Introductory Applied Statistics:
A Variable Approach
TI Manual

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Acknowledgements

This TI manual was written during the summer of 2014 by Paul Stephenson to accompany the textbook, “Introductory Applied Statistics: A Variable Approach” by John Gabrosek and Paul Stephenson. This TI manual is included as Appendix B in the textbook. The page and section numbering has been set to match the numbering in the textbook.

Contents

Instructions for the TI Calculator

Given the prominence of TI calculators the authors have organized a set of step-by-step instructions for the TI-84 calculator. Throughout this Appendix the authors use GREEN TEXT to emphasize buttons, options, commands, or text on the TI-84 calculator.

> ***Message!*** *The authors used the INSERT NAME HERE TI calculator when writing this manual. Older versions of the TI-83 and TI-84 calculators have slightly different menu choices for some functions. The authors have made a note where the differences are not obvious.*

B.1 Generating Random Numbers

We want to generate 6 random integers between 1 and 100. A list of 6 random numbers can be found by:

1. Press MATH for the mathematics menu.
2. Use the arrow keys to scroll across to the PROB, use the arrow keys to scroll down to the 5:randInt(, and press ENTER.
3. The syntax for the random integer command is randInt(1,100,6). Note: Some of the newer TI-84 calculators provide a menu for entering the inputs, and older calculators paste the function command into the screen and the user must enter the inputs in the appropriate order.

Therefore, the desired list of 6 random integers is displayed on the screen as demonstrated below:

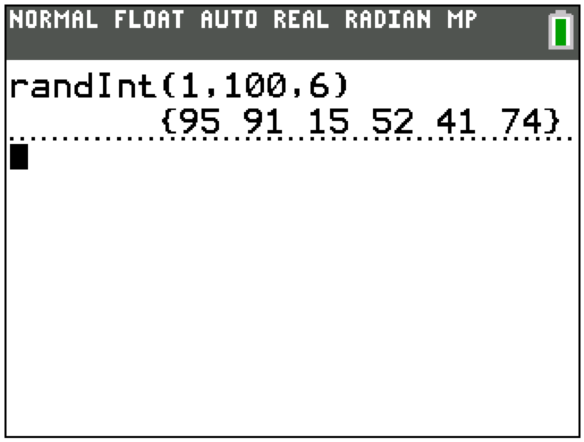

Figure B.1: Generating 6 Random Integers between 1 and 100

Note: You are unlikely to match the six random numbers generated in Figure B.1. The reason is that the numbers are random. We could all come up with the same "random" numbers if we had started by entering a seed value. Instructions on how to enter a seed value are given below. For example, if we entered seed value 728 and then followed the instructions to generate six random numbers between 1 and 100, then we would all get the numbers 77, 10, 7, 60, 92, 83.

Entering a Seed Value

1. To enter seed value 728: Type 728, then Press STO> button in lower left.

2. Press MATH for the mathematics menu.

3. Use the arrow keys to scroll across to the PROB, use the arrow keys to scroll to the 1:rand, and press ENTER.

   item Press ENTER one more time. The output should show the number 728. You are now ready to match the random numbers 77, 10, 7, 60, 92, 83.

Generating other Random Numbers

We can also generate (a) 1 random value between 0 and 1 using the command rand (Note: This command has no additional inputs.), (b) m random integers with no repetition using the command randIntNoRep(lower,upper,m), (c) m random values from a normal distribution using the command randNorm(mean,standard deviation,m), and (d) m random values from a binomial distribution using the command randBin(n,p,m).

The following figure illustrates the random generation of 7 random integers from a binominal distribution with inputs $n = 10$ and $p = 0.6$:

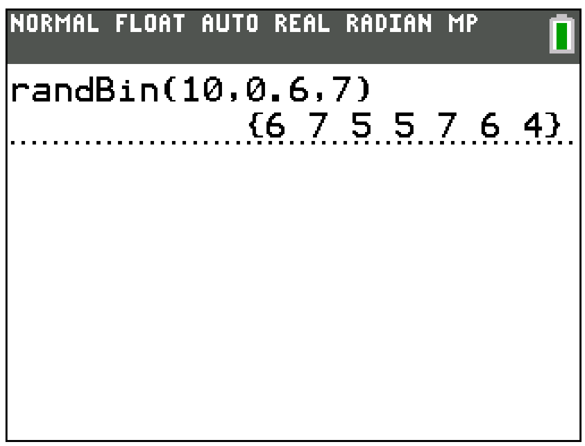

Figure B.2: Generating 7 Random Integers from the Bin(10,0.6) Distribution

B.2 Binomial Distribution

Using the Binomial PDF

We want to find the $Pr(X = 2)$ if $n = 22$ and $p = 0.12$. This probability can be found using the binompdf function by:

1. Press 2ND then VARS [DISTR] for the distribution menu.
2. Scroll down to binompdf and press ENTER.
3. The syntax for the binomial probability density function command is binompdf(n,p,x). Note: Some of the newer TI-84 calculators provide a menu for entering the inputs and the value of x, and older calculators paste the function command into the screen and the user must enter the inputs in the appropriate order. An additional note: The order of the inputs in the syntax of the TI command is different from the order of the inputs in the textbook notation for the binomial distribution.

