# CHAPTER 2

2.1 (a) Category Frequency Percentage

A 13 26%

B 28 56

C 9 18

(b) Category “B” is the majority.

2.16 (a) Electricity Costs Frequency Percentage

$80 to $99 4 8%

$100 to $119 7 14

$120 to $139 9 18

$140 to $159 13 26

$160 to $179 9 18

$180 to $199 5 10

$200 to $219 3 6

(b)

|  |  |  |  |
| --- | --- | --- | --- |
| *Electricity Costs* | *Frequency* | *Percentage* | *Cumulative %* |
| $99 | 4 | 8% | 8% |
| $119 | 7 | 14% | 22% |
| $139 | 9 | 18% | 40% |
| $159 | 13 | 26% | 66% |
| $179 | 9 | 18% | 84% |
| $199 | 5 | 10% | 94% |
| $219 | 3 | 6% | 100% |

(c) The majority of utility charges are clustered between $120 and $180.

2.20 (a)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Bulb Life (hrs)* | *Frequency*  *Manufacturer A* |  | *Bulb Life (hrs)* | *Frequency*  *Manufacturer B* |
| 650 -- 749 | 3 |  | 750 -- 849 | 2 |
| 750 -- 849 | 5 |  | 850 -- 949 | 8 |
| 850 -- 949 | 20 |  | 950 -- 1049 | 16 |
| 950 -- 1049 | 9 |  | 1050 -- 1149 | 9 |
| 1050 -- 1149 | 3 |  | 1150 -- 1249 | 5 |

2.20 (a), (b)

cont.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Bulb Life (hrs)* | *A* | | *B* | |
|  | *Percentage* | *Cumulative %* | *Percentage* | *Cumulative %* |
| 650 – 749 | 7.50% | 7.50% | .00% | 0.00% |
| 750 – 849 | 12.50% | 20.00% | 5.00% | 5.00% |
| 850 – 949 | 50.00% | 70.00% | 20.00% | 25.00% |
| 950 – 1049 | 22.50% | 92.50% | 40.00% | 65.00% |
| 1050 – 1149 | 7.50% | 100.00% | 22.50% | 87.50% |
| 1150 – 1249 | 0.00% | 100.00% | 12.50% | 100.00% |

(c) Manufacturer B produces bulbs with longer lives than Manufacturer A. The cumulative percentage for Manufacturer B shows 65% of its bulbs lasted less than 1,050 hours, contrasted with 70% of Manufacturer A’s bulbs, which lasted less than 950 hours. None of Manufacturer A’s bulbs lasted more than 1,149 hours, but 12.5% of Manufacturer B’s bulbs lasted between 1,150 and 1,249 hours. At the same time, 7.5% of Manufacturer A’s bulbs lasted less than 750 hours, whereas all of Manufacturer B’s bulbs lasted at least 750 hours

2.36 (a)



2.36 (a)

cont.



(b)



(c) The majority of utility charges are clustered between $120 and $180.

# CHAPTER 3

3.3 (a) Excel output:

|  |  |
| --- | --- |
| *X* | |
| Mean | 6 |
| Median | 7 |
| Mode | 7 |
| Standard Deviation | 4 |
| Sample Variance | 16 |
| Kurtosis | -0.34688 |
| Minimum | 0 |
| Maximum | 12 |
| Sum | 42 |
| Count | 7 |
| First Quartile | 3 |
| Third Quartile | 9 |
| Interquartile Range | 6 |
| Coefficient of Variation | 66.6667% |

Mean = 6 Median = 7 Mode = 7

(b) Range = 12 Variance = 16 Standard deviation = 4

Coefficient of variation = (4/6)•100% = 66.67%

(c) Z scores: 1.5, 0.25, -0.5, 0.75, -1.5, 0.25, -0.75. There is no outlier.

(d) Since the mean is less than the median, the distribution is left-skewed.

3.27 (a) *Q*1 = 3, *Q*3 = 9, interquartile range = 6

(b) Five-number summary: 0 3 7 9 12

(c)



The distribution is left-skewed.

(d) Answers are the same.

