

### Text Exercise Set 22

**22-1** During the lunch hour on weekdays in a certain restaurant, 20% of the customers order dessert. One particular week employees are specifically instructed to state the dessert choices and ask customers if they wish to order to dessert, whenever an order is placed, to see if the percentage ordering dessert is increased. It is found that 148 customers order dessert out of 588 who were asked if they wish to order to dessert. These customers are treated as a simple random sample for a hypothesis test to see if there is any evidence that the proportion of customers who order dessert is greater than 0.2. A 0.01 significance level is selected.

(a) Complete the four steps of the hypothesis test by completing the following:

Step 1  $H_0$ :

$H_1$ :

$\alpha =$

Step 2

Step 3

Step 4

- (b) Verify that the sample size is sufficiently large for the  $z$  statistic to be appropriate.
- (c) Considering the results of the hypothesis test, decide which of the Type I or Type II errors is possible, and describe this error.
- (d) Decide whether  $H_0$  would have been rejected or would not have been rejected with each of the following significance levels: (i)  $\alpha = 0.05$ , (ii)  $\alpha = 0.10$ .
- (e) In the list below, circle the best graphical display for this data and say why.
- (i) bar or pie chart      (ii) scatter plot      (iii) box plot

**22-2** A 0.05 significance level is selected for a hypothesis test to see if there is any evidence that the percentage of patrons of an ice cream parlor who favor strawberry ice cream is less than 25%. A simple random sample of 378 patrons are surveyed, and 68 are found to favor strawberry ice cream.

(a) Complete the four steps of the hypothesis test by completing the following:

Step 1  $H_0$ :

$H_1$ :

$\alpha =$

Step 2

Step 3

Step 4

- (b) Verify that the sample size is sufficiently large for the  $z$  statistic to be appropriate.
- (c) Considering the results of the hypothesis test, decide which of the Type I or Type II errors is possible, and describe this error.
- (d) Decide whether  $H_0$  would have been rejected or would not have been rejected with each of the following significance levels: (i)  $\alpha = 0.01$ , (ii)  $\alpha = 0.10$ .
- (e) In the list below, circle the best graphical display for this data and say why.
- (i) bar or pie chart      (ii) scatter plot      (iii) box plot

**22-3** A 0.01 significance level is chosen to see if there is any evidence that the mean time female voters spend watching TV weekly is different from 12 hours. The 15 females selected for the SURVEY DATA, displayed as Data Set A.1 in the appendix, are treated as a simple random sample. This sample of weekly TV times in hours is as follows:

20 18 10 8 12 8 11 8 9 9 6 11 5 8 10

(a) Complete the four steps of the hypothesis test by completing the following:

Step 1  $H_0$ :

$H_1$ :

$\alpha =$

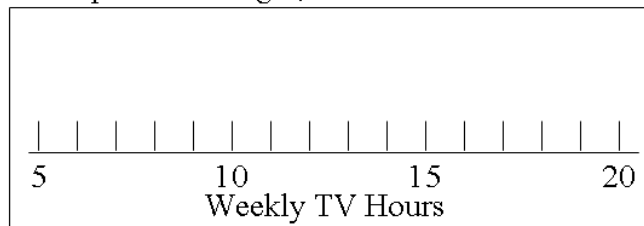
Step 2

Step 3

Step 4

(b) Why would a box plot be an appropriate graphical display for the data used in this hypothesis test?

(c) Complete the construction of the box plot on the right, and comment on whether the  $t$  statistic appears to be appropriate.



(d) Considering the results of the hypothesis test, decide which of the Type I or Type II errors is possible, and describe this error.

(e) Decide whether  $H_0$  would have been rejected or would not have been rejected with each of the following significance levels: (i)  $\alpha = 0.05$ , (ii)  $\alpha = 0.10$ .

**22-4** A 0.10 significance level is chosen to decide if the mean time male voters in a state spend watching TV weekly is greater than 10 hours. The 15 males selected for the SURVEY DATA, displayed as Data Set A.1 in the appendix, are treated as a simple random sample. This sample of weekly TV times in hours is as follows:

15 12 14 11 12 21 18 17 8 27 14 15 10 13 9

(a) Complete the four steps of the hypothesis test by completing the following:

Step 1  $H_0$ :

$H_1$ :

$\alpha =$

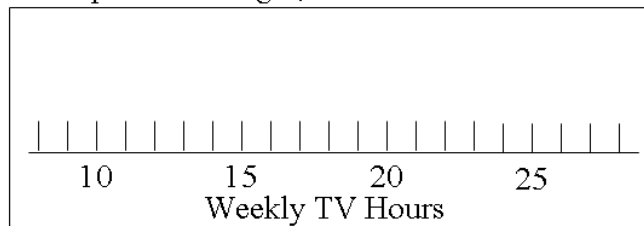
Step 2

Step 3

Step 4

(b) Why would a box plot be an appropriate graphical display for the data used in this hypothesis test?

(c) Complete the construction of the box plot on the right, and comment on whether the  $t$  statistic appears to be appropriate.



(d) Considering the results of the hypothesis test, decide which of the Type I or Type II errors is possible, and describe this error.