Therefore, the desired probability can be found from:

$$Pr(X = 2) = \text{binompdf(22,0.12,2)} = 0.25800.$$

Using the Binomial CDF

We want to find the $Pr(X \geq 3)$ if $n = 22$ and $p = 0.12$. This probability can be found using the binomcdf function by:

$$\begin{aligned} Pr(X \geq 3) = 1 - Pr(X \leq 2) &= 1 - \text{binomcdf(22,0.12,2)} \\ &= 1 - 0.49826 = 0.50174. \end{aligned}$$

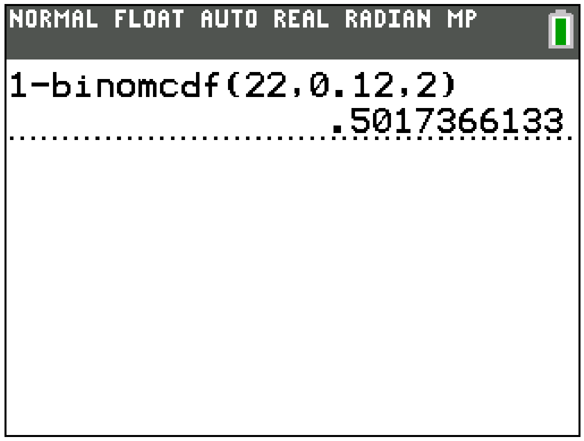

Figure B.3: Illustration of Binomial cdf

Note: $Pr(X \geq 3) = 1 - Pr(X \leq 2)$ uses the rule of complements introduced in Definition 1.13.

B.3 Confidence Interval for Proportion

We observe 354 successes in 1011 trials and want to construct a 90% confidence interval for p. This confidence interval can be found by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to A:1-PropZInt and press ENTER. This will bring up the 1-PropZInt menu.
3. Enter 354 for x:, enter 1011 for n:, enter .90 for C-Level, select Calculate, and press ENTER. The input screen is illustrated below.

The desired confidence interval for p is $(0.32547, 0.37482)$ with a center of $\hat{p} = 0.3501$.

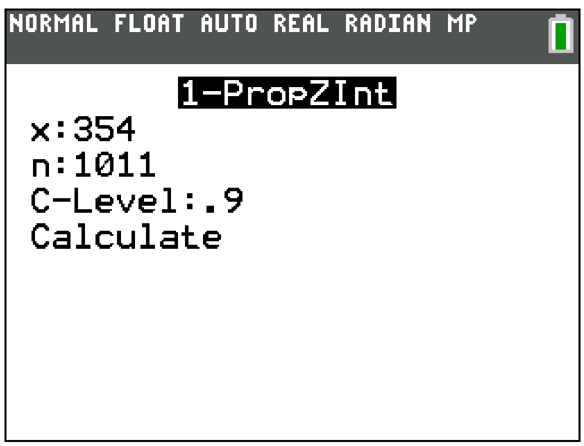

Figure B.4: Input for Confidence Interval for Proportions

B.4 Hypothesis Test for Proportion

We observe 720 successes in 1029 trials and want to test the hypotheses $Ho:$ $p \leq 0.65$ vs $Ha: p > 0.65$. This test can be performed by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 5:1-PropZTest and press ENTER. This will bring up the 1-PropZTest menu.
3. Enter 0.65 for p0:, enter 720 for x:, enter 1029 for n:, select >p0, select Calculate or Draw, and press ENTER.

   The input screen is illustrated below.

The test statistic is $z = 3.343$ and the $p-$value is $p - \text{value} = 0.000414$.

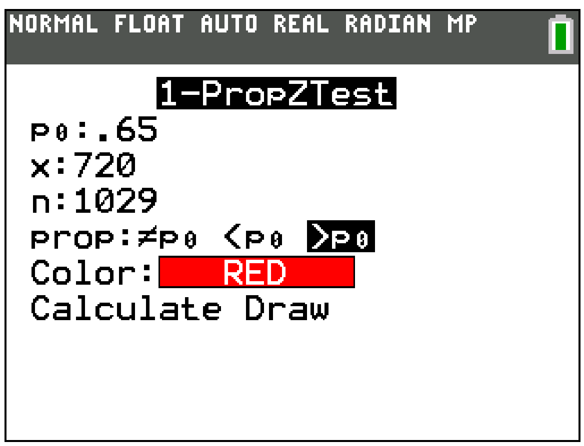

Figure B.5: Input for Hypothesis Tests for Proportions

Note: Older versions of the TI-83 and TI-84 do not give a color option.