3.37 (a) Population Mean = 6

(b)  = 9.4 

**CHAPTER 4**

4.3 (a) 30/90 = 1/3 = 0.33 (b) 60/90 = 2/3 = 0.67

(c) 10/90 = 1/9 = 0.11 (d) 

4.17 (a) *P*(*A* | *B*) = 10/35 = 2/7 = 0.2857

(b) *P*(*A’* | *B’*) = 35/65 = 7/13 = 0.5385

(c) *P*(*A* | *B’*) = 30/65 = 6/13 = 0.4615

(d) Since *P*(*A* | *B*) = 0.2857 and *P*(*A*) = 0.40, events *A* and *B* are not statistically independent.

4.27 (a) *P*(higher for the year) = (34+11)/(34+11+5+11) = 0.7377

(b) *P*(higher for the year | higher first week) = 34/(34+5) = 0.8718

(c) Since *P*(higher for the year) = 0.7377 is not equal to *P*(higher for the year | higher first week) = 0.8718, the two events, “first-week performance” and “annual performance”, are not statistically independent.

(d) For 2012, the S&P 500 finished higher after the first five days of trading. As of Nov 4, 2012, the S&P 500 finished lower than at the end of last year. Of course, there are still more than one month of trading days remaining, so it can end up higher or lower than last year.

**CHAPTER 5**

5.1 PHStat output for Distribution A:

|  |  |  |  |
| --- | --- | --- | --- |
| **Probabilities & Outcomes:** | **P** | **X** | **Y** |
|  | **0.5** | **0** |  |
|  | **0.2** | **1** |  |
|  | **0.15** | **2** |  |
|  | **0.1** | **3** |  |
|  | **0.05** | **4** |  |
|  |  |  |  |
| **Statistics** |  |  |  |
| **E(X)** | **1** |  |  |
| **E(Y)** | **0** |  |  |
| **Variance(X)** | **1.5** |  |  |
| **Standard Deviation(X)** | **1.224745** |  |  |
| **Variance(Y)** | **0** |  |  |
| **Standard Deviation(Y)** | **0** |  |  |
| **Covariance(XY)** | **0** |  |  |
| **Variance(X+Y)** | **1.5** |  |  |
| **Standard Deviation(X+Y)** | **1.224745** |  |  |

PHStat output for Distribution B:

|  |  |  |  |
| --- | --- | --- | --- |
| **Probabilities & Outcomes:** | **P** | **X** | **Y** |
|  | **0.05** | **0** |  |
|  | **0.1** | **1** |  |
|  | **0.15** | **2** |  |
|  | **0.2** | **3** |  |
|  | **0.5** | **4** |  |
|  |  |  |  |
| **Statistics** |  |  |  |
| **E(X)** | **3** |  |  |
| **E(Y)** | **0** |  |  |
| **Variance(X)** | **1.5** |  |  |
| **Standard Deviation(X)** | **1.224745** |  |  |
| **Variance(Y)** | **0** |  |  |
| **Standard Deviation(Y)** | **0** |  |  |
| **Covariance(XY)** | **0** |  |  |
| **Variance(X+Y)** | **1.5** |  |  |
| **Standard Deviation(X+Y)** | **1.224745** |  |  |

5.1 (a) Distribution A Distribution B

cont. *X P(X) X\*P(X) X P(X) X\*P(X)*

0 0.50 0.00 0 0.05 0.00

1 0.20 0.20 1 0.10 0.10

2 0.15 0.30 2 0.15 0.30

3 0.10 0.30 3 0.20 0.60

4 0.05 0.20 4 0.50 2.00

1.00 1.00 1.00 3.00

 = 1.00  = 3.00

1. Distribution A

|  |  |  |  |
| --- | --- | --- | --- |
| *X* | (*X*–)2 | *P(X)* | (*X*–)2\**P(X)* |
| 0 | (–1)2 | 0.50 | 0.50 |
| 1 | (0)2 | 0.20 | 0.00 |
| 2 | (1)2 | 0.15 | 0.15 |
| 3 | (2)2 | 0.10 | 0.40 |
| 4 | (3)2 | 0.05 | 0.45 |
|  |  | 2= | 1.50 |

 = 1.22

(b)

Distribution B

|  |  |  |  |
| --- | --- | --- | --- |
| *X* | (*X*–)2 | *P(X)* | (*X*–)2\**P(X)* |
| 0 | (–3)2 | 0.05 | 0.45 |
| 1 | (–2)2 | 0.10 | 0.40 |
| 2 | (–1)2 | 0.15 | 0.15 |
| 3 | (0)2 | 0.20 | 0.00 |
| 4 | (1)2 | 0.50 | 0.50 |
|  |  | 2= | 1.50 |

 = 1.22

(c) The means are different but the variances are the same.

