
\[ t \text{-critical} = \pm 1.96 \]

Fail to reject \( H_0 \)

\[ P = 0.0748 > 0.05 = \alpha \]
\[ P > \alpha \]

Fail to reject \( H_0 \)

\[ t < t \text{-critical} \]

Test the indicated claim about the variances or standard deviations of two populations. Assume with a mean that both samples are independent simple random samples from populations having normal distributions.

5) A random sample of 16 women resulted in blood pressure levels with a standard deviation of 22.7 mm Hg. A random sample of 17 men resulted in blood pressure levels with a standard deviation of 20.1 mm Hg. Use a 0.05 significance level to test the claim that blood pressure levels for women vary more than blood pressure levels for men.

\[ H_0: \sigma_1 = \sigma_2 \]
\[ H_1: \sigma_1 > \sigma_2 \text{ (original)} \]

\[ \sigma_1 = \text{standard deviation for women} \]
\[ \sigma_2 = \text{standard deviation for men} \]

\[ F = \frac{S_1^2}{S_2^2} = \frac{22.7^2}{20.1^2} = 1.2754 \]

\[ P \]
Assume that you want to test the claim that the paired sample data come from a population for which the mean difference is \( \mu_d = 0 \). Compute the value of the \( t \) test statistic. Round intermediate calculations to four decimal places as needed and final answers to three decimal places as needed.

\[
\begin{array}{cccccccc}
\text{x} & 6.8 & 5.4 & 3.6 & 9.7 & 5 & 11.3 & 8.1 & 5.7 \\
\text{y} & 5 & 5.1 & 4.7 & 5 & 5.4 & 6 & 4.2 & 4
\end{array}
\]

\( \alpha = 0.05 \) 2 tail  
\( n = 8 \)  
\( df = 7 \)

A) \( H_0 : \mu_d = 0 \) (Original)

1. \( H_1 : \mu_d \neq 0 \)

2. \( TS : t = 2.391 \)

3. \( CV : t = \pm 2.365 \)

4. \( P : \quad 0.04811 < 0.05 = \alpha \)

Treat \( H_0 \): Reject \( H_0 \)

Conclusion: There is sufficient evidence to warrant rejection of the claim that the paired data come from a population for which the mean difference \( \mu_d = 0 \).

Construct a confidence interval for \( \mu_d \), the mean of the differences \( d \) for the population of paired data. Assume that the population of paired differences is normally distributed.

6) B) \( 0.2216, 4.0278 \)

\( 0.62 < \mu_d < 4.03 \)
Provide an appropriate response.

1) A set of data consists of the number of years that applicants for foreign service jobs have studied German and the grades that they received on a proficiency test. The following regression equation is obtained: \( \hat{y} = 31.6 + 10.9x \), where \( x \) represents the number of years of study and \( y \) represents the grade on the test. What does the slope of the regression line represent in terms of grade on the test?

The marginal change is how will one additional year of study increase the score on the test. The grade on the test increases by an estimated 10.9 points for each additional year of study.

Given the linear correlation coefficient \( r \) and the sample size \( n \), determine the critical values of \( r \) and use your finding to state whether or not the given \( r \) represents a significant linear correlation. Use a significance level of 0.05.

2) \( r = 0.898, n = 9 \)

\[ n = 9 \quad x = 0.05 \]

\( r = +0.666 \)

Conclusion: \( r = 0.898 \) is significant

Find the value of the linear correlation coefficient \( r \).

3) The paired data below consist of the costs of advertising (in thousands of dollars) and the number of products sold (in thousands):

<table>
<thead>
<tr>
<th>Cost</th>
<th>9</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>2</th>
<th>5</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>85</td>
<td>52</td>
<td>55</td>
<td>68</td>
<td>67</td>
<td>86</td>
<td>83</td>
<td>73</td>
</tr>
</tbody>
</table>

\[ r = 0.708 \]

\[ (\bar{x}, \bar{y}) = (55, 71.1) \]

The standard error of estimate = 10.0

The equation of the regression line is \( \hat{y} = 55.8 + 2.79x \)

Is the data point, \( P \), an outlier, an influential point, both, or neither?