B.5 Entering Quantitative Data

We observe the $n = 47$ values tabled below. We want to compute descriptive statistics for this data set.

3	6	13	20	24	27	31	34
4	8	14	21	24	27	31	35
4	8	16	21	25	28	31	35
4	10	16	22	25	29	32	41
4	11	18	23	26	30	33	48
5	11	20	23	27	30	33	

Enter a quantitative data set by:

1. Press STAT for the statistics menu.

2. If the cursor is not already on the default position, scroll to 1:Edit... of the EDIT menu, and press ENTER. This will bring up the data entry screen (it will look like a table).

3. If the first column has data in the column, using the arrow keys move the cursor over the L1 position, and press CLEAR and ENTER. **Do not accidentally press DEL!**

4. Using the arrow keys move the cursor onto the 1^{st} row in the L1 column, type '3' such that the bottom line of the screen reads L1(1)=3, and press ENTER. The cursor will automatically advance to the 2^{nd} row in the L1 column. Continue entering observations until the data set is completely entered.

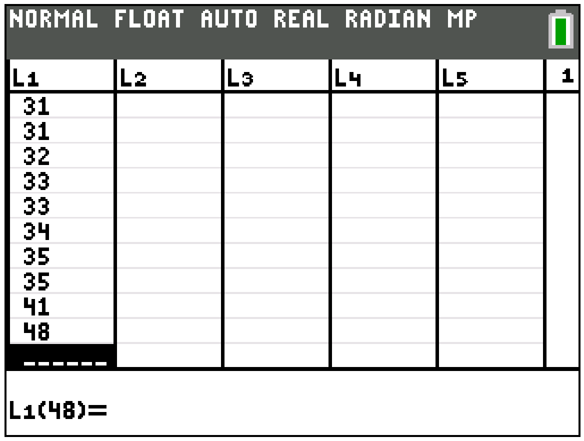

Figure B.6: Entering Numeric Data

B.6 Numerical Summaries for Quantitative Data

Using the same data set from Section B.5 we can use the calculator to compute a variety of numerical summaries for quantitative data by:

1. Once the complete data set has been entered, press STAT for the statistics menu.

2. Scroll across to the CALC menu. Scroll down to 1:1-Var Stats (which should be the default position in the CALC menu), and press ENTER.

3. Press 2ND then 1 [L1] for List:, leave the FreqList: empty, arrow down to Calculate, and press ENTER. **Note: If you have an older version of the TI-83 or TI-84 you will not have the List: or FreqList: options. After you put in L1 just press Enter.**

The TI calculator outputs a variety of statistics including: $\bar{x}$= 21.51, Sx = 11.08 (which denotes the standard deviation for a sample), n = 47, minX = 3, Q1 = 11, Med = 23, Q3 = 30, and maxX = 48.

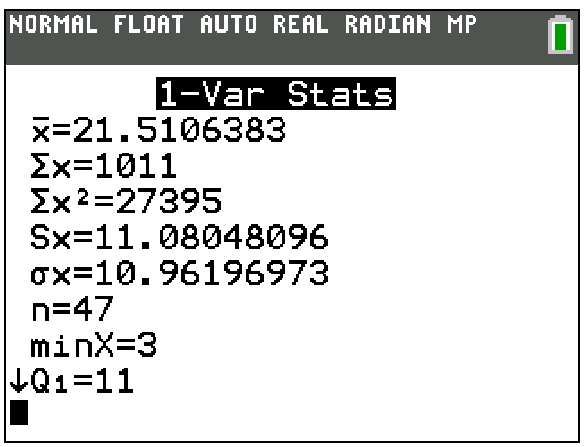

Figure B.7: Illustration of 1-Var Stats Output

Note: By scrolling down in the output you can see the five-number summary.

B.7 Boxplot for Quantitative Data

We want to construct a boxplot for the data utilized in Section B.5. After entering the data (as demonstrated in steps 1 - 4 in Section B.5), a boxplot can be obtained by:

1. Press 2ND then press Y= for the STATPLOT menu.

2. Select the plot that you would like to use, e.g., 1:Plot1..., and press ENTER. This will bring up the plot entry screen.

3. Select On by moving your cursor above the On position and pressing ENTER.

4. Using the arrow keys move the cursor over the Type: position for the graph of interest (this will be indicated by the picture of the boxplot with outliers displayed), and press ENTER.

