

### Case 1: Watchdog, Inc: Keeping hospitals honest

Insurance companies hire independent firms like Watchdog, Inc to review their hospital bills. They pay Watchdog a percentage of the overcharges it finds. Suppose Watchdog selects a pilot random sample of 5 bills to estimate the mean amount of overcharges it can expect to find.

Amount of overcharge (in \$100): 5, 8, 13, 8, 6

1. The mean error in billing (in hundreds) for the sample is
  - a. 7.0
  - b. 7.5
  - c. 8.0
  - d. 8.5
  
2. The median error in billing (in hundreds) of the sample is
  - a. 13
  - b. 8
  - c. 8.5
  - d. 9.0
  
3. Assume the sample mean is 8. The sample standard deviation is
  - a. 5.3
  - b. 3.1
  - c. 2.8
  - d. 3.6
  
4. Assume that the sample mean based on the sample of 5 bills was 9.0 and the sample standard deviation was 2.24. Construct a 90% confidence interval for the mean amount overcharged for this group of hospital bills. Does your confidence interval suggest that the mean amount overcharged per bill for this group of hospital bills is less than 10, i.e., less than \$1000?
  - a. Yes, because the upper limit of the confidence interval is greater than 10.
  - b. No, because the upper limit of the confidence interval is greater than 10.
  - c. Yes, because the lower limit of the confidence interval is less than 10.
  - d. No, because the lower limit of the interval is greater than 10.

**Case 2: New City, Georgia: Curbing the drug problem of public employees.**

Under pressure from concerned citizens, the New City Council is considering requiring all public employees to submit to random drug testing using a new test developed by a local medical company. As evidence of the effectiveness of the test, the company provides the test results of 1000 subjects. of the 1000 tested, 200 were known drug users and 800 where known not to use drugs.

		Drug User		Total
		Yes	No	
Test result	Yes	180	160	340
	No	20	640	660
Total		200	800	1000

5. What proportion of the people whose test results are NO, are NOT drug users?  
 a. 0.03      b. 0.10      c. 0.64      d. 0.97
  
6. What proportion of the people have test result NO and are NOT drug users?  
 a. 0.03      b. 0.10      c. 0.64      d. 0.97
  
7. To determine whether drug use and the drug test are statistically associated, one would evaluate which of the following pairs of expressions?  
 a. Among the people who are drug users, the proportion who have test results NO. AND Among the people who are NOT drug users, the proportion who have test results NO.  
 b. The proportion of people whose test results are NO. AND The proportion who are NOT drug users.  
 c. Among the people who have test results NO, the proportion who are drug users. AND Among the people who have test results NO, the proportion who are NOT drug users.  
 d. The proportion of people who are NOT drug users. AND The proportion of people who are drug users.
  
8. Suppose the medical company performed a chi-square test of no relationship between drug use and a drug test on the data. Calculate the expected number of subjects who are drug users AND the test result is YES (under the null hypothesis of no relationship).  
 a. 68      b. 76      c. 160      d. 180

**Case 3: ARCO Inc. Determining accident rates**

ARCO has kept records over the past 60 months of the number of Workers Compensation accidents it has had in its plants. The data distribution are shown below.

Accidents Per Month	0	1	2	3
#of Months of Occurrences	30	21	6	3

9. Based on this empirical distribution, in what proportion of the months did more than one accident occur?  
a. 9    b. 0.15    c. 0.50    d. 0.35
10. How would you describe the shape of the distribution of accidents per month?  
a. bell-shaped    b. skewed right    c. contains outlier(s)    d. all of the above

**Case 4: ABC Industries: Improving job satisfaction.**

ABC Industries undertook a training program to improve perceived job satisfaction. Its goal was to increase the perceived job satisfaction score of its employees to a mean level above 70 on a scale from 0 to 100. After the program the company sends letters to a random sample of 36 of its employees and finds that the mean satisfaction score is 74 with a sample standard deviation of 9. The firm decides to use an  $\alpha=0.05$  significance level.

11. The appropriate null and alternative hypotheses would be:  
a.  $H_0: \mu = 74$                       vs         $H_a: \mu > 74$   
b.  $H_0: \mu = 70$                       vs         $H_a: \mu > 70$   
c.  $H_0: \bar{x} = 74$                       vs         $H_a: \bar{x} > 74$   
d.  $H_0: \mu > 70$                       vs         $H_a: \mu = 70$
12. Given the sample data, ABC should use what estimated standard error?  
a. 10            b. 9            c. 6            d. 1.5
13. If ABC made a type-I error this would translate to  
a. concluding incorrectly that the training program had failed.  
b. concluding incorrectly that the training program was a success.  
c. concluding the mean is above 74 when it is not.  
d. concluding the mean is not above 74 when it is.
14. Given the sample data, ABC should  
a. reject the null hypothesis  
b. fail to reject the null hypothesis  
c. reject the alternative hypothesis  
d. fail to reject the alternative hypothesis
15. Assume that from the data ABC calculates  $t=2.67$  for an upper tail one-sided alternative hypothesis. Which of the following best describes the (conservative relative to the sample size) P-value for the test?  
a.  $P\text{-value} < 0.10$     b.  $P\text{-value} < 0.05$     c.  $P\text{-value} < 0.01$     d.  $P\text{-value} < 0.001$

**Case 5 calculators serviced: TV Associates: How much time do Atlantans watch TV?**

TV Associates has been hired by a local TV station WQXX to estimate the proportion of viewers that watch one of its local programs. TV Associates conducts a telephone survey while the program is being aired. Of the 400 households contacted, 88 said they were watching the program.