4) The regression equation for a set of paired data is \( \hat{y} = 38.4 + 0.9x \). The values of \( x \) run from 100 to 400. A new data point, \( P(375, -299.1) \), is added to the set.

A) Neither  
B) Influential point  
C) Outlier  
D) Both

Use the given information to find the coefficient of determination.

5) A regression equation is obtained for a collection of paired data. It is found that the total variation is 128.6, the explained variation is 84, and the unexplained variation is 44.6.
Find the coefficient of determination.

\[ r^2 = \frac{84}{128.6} = 0.653 \]

Use the given data to find the best predicted value of the response variable.

6) Six pairs of data yield \( r = 0.444 \) and the regression equation \( \hat{y} = 5x + 2 \). Also, \( \bar{y} = 18.3 \).
What is the best predicted value of \( y \) for \( x = 5? \)

\[ T \quad r = 0.444 \]
\[ CV \quad r = 0.811 \]

Use the computer display to answer the question.

7) A collection of paired data consists of the number of years that students have studied Spanish and their scores on a Spanish language proficiency test. A computer program was used to obtain the least squares linear regression line and the computer output is shown below. Along with the paired sample data, the program was also given an \( x \) value of 2 (years of study) to be used for predicting test score.

The regression equation is

\[ \text{Score} = 31.55 + 10.90 \times \text{Years} \]

\[ \text{Predictor} \quad \text{Coeff} \quad \text{StDev} \quad T \quad P \]
\[ \text{Constant} \quad 31.55 \quad 6.360 \quad 4.96 \quad 0.000 \]
\[ \text{Years} \quad 10.90 \quad 1.744 \quad 6.25 \quad 0.000 \]

\[ S = 5.651 \quad R-Sq = 83.0\% \quad R-Sq (Adj) = 82.7\% \]

Predicted values

\[ \text{Fit} \quad \text{StDev Fit} \quad 95.0\% \text{ CI} \quad 95.0\% \text{ PI} \]
\[ 53.35 \quad 3.168 \quad (42.72, 63.98) \quad (31.61, 75.09) \]

If a person studies 4.5 years, what is the single value that is the best predicted test score? Assume that there is a significant linear correlation between years of study and test score.

\[ Y = 80.6 \]
Use the given data to find the equation of the regression line. Round the final values to three significant digits, if necessary.

\( 8) \begin{array}{c|cccc}
\times & 6 & 8 & 20 & 28 & 36 \\
y & 2 & 4 & 13 & 20 & 30 \\
\end{array} \quad 2 \quad r = \frac{995}{2} \quad 2 \quad r^2 = \frac{989}{2} \quad 2 \quad (\bar{x}, \bar{y}) = (19.6, 13.6) \quad (19.6, 13.6) \\

2. The standard error of estimate \( \hat{e} = 1.40 \)

2. The equation of the regression line is \( \hat{y} = 3.79 + .897x \)

22

\( H_0: \rho = 0 \quad \text{2. } P: 4.666 \times 10^{-4} \quad \text{2. } \text{Treat } H_0: \text{ reject } H_0 \)

2. \( H_1: \rho \neq 0 \quad \text{2. Conclusion: The Correlation} \)

2. TS: \( t = 4.476 \quad \text{is significant} \)

2. CV: \( t = \pm 3.182 \)

9) Among the four northwestern states, Washington has 51% of the total population, Oregon has 30%, Idaho has 11%, and Montana has 8%. A market researcher selects a sample of 1000 subjects, with 450 in Washington, 340 in Oregon, 150 in Idaho, and 60 in Montana. At the 0.05 significance level, test the claim that the sample of 1000 subjects has a distribution that agrees with the distribution of state populations.

\( H_0: \text{Distribution agrees with population} \quad \text{1. } H_0: \text{agree} \quad \text{1. } H_1: \text{disagree} \)

\( H_1: \text{Distribution does not agree} \quad \text{2. } \text{TS: } 31.938 \)

2. CV: 7.815

2. P: 5.394 \times 10^{-7} 

2. Treat \( H_0: \text{ reject } H_0 \)

2. Conclusion: Conclude. There is sufficient evidence to warrant rejection of the claim that the sample of 1000 subjects has a distribution that agrees with the distribution of the state populations.
Use a $\chi^2$ test to test the claim that in the given contingency table, the row variable and the column variable are independent.