   Note: You can make a simple boxplot by choosing the graphic of a boxplot without outliers.

5. Enter L1 for Xlist:, leave the Freq: set to 1.

6. Using the arrow keys move the cursor over the Mark: position for the symbol of interest (this symbol will be used to denote outliers, if any exist), and press ENTER.

7. Press the ZOOM button (directly under the screen on your calculator) and arrow down to 9:ZoomStat and press ENTER. This will allow us to see their boxplot.

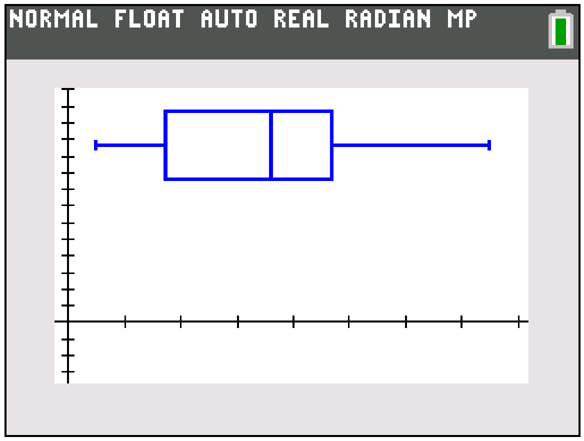

Figure B.8: Illustration of a Boxplot

Note: The modified boxplot produced by the TI calculator does not distinguish between mild and extreme outliers.

B.8 Histogram for Quantitative Data

We want to construct a histogram for the data utilized in Section B.5. After entering the data (as demonstrated in steps 1 - 4 in Section B.5), a histogram can be obtained by:

1. Press 2ND then press Y= for the STATPLOT menu.
2. Select the plot that you would like to use, e.g., 1:Plot1..., and press ENTER. This will bring up the plot entry screen.
3. Select On by moving your cursor above the On position and pressing ENTER.
4. Using the arrow keys move the cursor over the Type: position for the graph of interest (this will be indicated by the picture of the histogram), and press ENTER.
5. Enter L1 for Xlist:, leave the Freq: set to 1.
6. Press the ZOOM button (directly under the screen on your calculator) and arrow down to 9:ZoomStat and press ENTER. This will allow us to see the histogram.

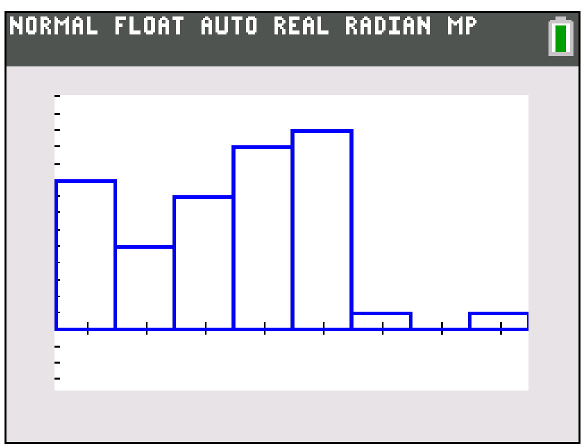

Figure B.9: Illustration of a Histogram

B.9 Normal Distribution

Using Normal CDF to Find a Probability

We want to find the $Pr(X > 72)$ if $\mu = 69.5$ and $\sigma = 3.3$. This probability can be found using the normalcdf function by:

1. Press 2ND then VARS [DISTR] for the distribution menu.
2. Scroll down to normalcdf and press ENTER.
3. The syntax for the normal cumulative density function command is normalcdf(lower,upper,μ,σ). Note: The value of 1E99 can be used as the upper bound value to represent ∞, and similarly $-$1E99 can be used as the lower bound value to represent $-\infty$.

   The E is found on the calculator using: Press 2ND then , [EE].

Therefore, the desired probability can be found from:

$$Pr(X > 72) = \text{normalcdf(72,1E99,69.5,3.3)} = 0.22435.$$

Note: The value obtained directly using the normalcdf is the exact probability. However, the examples in the text first compute the z value corresponding to an x value of 72 and finds the desired probability using an approximation from the normal table. This process results in an approximation of the desired probability.

Using invNorm to Find a Data Value

We want to find the value x_0 such that $Pr(X < x_0) = 0.99$ if $\mu = 0.270$ and $\sigma = 0.0289$. The value of x_0 can be found using the invNorm function by:

1. Press 2ND then VARS [DISTR] for the distribution menu.
2. Scroll down to invNorm and press ENTER.
3. The syntax for the inverse of the normal cumulative density function command is invNorm(percentile,μ,σ).