5.19 PHstat output:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Binomial Probabilities** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Data** |  |  |  |  |  |  |
| **Sample size** | **5** |  |  |  |  |  |
| **Probability of an event of interest** | **0.4** |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Statistics** |  |  |  |  |  |  |
| **Mean** | **2** |  |  |  |  |  |
| **Variance** | **1.2** |  |  |  |  |  |
| **Standard deviation** | **1.095445** |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Binomial Probabilities Table** | |  |  |  |  |  |
|  | **X** | **P(X)** | **P(<=X)** | **P(<X)** | **P(>X)** | **P(>=X)** |
|  | **0** | **0.07776** | **0.07776** | **0** | **0.92224** | **1** |
|  | **1** | **0.2592** | **0.33696** | **0.07776** | **0.66304** | **0.92224** |
|  | **2** | **0.3456** | **0.68256** | **0.33696** | **0.31744** | **0.66304** |
|  | **3** | **0.2304** | **0.91296** | **0.68256** | **0.08704** | **0.31744** |
|  | **4** | **0.0768** | **0.98976** | **0.91296** | **0.01024** | **0.08704** |
|  | **5** | **0.01024** | **1** | **0.98976** | **0** | **0.01024** |

(a) *P*(*X* = 4) = 0.0768

(b) *P*(*X*  3) = 0.9130

(c) *P*(*X* < 2) = 0.3370

(d) *P*(*X* > 1) = 0.6630

5.23 PHStat output:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Data |  |  |  |  |  |  |
| **Sample size** | **5** |  |  |  |  |  |
| **Probability of an event of interest** | **0.25** |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Statistics** |  |  |  |  |  |  |
| **Mean** | **1.25** |  |  |  |  |  |
| **Variance** | **0.9375** |  |  |  |  |  |
| **Standard deviation** | **0.968246** |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Binomial Probabilities Table** | |  |  |  |  |  |
|  | **X** | **P(X)** | **P(<=X)** | **P(<X)** | **P(>X)** | **P(>=X)** |
|  | **0** | **0.237305** | **0.237305** | **0** | **0.762695** | **1** |
|  | **1** | **0.395508** | **0.632813** | **0.237305** | **0.367188** | **0.762695** |
|  | **2** | **0.263672** | **0.896484** | **0.632813** | **0.103516** | **0.367188** |
|  | **3** | **0.087891** | **0.984375** | **0.896484** | **0.015625** | **0.103516** |
|  | **4** | **0.014648** | **0.999023** | **0.984375** | **0.000977** | **0.015625** |
|  | **5** | **0.000977** | **1** | **0.999023** | **0** | **0.000977** |

If ** = 0.25 and *n* = 5,

(a) *P*(*X* = 5) = 0.0010

(b) *P*(*X*  4) = *P*(*X* = 4) + *P*(*X* = 5) = 0.0146 + 0.0010 = 0.0156

(c) *P*(*X* = 0) = 0.2373

(d) *P*(*X*  2) = *P*(*X* = 0) + *P*(*X* = 1) + *P*(*X* = 2)

= 0.2373 + 0.3955 + 0.2637 = 0.8965

**CHAPTER 6**

6.1 PHStat output:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Normal Probabilities** |  |  |  |  |
|  |  |  |  |  |
| **Common Data** |  |  |  |  |
| **Mean** | **0** |  |  |  |
| **Standard Deviation** | **1** |  |  |  |
|  |  |  | **Probability for a Range** |  |
| **Probability for X <=** |  |  | **From X Value** | **1.57** |
| **X Value** | **1.57** |  | **To X Value** | **1.84** |
| **Z Value** | **1.57** |  | **Z Value for 1.57** | **1.57** |
| **P(X<=1.57)** | **0.9417924** |  | **Z Value for 1.84** | **1.84** |
|  |  |  | **P(X<=1.57)** | **0.9418** |
| **Probability for X >** |  |  | **P(X<=1.84)** | **0.9671** |
| **X Value** | **1.84** |  | **P(1.57<=X<=1.84)** | **0.0253** |
| **Z Value** | **1.84** |  |  |  |
| **P(X>1.84)** | **0.0329** |  | **Find X and Z Given Cum. Pctage.** | |
|  |  |  | **Cumulative Percentage** | **95.00%** |
| **Probability for X<1.57 or X >1.84** | |  | **Z Value** | **1.644854** |
| **P(X<1.57 or X >1.84)** | **0.9747** |  | **X Value** | **1.644854** |