10) Responses to a survey question are broken down according to employment status and the sample results are given below. At the 0.10 significance level, test the claim that response and employment status are independent.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Undecided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td>30</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Unemployed</td>
<td>20</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>

$H_0$: \underline{Response and employment independent (original)}

$H_1$: \underline{Response and employment are dependent}

TS: $\chi^2 = 5.42$

CV: $\chi^2 = 4.605$

$P = 0.512 \leq 0.10 = \alpha$

1. Treat $H_0$: Reject $H_0$

2. Conclusion: There is sufficient evidence to warrant rejection of the claim that response and employment are independent.
Given below are the analysis of variance results from a Minitab display. Assume that you want to use a 0.05 significance level in testing the null hypothesis that the different samples come from populations with the same mean.

1) Find the critical value.

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>3</td>
<td>13.50</td>
<td>4.500</td>
<td>5.17</td>
<td>0.011</td>
</tr>
<tr>
<td>Error</td>
<td>16</td>
<td>13.925</td>
<td>0.870</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>27.425</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Find the critical value. \[ F_{16,0.05} = 3.2389 \]

What can you conclude about the equality of the population means?

A) Accept the null hypothesis since the \( p \)-value is less than the significance level.
B) Reject the null hypothesis since the \( p \)-value is greater than the significance level.
C) Reject the null hypothesis since the \( p \)-value is less than the significance level.
D) Accept the null hypothesis since the \( p \)-value is greater than the significance level.

Test the claim that the samples come from populations with the same mean. Assume that the populations are normally distributed with the same variance.

2) Given the sample data below, test the claim that the populations have the same mean.

Use a significance level of 0.05.

<table>
<thead>
<tr>
<th>Brand</th>
<th>( n = 16 )</th>
<th>( \bar{x} )</th>
<th>( s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.09</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>3.48</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1.86</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>2.84</td>
<td>0.53</td>
<td></td>
</tr>
</tbody>
</table>

\[ F = \frac{\frac{\bar{x}_A^2}{s_A^2}}{\frac{\bar{x}_B^2}{s_B^2}} = \frac{16(0.54516)}{2.481} = 35.1573 \]

\[ F_{0.05} = 2.7581 \]

\[ P = 3.0573 \times 10^{-13} \]

Treat \( H_0 \): Reject \( H_0 \)

Conclusion: There is sufficient evidence to warrant rejection of the claim that the populations have the same mean.
3) At the 0.025 significance level, test the claim that the four brands have the same mean if the following sample results have been obtained.

<table>
<thead>
<tr>
<th>Brand A</th>
<th>Brand B</th>
<th>Brand C</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>20</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>21</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>22</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>21</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>37</td>
<td></td>
<td>29</td>
</tr>
</tbody>
</table>

1. $H_0 : \mu_A = \mu_B = \mu_C = \mu_D$
2. $F_{0.025} = 4.8567$

$\text{CV: } F = \frac{S^2}{ \text{MS}_p }$

1. $H_1 : \text{At least one } \mu_i \neq \mu_j$
2. $P : 1.6934 > \alpha = .025$

$\text{TS: } 79.88$

Compare P to $\alpha$

Fail to reject $H_0$

---

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares (SS)</th>
<th>Degrees of Freedom</th>
<th>Mean Square (MS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>405.5490</td>
<td>2</td>
<td>207.7745</td>
</tr>
<tr>
<td>Error</td>
<td>355.3</td>
<td>14</td>
<td>25.30895</td>
</tr>
<tr>
<td>Total</td>
<td>395.8833</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

$\bar{x}_A = \frac{6}{50} = 0.12$
$\bar{x}_B = \frac{23}{14} = 1.64$
$\bar{x}_C = \frac{22}{14} = 1.57$
$\bar{x}_D = \frac{15}{6} = 2.50$