Therefore, the desired value x_0 can be found from:

$$x_0 = \text{invNorm(0.99,0.270,0.0289)} = 0.33723.$$

Note: The x_0 obtained directly using the invNorm is the exact value. However, the examples in the text first finds the z value using an approximation from the normal table, and then computes the x_0 value from the z value (using $x_0 = \mu + z\sigma$). This process results in an approximation of the desired probability.

B.10 Normal Probability Plot

We want to construct a normal probability plot for the data utilized in Section B.5. After entering the data (as demonstrated in steps 1 - 4 in Section B.5), a normal probability plot can be obtained by:

1. Press 2ND then press Y= for the STATPLOT menu.
2. Select the plot that you would like to use, e.g., 1:Plot1..., and press ENTER. This will bring up the plot entry screen.
3. Select On by moving your cursor above the On position and pressing ENTER.
4. Using the arrow keys move the cursor over the Type: position for the graph of interest (the normal probability plot is displayed by the zig-zag line on the far right), and press ENTER.
5. Enter L1 for Data List:, and highlight X for Data Axis:.
6. Using the arrow keys move the cursor over the Mark: position for the symbol of interest for plotting and press ENTER.
7. Press the ZOOM button (directly under the screen on your calculator) and arrow down to 9:ZoomStat and press ENTER. This will allow us to see the normal probability plot.

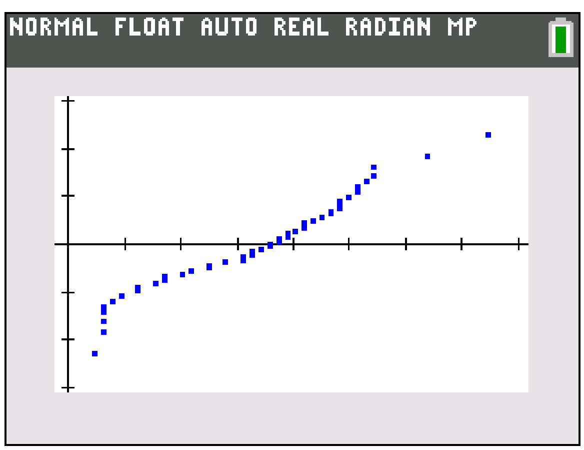

Figure B.10: Illustration of a Normal Probability Plot

B.11 Student t Distribution

Using tcdf to Find a Probability

We want to find the $Pr(t > 2.84)$ if $df = 24$. The value can be found using the tcdf function by:

1. Press 2ND then VARS [DISTR] for the distribution menu.
2. Scroll down to tcdf and press ENTER.
3. The syntax for the t cumulative density function command is

   tcdf(lower,upper,df). Note: The value of 1E99 can be used as the upper bound value to represent ∞, and similarly $-$1E99 can be used as the lower bound value to represent $-\infty$.

   The E is found on the calculator using: Press 2ND then , [EE].

Therefore, the desired probability can be found from:

$$Pr(t > 2.84) = \text{tcdf(2.84,1E99,24)} = 0.00452.$$

Using invT to Find a Confidence Level Multiplier

We want to find the value t_0 such that $Pr(t < t_0) = 0.975$ if $df = 24$. (This corresponds to finding the confidence level multiplier C for a 95% confidence interval where $df = 24$.) The value of t_0 can be found using the invT function by:

1. Press 2ND then VARS [DISTR] for the distribution menu.
2. Scroll down to invT and press ENTER.
3. The syntax for the inverse of the normal cumulative density function command is invT(percentile,df).

Therefore, the desired value t_0 can be found from:

$$t_0 = \text{invT(0.975,24)} = 2.064.$$

B.12 Confidence Interval for Population Mean

Finding a Confidence Interval from Entered Data

We observe the 24 quantitative observations tabled below, and want to construct a 95% confidence interval for the population mean μ.

Data:	335	361	362	358	345	306	340	331
	315	305	338	329	320	326	312	362
	301	317	330	317	337	319	313	335

After entering the data (as demonstrated in steps 1 - 4 in Section B.5), a confidence interval for μ can be obtained by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 8:TInterval, and Press ENTER.
3. In INPT: choose Data.
4. In List: choose 2ND then 1 [L1]. Leave the Freq: set to 1.
5. Set the confidence level to the desired value by placing .95 for C-Level:, then select Calculate, and press ENTER.

The desired confidence interval for μ is $(322.01, 337.49)$ with a center of $\bar{x} = 329.75$.