(a) *P*(*Z* < 1.57) = 0.9418

(b) *P*(*Z* > 1.84) = 1 – 0.9671 = 0.0329

(c) *P*(1.57 < *Z* < 1.84) = 0.9671 – 0.9418 = 0.0253

(d) *P*(*Z* < 1.57) + *P*(*Z* > 1.84) = 0.9418 + (1 – 0.9671) = 0.9747

6.7 (a) *P*(*X* > 10) = *P*(*Z* > 0.2827) = 0.3887



(b) *P*(3 < *X* < 5) = *P*(-2.0506 < *Z* < -1.384) = 0.0630



(c) *P*(*X* < 5) = *P*(*Z* < -1.384) = 0.0832



(d) *P*(*X* < *A*) = 0.99 *Z* = 2.3263= *A* = 16.1310



*Note*: The above answers are obtained using PHStat. They may be slightly different when Table E.2 is used.

6.23 (a) *P*(5 < *X* < 7) = (7 – 5)/10 = 0.2

(b) *P*(2 < *X* < 3) = (3 – 2)/10 = 0.1

(c)  (d) 

6.27 (a) *P*(*X* < 70) = (70 – 64)/(74 – 64) = 0.6

(b) *P*(65 < *X* < 70) = (70 – 65)/(74 – 64) = 0.5

(c) *P*(*X* > 65) = (74 – 65)/(74 – 64) = 0.9

(d)  

# CHAPTER 7

7.1 PHstat output:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Common Data** | |  |  |  |
| **Mean** | **100** |  |  |  |
| **Standard Deviation** | **2** |  |  |  |
|  |  |  | **Probability for a Range** | |
| **Probability for X <=** | |  | **From X Value** | **95** |
| **X Value** | **95** |  | **To X Value** | **97.5** |
| **Z Value** | **-2.5** |  | **Z Value for 95** | **-2.5** |
| **P(X<=95)** | **0.0062097** |  | **Z Value for 97.5** | **-1.25** |
|  |  |  | **P(X<=95)** | **0.0062** |
| **Probability for X >** | |  | **P(X<=97.5)** | **0.1056** |
| **X Value** | **102.2** |  | **P(95<=X<=97.5)** | **0.0994** |
| **Z Value** | **1.1** |  |  |  |
| **P(X>102.2)** | **0.1357** |  | **Find X and Z Given Cum. Pctage.** | |
|  |  |  | **Cumulative Percentage** | **35.00%** |
| **Probability for X<95 or X >102.2** | |  | **Z Value** | **-0.38532** |
| **P(X<95 or X >102.2)** | **0.1419** |  | **X Value** | **99.22936** |

(a) *P*( < 95) = P(*Z* < – 2.50) = 0.0062

(b) *P*(95 <  < 97.5) = *P*(– 2.50 < *Z* < – 1.25) = 0.1056 – 0.0062 = 0.0994

(c) *P*( > 102.2) = *P*(*Z* > 1.10) = 1.0 – 0.8643 = 0.1357

(d) *P*( > *A*) = *P*(*Z* > – 0.39) = 0.65 = 100 – 0.39() = 99.22

7.3 (a) For samples of 25 travel expense vouchers for a university in an academic year, the sampling distribution of sample means is the distribution of means from all possible samples of 25 vouchers that could occur.

(b) For samples of 25 absentee records in 2012 for employees of a large manufacturing company, the sampling distribution of sample means is the distribution of means from all possible samples of 25 records that could occur.

(c) For samples of 25 sales of unleaded gasoline at service stations located in a particular state, the sampling distribution of sample means is the distribution of means from all possible samples of 25 sales that could occur.