16. Construct a 95% confidence interval for the population proportion of TV watches who watch the local program.

- a. (0.13, 0.31)    b. (0.18, 0.26)    c. (0.16, 0.28)    d. (0.17, 0.27)

17. Which of the following best interprets the meaning of the confidence interval for the population proportion?

- a. With repeated sampling, 95% of all sample proportions will fall within the confidence interval.  
b. 95% of the time the sample proportion will fall within the confidence interval.  
c. I am 95% confident that the population proportion will be at the center of the confidence interval.  
d. 95% of the confidence intervals will contain the population proportion

**Case 6: The Drive to Work**

A person who commutes to work by automobile believes that the time required to make the trip is a normally distributed random variable with a mean of 35 minutes and a standard deviation of 5 minutes.

18. What is the probability that the trip will require more than 45 minutes?

- a. 0.4772            b. 0.9500            c. 0.0228            d. 0.9772

19. If the person intends to record the times spent traveling to work over the a random sample of 25 days, what is the probability that the sample mean based on these 25 drive times will be less than 32 minutes?

- a. 0.0013    b. 0.2257    c. 0.2743    d. 0.4987

### Case 7: Training Associates: Does training work?

Training specialists compared two groups of employees—a group of trained employees and a group of untrained employees. The training specialists measured the hourly productivity for each subject. The sample sizes, the sample means, and the sample standard deviations for the two groups are given below.

<u>Group</u>	<u>n</u>	<u>Mean</u>	<u>Standard deviation</u>
trained employees	16	4.2	0.6
untrained employees	16	3.7	0.8

The training specialists wished to test the hypotheses

Ho: the mean productivity for trained employees and untrained employees are the same

Ha: the mean productivity for trained employees is larger than for the mean productivity for untrained employees

20. The data showed no strong outliers or strong skewness, so the training specialists decided to use the two-sample  $t$  test. The value of the two-sample  $t$  test statistic is

- a. 0.25      b. 0.5      c. 2.0      d. 4.0

21. A 90% confidence interval for  $\mu_{\text{trained}} - \mu_{\text{untrained}}$  is (use the conservative value for the degrees of freedom)

- a.  $0.5 \pm 0.011$       b.  $0.5 \pm 0.25$       c.  $0.5 \pm 0.44$       d.  $0.5 \pm 1.753$

22. Assume that 99% confidence interval for  $\mu_{\text{trained}} - \mu_{\text{untrained}}$  is  $(-0.30, 1.30)$ .

Correspondingly, the Training Associates' management should conclude which of the following with a high degree of confidence?

- a. The training has been successful since the upper confidence limit is above 0.  
b. The training may be unsuccessful since the upper confidence limit is above 0.  
c. The training has been successful since the lower confidence limit is above 0.  
d. The training may be unsuccessful since the lower confidence limit is below 0.

### Case 8: Important statistical concepts

23. Which of the following basic principles of sampling is LEAST valid?
- Sample statistics should be gathered from normal or near-normal populations.
  - Population parameters are fixed but unknown values.
  - We estimate population parameters by using corresponding sample statistics.
  - As sample size increases the standard error of the sample statistic decreases.
  - Confidence intervals show how much different a sample statistic might be from the population parameter
24. A radio show runs a phone-in survey each morning. One morning the show asked its listeners whether they would prefer Congress or the President to set policy for the nation. The majority of those phoning in their responses answered "Congress," and the station reported the results as statistically significant. We may safely conclude
- there is deep discontent in the nation with the President.
  - it is unlikely that, if all Americans were asked their opinion, the result would differ from that obtained in the poll.
  - there is strong evidence that the majority of Americans prefer Congress to set national policy.
  - very little other than the majority of those phoning in their responses preferred Congress to set policy for the nation.
25. In order to have a correlation coefficient between traits A and B, it is necessary to have:
- one group of subjects, some of whom possess characteristics of trait A, the remainder possessing those of trait B
  - measures of trait A on one group of subjects and of trait B on another group
  - two groups of subjects, one which could be classified as A or not A, the other as B or not B
  - measures of traits A and B on each subject in one group

### Case 9: Tri-City Equipment Corporation

The Tri-City Office Equipment Corporation sells a desk calculator on a franchise basis and performs preventive maintenance and repair service on this calculator. A company analyst believe there is a linear relationship between the number of minutes required on a customer service call and the number of calculators serviced. The fitted least squares regression line is

$$\text{MINUTES} = 10.2 + 13.0 \text{ CALCULATORS}$$

26. Based on this model, how would you characterize the relationship between the number of calculators serviced and the number of minutes to complete customer service call?
- The average time to complete a service call increases by 13 minutes for each additional calculator serviced.
  - The average time to complete a service call increases by 10.2 minutes for each additional calculator serviced.
  - The average time to complete a service call increases by 23.2 minutes for each additional calculator serviced.
  - Servicing 10 calculators requires an average of 130 minutes.
27. The correlation squared ( $r^2$ ) is equal to 0.85. This means that
- 85 percent of the variability in the number of calculators serviced is explained.
  - The correlation between minutes to complete a service call and number of calculators serviced is 0.85.
  - 85 percent of the variation in the number of minutes to complete a job is explained by the number of calculators serviced.
  - 15 percent of the variation in the number of calculators serviced is unexplained.
28. The next service call requires that 5 calculators must be serviced. The expected time to complete the call is how many minutes?
- a. 65      b. 75.2      c. 15.0      d. 20.3
29. The model predicted that particular service call would require 55 minutes but actually the service call required 50 minutes. Which statement is true for this service call.
- The residual is -5 minutes.
  - The service call is an outlier.
  - The number of calculators serviced was 6.
  - The correlation is negative.