Finding a Confidence Interval from Numerical Summaries

Suppose that instead of entering the data into the TI, you were given that the sample mean is $\bar{x} = 329.75$, the sample standard deviation is $s = 18.34$, and the sample size is $n = 24$. A confidence interval for μ can be obtained by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 8:TInterval, and Press ENTER.
3. In INPT: choose Stats. Enter the values for $\bar{x}, s,$ and n.
4. Set the confidence level to the desired value by placing .95 for C-Level:, then select Calculate, and press ENTER.

B.13 Hypothesis Test for the Population Mean

Right-tailed test

We observe a sample of 51 observations with a sample mean of 3.2 and a standard deviation of 0.43, and want to test the hypotheses $Ho : \mu \leq 3$ vs $Ha : \mu > 3$. This test can be performed by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 2:T-Test and press ENTER. This will bring up the T-Test menu.
3. Use the arrow keys to highlight the Stats option for Inpt:, and press ENTER.
4. Enter 3 for $\mu0$:, enter 3.2 for $\bar{x}$:, enter 0.43 for Sx:, and enter 51 for n:
5. Use the arrow keys to highlight the $> \mu0$ option for μ:, and press ENTER.
6. Select Calculate or Draw, and press ENTER.

The test statistic is $t = 3.32$ and $p-$value is $p - \text{value} = 0.000839$.

Two-Tailed Test

We observe a sample of 14 observations with a sample mean of 12.8 and a standard deviation of 9.3, and want to test the hypotheses $Ho : \mu = 11.1$ vs $Ha : \mu \neq 11.1$. This test can be performed by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 2:T-Test and press ENTER. This will bring up the T-Test menu.
3. Use the arrow keys to highlight the Stats option for Inpt:, and press ENTER.
4. Enter 11.1 for $\mu0$:, enter 12.8 for $\bar{x}$:, enter 9.3 for Sx:, and enter 14 for n:
5. Use the arrow keys to highlight the $\neq \mu0$ option for μ:, and press ENTER.
6. Select Calculate or Draw, and press ENTER.

In the event that you selected the Draw option, the following display would be the input screen:

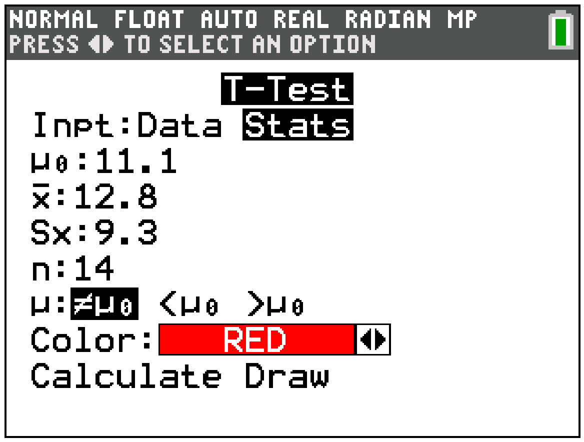

Figure B.11: Input for the Hypothesis Test for a Mean

Note: Older versions of the TI-83 and TI-84 do not have the color option.

The following display would be the results:

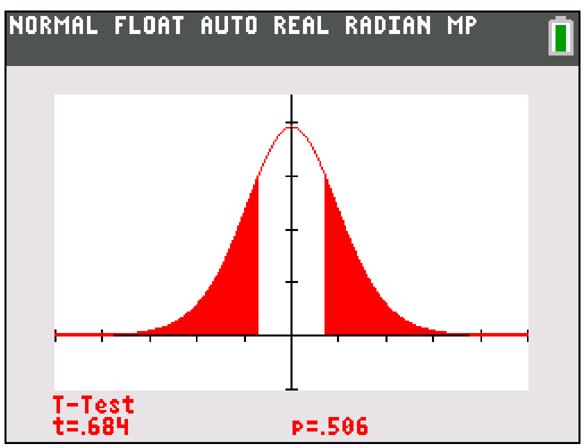

Figure B.12: Output for the Hypothesis Test for a Mean

Note: You can also enter the data into a list in the TI (see Section B.5) and highlight the Data option for Inpt: and press ENTER. Be sure that Freq: is set to 1.

B.14 χ^2 Distribution

Using χ^2cdf to Find a Probability

We want to find the $Pr(\chi^2 > 4.71)$ if $df = 1$. The value can be found using the χ^2cdf function by:

1. Press 2ND then VARS [DISTR] for the distribution menu.
2. Scroll down to χ^2cdf and press ENTER.
3. The syntax for the χ^2 cumulative density function command is χ^2cdf(lower,upper,df). Note: The value of 1E99 can be used as the upper bound value to represent ∞.

   The E is found on the calculator using: Press 2ND then , [EE].

Therefore, the desired probability can be found from:

$$Pr(\chi^2 > 4.71) = \chi^2\text{cdf}(4.71,1E99,1) = 0.02999.$$

B.15 χ^2 Test for Independence

Suppose a researcher collects the data that is displayed below in the two-way table. The researcher is interested in determining if a relationship exists between the Responses in Variable A and the Groups in Variable B.