7.9 (a) *p*= 48/64 = 0.75 (b)  =  = 0.0573

7.19 Because the average of all the possible sample means of size *n* is equal to the population mean.

# CHAPTER 8

8.1  =  83.04  86.96

8.5 If all possible samples of the same size *n*=100 are taken, 95% of them will include the true population mean time spent on the site per day. Thus you are 95 percent confident that this sample is one that does correctly estimate the true mean time spent on the site per day.

8.7 If the population mean time spent on the site is 36 minutes a day, the confidence interval estimate stated in Problem 8.5 is correct because it contains the value 36 minutes.

8.8 Equation (8.1) assumes that you know the population standard deviation. Because you are selecting a sample of 100 from the population, you are computing a sample standard deviation, not the population standard deviation.

8.11  66.8796  83.1204

8.17 (a)  184.6581  205.9419

(b) No, a grade of 200 is in the interval.

(c) It is not unusual to have an observed tread wear index of 210, which is outside the 95% confidence interval for the population mean tread wear index, because the standard deviation of the sample mean  is smaller than the standard deviation of the population  of the tread wear index for a single observed treat wear. Hence, the value of a single observed tread wear index varies around the population mean more than a sample mean does.

8.35  = 166.41 Use *n* = 167

8.47 (a) = 224/368 = 0.6087 

0.5588 0.6586



(b) You are 95% confident that the proportion of San Francisco Bay Area nonprofits that collaborated with other organizations to provide services. is somewhere between 0.5588 and 0.6586.

(c)  = 9,149.7885 Use *n* = 9,150

Note: This is obtained using PHStat. If you use four decimal places of accuracy on a calculator, you will get 9150.088 which rounds up to 9151.

8.51 The *t* distribution is used for obtaining a confidence interval for the mean when  is unknown.

CHAPTER 9

9.13 (a) *H*0:  = 12.1 hours

*H*1:  12.1 hours

(b) A Type I error is the mistake of concluding that the mean number of hours studied by marketing majors at your school is different from the 12.1-hour-per-week benchmark reported by *The Washington Post* when in fact it is not any different.

(c) A Type II error is the mistake of not concluding the mean number of hours studied by

marketing majors at your school is different from the 12.1-hour-per-week benchmark reported by *The Washington Post* when it is in fact different.

9.16 (a) Test statistic: 

cont. Decision: Since *|ZSTAT*| < 2.5758, do not reject . There is not enough evidence to conclude that the mean amount of paint contained in 1-gallon cans purchased from a nationally known manufacturer is different from 1 gallon.

(b) *p*-value = 0.0771. If the population mean amount of paint contained in 1-gallon cans purchased from a nationally known manufacturer is actually 1 gallon, the probability of obtaining a test statistic that is more than 1.7678 standard error units away from 0 is 0.0771.

(c) PHStat output:

|  |  |
| --- | --- |
| **Data** | |
| **Population Standard Deviation** | **0.02** |
| **Sample Mean** | **0.995** |
| **Sample Size** | **50** |
| **Confidence Level** | **99%** |
|  |  |
| Intermediate Calculations |  |
| Standard Error of the Mean | 0.002828427 |
| Z Value | -2.5758293 |
| Interval Half Width | 0.007285545 |
|  |  |
| **Confidence Interval** |  |
| **Interval Lower Limit** | **0.987714455** |
| **Interval Upper Limit** | **1.002285545** |

 

You are 99% confident that population mean amount of paint contained in 1-gallon cans purchased from a nationally known manufacturer is somewhere between 0.9877 and 1.0023 gallons.

(d) Since the 99% confidence interval does contain the hypothesized value of 1, you will not reject . The conclusions are the same.

9.24 PHStat output:

|  |  |
| --- | --- |
| **t Test for Hypothesis of the Mean** | |
| **Data** |  |
| **Null Hypothesis μ =** | **3.7** |
| **Level of Significance** | **0.05** |
| **Sample Size** | **64** |
| **Sample Mean** | **3.57** |
| **Sample Standard Deviation** | **0.8** |
| Intermediate Calculations |  |
| Standard Error of the Mean | 0.1 |
| Degrees of Freedom | 63 |
| ***t* Test Statistic** | **-1.3** |
| **Two-Tail Test** | |
| **Lower Critical Value** | **-1.9983405** |
| **Upper Critical Value** | **1.9983405** |
| ***p*-Value** | **0.1983372** |
| **Do not reject the null hypothesis** | |

(a)  

Decision rule: Reject  if *|tSTAT|* > 1.9983 *d.f.* = 63

Test statistic: 

Decision: Since *|tSTAT*| < 1.9983, do not reject . There is not enough evidence to conclude that the population mean waiting time is different from 3.7 minutes at the 0.05 level of significance.