(e) Decide whether  $H_0$  would have been rejected or would not have been rejected with each of the following significance levels: (i)  $\alpha = 0.01$ , (ii)  $\alpha = 0.05$ .

**22-5** The mean weight of raisins per box on an assembly line is supposed to be 8 ounces. A 0.05 significance level is chosen for a hypothesis test to see if there is any evidence that the mean weight of raisins per box is less than 8 ounces. In a simple random sample of 60 boxes of raisins, the mean weight of raisins per box is found to be 7.89 ounces, and the standard deviation is found to be 0.41 ounces.

(a) Complete the four steps of the hypothesis test by completing the following:

Step 1  $H_0$ :

$H_1$ :

$\alpha =$

Step 2

Step 3

Step 4

(b) In the list below, circle the best graphical display for this data and say why.

(i) bar or pie chart      (ii) scatter plot      (iii) box plot

(c) Considering the results of the hypothesis test, decide which of the Type I or Type II errors is possible, and describe this error.

(d) Decide whether  $H_0$  would have been rejected or would not have been rejected with each of the following significance levels: (i)  $\alpha = 0.01$ , (ii)  $\alpha = 0.10$ .

(e) What would the presence of one or more outliers in the data suggest about using the  $t$  statistic?

**22-6** A 0.05 significance level is chosen for a hypothesis test to see if there is any evidence that the mean nicotine content per cigarette for a particular brand of cigarettes is greater than 25 milligrams. In a simple random sample of 20 cigarettes, the mean nicotine content per cigarette is found to be 25.80 milligrams, and the standard deviation is found to be 1.83 milligrams.

(a) Complete the four steps of the hypothesis test by completing the following:

Step 1  $H_0$ :

$H_1$ :

$\alpha =$

Step 2

Step 3

Step 4

(b) In the list below, circle the best graphical display for this data and say why.

(i) bar or pie chart      (ii) scatter plot      (iii) box plot

(c) Considering the results of the hypothesis test, decide which of the Type I or Type II errors is possible, and describe this error.

(d) Decide whether  $H_0$  would have been rejected or would not have been rejected with each of the following significance levels: (i)  $\alpha = 0.01$ , (ii)  $\alpha = 0.10$ .

(e) What would the presence of one or more outliers in the data suggest about using the  $t$  statistic?

**22-7** Suppose the hypothesis test  $H_0: \mu = 10$  vs.  $H_1: \mu > 10$  was being performed with  $\alpha = 0.05$ .

- (a) If you were told that  $\bar{x} = 11.1$ , explain why you do not have enough information to know whether or not  $H_0$  is rejected.
  
- (b) If you were told that  $\bar{x} = 8.9$ , explain why this is enough information to know that  $H_0$  will not be rejected.

**22-8** Suppose the hypothesis test  $H_0: \lambda = 0.5$  vs.  $H_1: \lambda < 0.5$  was being performed with  $\alpha = 0.05$ .

- (a) If you were told that  $\bar{p} = 0.475$ , explain why you do not have enough information to know whether or not  $H_0$  is rejected.
  
- (b) If you were told that  $\bar{p} = 0.525$ , explain why this is enough information to know that  $H_0$  will not be rejected.

**22-9** Decide whether each situation described is addressing statistical significance or clinical significance, and write the appropriate answer after each description.

- (a) After a campaign to increase dessert sales at a restaurant, it is concluded that the increase in the proportion of customers who order dessert will not substantially increase profits.
- (b) After a series of commercials advertising the variety of ice cream flavors at an ice cream parlor, the results of a hypothesis test indicate that the percentage of patrons who favor raspberry swirl ice cream has increased.
- (c) After a campaign to encourage smoking employees of a certain company to quit smoking, the results of a hypothesis test indicate that there has been no reduction in mean weekly nicotine intake per smoker.
- (d) After an advertising campaign to promote a morning radio program, the increase in mean time people spend listening to the program has convinced a department store owner to become one of the sponsors in order to increase sales.

**22-10** Circle the number of the response which correctly completes each statement.

- (a) A null hypothesis is rejected when the test statistic from a simple random sample falls
- (i) within the bounds we expect from sampling error if the null hypothesis were really true.
  - (ii) outside the bounds we expect from sampling error if the null hypothesis were really true.
  - (iii) within the bounds we expect from sampling error if the alternative hypothesis were really true.
  - (iv) outside the bounds we expect from sampling error if the alternative hypothesis were really true.
- (b) The  $p$ -value from a hypothesis test is often be treated as a measure of
- (i) the significance level.
  - (ii) how strongly the observed data supports the alternative hypothesis.
  - (iii) how strongly the observed data supports the null hypothesis.
  - (iv) the probability of making a type II error.
- (c) If  $0.01 < p\text{-value} < 0.05$  in a hypothesis test where  $\alpha = 0.01$ , then we can be certain that the results of the test are
- (i) clinically significant.
  - (ii) not clinically significant.
  - (iii) statistically significant.
  - (iv) not statistically significant.
- (d) If  $p\text{-value} = 0.0333$  in a hypothesis test where  $\alpha = 0.05$ , then we can be certain that the results of the test are
- (i) clinically significant.
  - (ii) not clinically significant.
  - (iii) statistically significant.
  - (iv) not statistically significant.