	Variable A	
Variable B	No	Yes
Group 1	44	6
Group 2	38	12

To perform the Chi-Square Test for Independence, we must first enter the observed cell counts in a matrix. Enter the observed cell counts in a matrix by:

1. Press 2ND then x^{-1} [MATRIX] for the matrix menu.

2. Scroll across to EDIT mode, and press ENTER. (This will allow us to edit the dimensions and values in the desired matrix. For purpose of illustration, we use matrix A.)

3. Enter 2 in the first dimension and arrow over to enter 2 in the second dimension. The cursor will advance to the first cell in matrix A.

4. Enter 44 in [A](1,1), enter 38 in [A](2,1), enter 6 in [A](1,2), and enter 12 in [A](2,2), and press ENTER.

The following figure displays the input screen for matrix A:

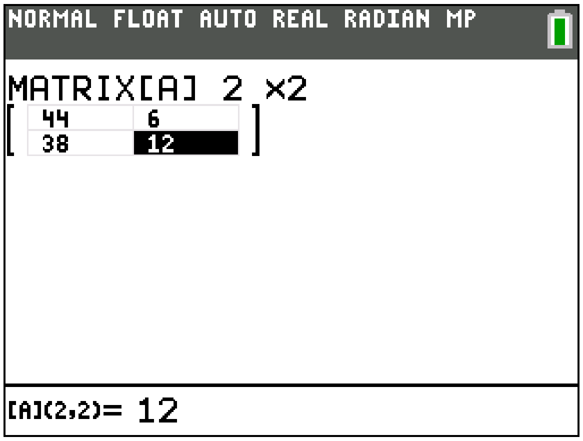

Figure B.13: Input of Matrix A

We can then perform the Chi-Square Test for Independence by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS, scroll down to C:χ^2-Test, and press ENTER.
3. Enter the desired matrix [A] after Observed: (Note: This is the default entry.), and keep the default of [B] for Expected:
4. Select Calculate or Draw, and press ENTER.

In the event that you select Draw option, the following display will be the result:

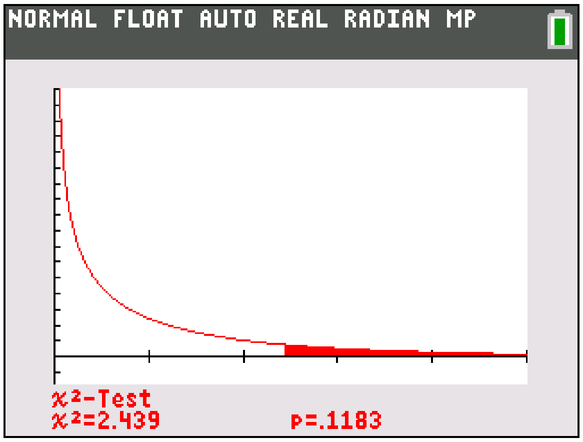

Figure B.14: Results for the Chi-Square Test

The test statistic is $\chi^2 = 2.439$ and the $p-$value is $p - \text{value} = 0.1183$. The TI calculator also outputs the expected cell counts in Matrix B.

B.16 Scatterplot

Suppose that a researcher is interested in examining the relationship between temperature and number of coffees sold for each Monday the cafe was open (the data is displayed in the following table).

Coffee Sold	High Temperature	Coffee Sold	High Temperature
20	36	27	37
18	31	31	26
25	36	24	40
8	48	5	47
16	56		

Following the instructions in steps 1 - 4 in Section B.5, we enter the "Coffee Sold" data into L1 and the "High Temperature" data into L2. (**Be sure that points are in the same row.** For example, the point (20,36) must have 20 and 36 in the same row.) After you have entered the tabled data, construct a scatterplot by:

1. Press 2ND then press Y= for the STATPLOT menu.
2. Select the plot that you would like to use, e.g., 1:Plot1..., and press ENTER. This will bring up the plot entry screen.
3. Select On by moving your cursor above the On position and pressing ENTER.
4. Using the arrow keys move the cursor over the Type: position for the graph of interest (the scatterplot is displayed on the far left), and press ENTER.
5. Enter L2 for XList: because we want "High Temperature" to be our explanatory variable, and enter L1 for YList: because we want "Coffee Sold" to be our response variable.
6. Using the arrow keys move the cursor over the Mark: position for the symbol of interest (this symbol will be used to denote plotted points), and press ENTER.
7. Press the ZOOM button (directly under the screen on your calculator) and arrow down to 9:ZoomStat and press ENTER. This will allow us to see the scatterplot.