Equation Development

$\bar{x} = \sum \bar{x}_i / n = 23.647$

$F = \frac{\sum (n_i - 1) s_i^2}{k-1}$

$F = \frac{6(23 - 23.647)^2 + 5(22 - 23.647)^2 + 6(25.7 - 23.647)^2}{17 - 3}$

$= \frac{5(50) + 4(14.5) + 6(9.46)}{14}$

$= \frac{569}{14}$

1. $\text{Treat } H_0: \text{ Fail to reject } H_0$
2. $\text{Conclusion: There is not sufficient evidence to warrant rejection of the claim that the brands have the same mean.}$
Use the Minitab display to test the indicated claim.

4) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

<table>
<thead>
<tr>
<th>Employee</th>
<th>Machine</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
<td>23, 27, 29</td>
<td>30, 27, 25</td>
<td>18, 20, 22</td>
</tr>
<tr>
<td>II</td>
<td>III</td>
<td>25, 26, 24</td>
<td>24, 29, 26</td>
<td>19, 16, 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28, 25, 26</td>
<td>25, 27, 23</td>
<td>15, 11, 17</td>
</tr>
</tbody>
</table>

**ANALYSIS OF VARIANCE ITEMS**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine</td>
<td>2</td>
<td>34.66</td>
<td>17.33</td>
<td>3.1857</td>
</tr>
<tr>
<td>Employee</td>
<td>2</td>
<td>504.67</td>
<td>252.33</td>
<td>46.3851</td>
</tr>
<tr>
<td>Interaction</td>
<td>4</td>
<td>26.68</td>
<td>6.67</td>
<td>1.2261</td>
</tr>
<tr>
<td>Error</td>
<td>18</td>
<td>97.42</td>
<td>5.44</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>663.93</td>
<td></td>
<td>664</td>
</tr>
</tbody>
</table>

5) Assume that the number of items produced is not affected by an interaction between employee and machine. Using a significance level, test the claim that the machine has no effect on the number of items produced.

H₀: Machine has no effect (\( \text{Org} \))

H₁: Machine has an effect

\( \text{TS} = 3.1857 \)

\( \text{P-value} = F_{df, \text{d}_{n}, \text{d}_{fa}}(3.1857, 200, 2, 18) \)

\( F_{0.05} = 3.5546 \)

\( P = 0.0639 \)

Treat \( H₀ \): Fail to reject \( H₀ \)

Conclusion: There is not sufficient evidence to warrant rejection of the claim that machine has no effect on the number of items produced.
Use the rank correlation coefficient to test for a correlation between the two variables.

6) Given that the rank correlation coefficient, \( r_s \), for 76 pairs of data is -0.526, test the claim of correlation between the two variables. Use a significance level of 0.05.

\[ H_0 : \rho_s = 0 \]
\[ H_1 : \rho_s \neq 0 \]

1. \( TS : V_s = -1.526 \)
2. \( CV : V_s = \pm 2.26, \quad V_s = \pm \frac{z_{0.025}}{\sqrt{n-1}} \)

1. Treat \( H_0 : \) reject \( H_0 \)
2. Conclusion: The rank order correlation is significant.

7) A placement test is required for students desiring to take a finite mathematics course at a university. The instructor of the course studies the relationship between students' placement test score and final course score. A random sample of eight students yields the following data.

<table>
<thead>
<tr>
<th>Placement Score</th>
<th>Final Course Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td>63</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>51</td>
</tr>
<tr>
<td>8</td>
<td>93</td>
</tr>
<tr>
<td>6</td>
<td>74</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>89</td>
</tr>
</tbody>
</table>

Compute the rank correlation coefficient, \( r_s \), of the data and test the claim of correlation between placement score and final course score. Use a significance level of 0.05.

1. \( H_0 : \rho_s = 0 \)
2. \( H_1 : \rho_s \neq 0 \)
3. \( CV : V_s = \pm 1.738 \)
4. \( TS : -1.167 \)

1. Treat \( H_0 : \) fail to reject \( H_0 \)
2. Conclusion: The rank order correlation is not significant.