(b) The sample size of 64 is large enough to apply the Central Limit Theorem and, hence, you do not need to be concerned about the shape of the population distribution when conducting the *t*-test in (a). In general, the *t* test is appropriate for this sample size except for the case where the population is extremely skewed or bimodal.

9.31 (a) PHStat output:

|  |  |
| --- | --- |
| **Data** |  |
| **Null Hypothesis =** | **20** |
| **Level of Significance** | **0.05** |
| **Sample Size** | **50** |
| **Sample Mean** | **43.04** |
| **Sample Standard Deviation** | **41.92605736** |
|  |  |
| Intermediate Calculations |  |
| Standard Error of the Mean | 5.929239893 |
| Degrees of Freedom | 49 |
| ***t* Test Statistic** | **3.885826921** |
|  |  |
| **Two-Tail Test** | |
| **Lower Critical Value** | **-2.009575199** |
| **Upper Critical Value** | **2.009575199** |
| ***p*-Value** | **0.000306263** |
| **Reject the null hypothesis** | |

 

Decision rule: Reject  if *tSTAT* > 2.0096 *d.f.* = 49

Test statistic: 

Decision: Since *tSTAT* > 2.0096, reject . There is enough evidence to conclude that the mean number of days is different from 20.

(b) The population distribution needs to be normal.

(c)



The normal probability plot indicates that the distribution is skewed to the right.

(d) Even though the population distribution is probably not normally distributed, the result obtained in (a) should still be valid due to the Central Limit Theorem as a result of the relatively large sample size of 50.

9.33 (a) 

Decision rule: Reject  if *|tSTAT|* > 1.9842 *d.f.* = 99

Test statistic: 

Decision: Since *|tSTAT*| < 1.9842, do not reject . There is not enough evidence to conclude that the mean difference is different from 0.0 inches.

(b)  -0.0005665  0.0001065

You are 95% confident that the mean difference is somewhere between -0.0005665 and 0.0001065 inches.

(c) Since the 95% confidence interval does not contain 0, you do not reject the null hypothesis in part (a). Hence, you will make the same decision and arrive at the same conclusion as in (a).

(d) In order for the *t* test to be valid, the data are assumed to be independently drawn from a population that is normally distributed. Since the sample size is 100, which is considered quite large, the *t* distribution will provide a good approximation to the sampling distribution of the mean as long as the population distribution is not very skewed.

The boxplot suggests that the data has a distribution that is skewed slightly to the right. Given the relatively large sample size of 100 observations, the *t* distribution should still provide a good approximation to the sampling distribution of the mean.

**CHAPTER 10**

10.9 (a)  Mean times to clear problems at Office I and Office II are the same.

 Mean times to clear problems at Office I and Office II are different.

PHStat output:

|  |  |
| --- | --- |
| **t Test for Differences in Two Means** |  |
| **Data** |  |
| **Hypothesized Difference** | **0** |
| **Level of Significance** | **0.05** |
| **Population 1 Sample** | |
| **Sample Size** | **20** |
| **Sample Mean** | **2.214** |
| **Sample Standard Deviation** | **1.718039** |
| **Population 2 Sample** | |
| **Sample Size** | **20** |
| **Sample Mean** | **2.0115** |
| **Sample Standard Deviation** | **1.891706** |
| Intermediate Calculations |  |
| Population 1 Sample Degrees of Freedom | 19 |
| Population 2 Sample Degrees of Freedom | 19 |
| Total Degrees of Freedom | 38 |
| Pooled Variance | 3.265105 |
| Difference in Sample Means | 0.2025 |
| *t*-Test Statistic | 0.354386 |
| **Two-Tailed Test** | |
| **Lower Critical Value** | **-2.02439** |
| **Upper Critical Value** | **2.024394** |
| ***p*-Value** | **0.725009** |
| **Do not reject the null hypothesis** | |

Since the *p*-value of 0.725 is greater than the 5% level of significance, do not reject the null hypothesis. There is not enough evidence to conclude that the mean time to clear problems in the two offices is different.

(b) *p*-value = 0.725. The probability of obtaining a sample that will yield a *t* test statistic more extreme than 0.3544 is 0.725 if, in fact, the mean waiting times between Office 1 and Office 2 are the same.

(c) We need to assume that the two populations are normally distributed.

(d) 



Since the Confidence Interval contains 0, we cannot claim that there’s a difference between the two means.

10.24 (a) define the difference in bone marrow micro vessel density as the density before the transplant minus the density after the transplant and assume that the difference in density is normally distributed.



Excel output:

|  |  |  |
| --- | --- | --- |
| t-Test: Paired Two Sample for Means |  |  |
|  | *Before* | *After* |
| Mean | 312.1429 | 226 |
| Variance | 15513.14 | 4971 |
| Observations | 7 | 7 |
| Pearson Correlation | 0.295069 |  |
| Hypothesized Mean Difference | 0 |  |
| df | 6 |  |
| t Stat | 1.842455 |  |
| P(T<=t) one-tail | 0.057493 |  |
| t Critical one-tail | 1.943181 |  |
| P(T<=t) two-tail | 0.114986 |  |
| t Critical two-tail | 2.446914 |  |

Test statistic:  = 1.8425

Decision: Since *tSTAT* =  is less than the critical value of 1.943, do not reject. There is not enough evidence to conclude that the mean bone marrow microvessel density is higher before the stem cell transplant than after the stem cell transplant.

(b) *p*-value = 0.0575. The probability of obtaining a mean difference in density that gives rise to a *t* test statistic that deviates from 0 by 1.8425 or more is .0575 if the mean density is not higher before the stem cell transplant than after the stem cell transplant.

(c)  

You are 95% confident that the mean difference in bone marrow microvessel density before and after the stem cell transplant is somewhere between -28.26 and 200.55.

(d) You must assume that the distribution of differences between the mean density of before and after stem cell transplant is approximately normal.

10.39 = 1.2109

**CHAPTER 11**

11.3 (a)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | ***df*** | ***SS*** | ***MS*** | ***F*** |
| Among groups | 4 | 60 | 15 | 3.00 |
| Within groups | 30 | 150 | 5 |  |
| Total | 34 | 210 |  |  |

(b) *F*4, 30 = 2.69

(c) Decision rule: If *F* > 2.69, reject *H*0.

(d) Decision: Since *F* = 3.00 is greater than the critical bound 2.69, reject *H*0.

11.5

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | ***df*** | ***SS*** | ***MS*** | ***F*** |
| Among groups | 4 – 1 =3 | (80) (3) = 240 | 80 | 80/20 = 4 |
| Within groups | 32 – 4 = 28 | 560 | 560/28 = 20 |  |
| Total | 32 – 1 = 31 | 240 + 560 = 800 |  |  |

# CHAPTER 13

13.5 (a)



(b) Excel output:



(c) For each additional unit increase in summated rating, the mean price will increase by an estimated $1.47. Literal interpretation of  is not meaningful because a summated rating of 0 is impossible in the setup.

(d)  .

13.17 (a) *r*2 = 0.4320. So, 43.20% of the variation in the cost of a restaurant meal can be explained by the variation in the summated rating.

(b) 10.4413

(c) Based on (a) and (b), the model is only moderately useful for predicting the cost of a restaurant meal.

13.25



Based on the residual plot, there appears to be a slight violation in the equal variance assumption where variance is smaller for smaller summated rating.



Based on the residual plot, there appears to be a slight violation in the equal variance assumption. The normal probability plot of the residuals does not indicate any departure from the normality assumption.

13.53 (a) *r* = 0.7903. There appears to be a strong positive linear relationship between the coaches’ salary and revenue.

(b) *t* = 9.8243, *p*-value is virtually zero. Reject *H*0. At the 0.05 level of significance, there is a significant linear relationship between the coaches’ salary and revenue.

13.57 (a) 25.8445 34.8195

(b) 9.1312 51.5327

(c) Part (b) provides an interval prediction for the individual response given a specific value of the independent variable, and part (a) provides an interval estimate for the mean value given a specific value of the independent variable. Since there is much more variation in predicting an individual value than in estimating a mean value, a prediction interval is wider than a confidence interval estimate holding everything else fixed.