The following figure displays the input screen for a scatterplot:

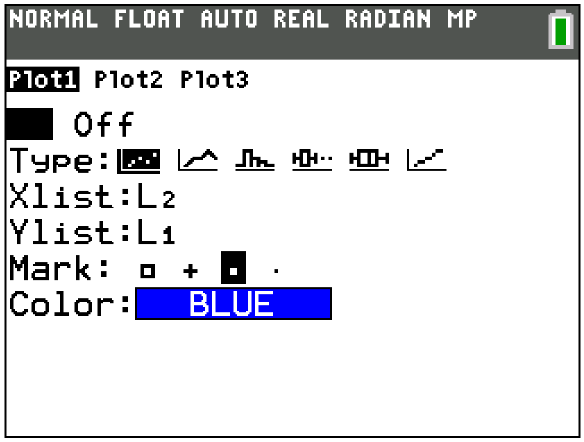

Figure B.15: Input Screen for a Scatterplot

Note: Older versions of the TI-83 and TI-84 will not have the color option.

The following figure displays the resulting scatterplot:

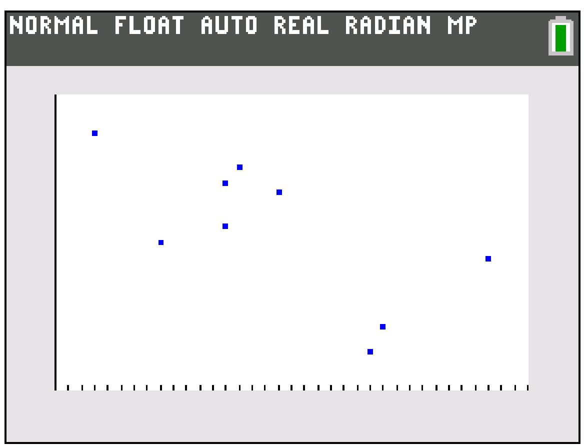

Figure B.16: Illustration of a Scatterplot

Note: Some versions of the TI-83 and TI-84 may automatically sketch a line (called the regression line) onto the scatterplot.

B.17 Correlation and Regression

Suppose that we want to build a regression model for the data in Section B.16. The first step is to be sure that your TI-84 diagnostics are turned on (which is required if you want the calculator to automatically compute the linear correlation r and the coefficient of determination r^2). This is accomplished by:

1. Press 2ND then press 0 [CATALOG] for the CATALOG menu.
2. Using the arrow keys move the cursor over the DiagnosticOn position, press ENTER, and then press ENTER again.

Note: Once you have turned the diagnostics on, they will remain on unless you turn them off or replace the batteries.

The method to get the linear correlation and regression line differ depending on whether you have a newer or older version of the TI calculator.

<u>For newer version of the TI-84</u>
After you have turned diagnostics on, you can determine the regression line by:

1. Press STAT, and scroll across to CALC, scroll down to 8:LinReg(a+bx), and press ENTER.
2. Enter L2 for XList: because we want "High Temperature" to be our explanatory variable, and enter L1 for YList: because we want "Coffee Sold" to be our response variable.
3. Using the arrow keys move the cursor over the Calculate position, and press ENTER. (Note: Do not enter any information into the FreqList: or the Store RegEQ: positions.)

The following figure displays the input screen for regression:

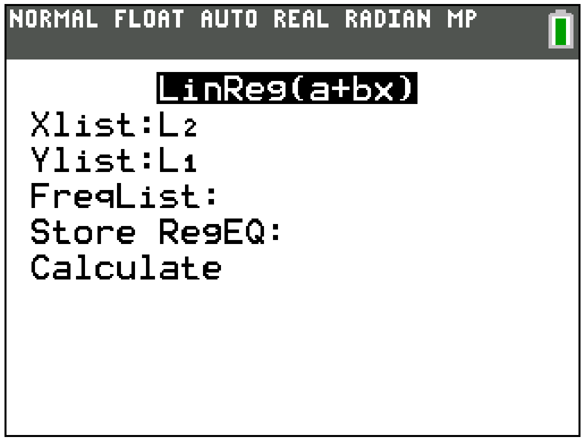

Figure B.17: Input Screen for Regression

For older versions of the TI-83 and TI-84

After you have turned diagnostics on, you can determine the regression line by:

1. Press STAT, and scroll across to CALC, scroll down to 8:LinReg(a+bx), and press ENTER.

2. Enter L2 for XList: because we want "High Temperature" to be our explanatory variable. Then, press the , key. Finally, enter L1 for YList: because we want "Coffee Sold" to be our response variable. Press ENTER.

The following figure displays the information for the regression line for either version of TI calculator:

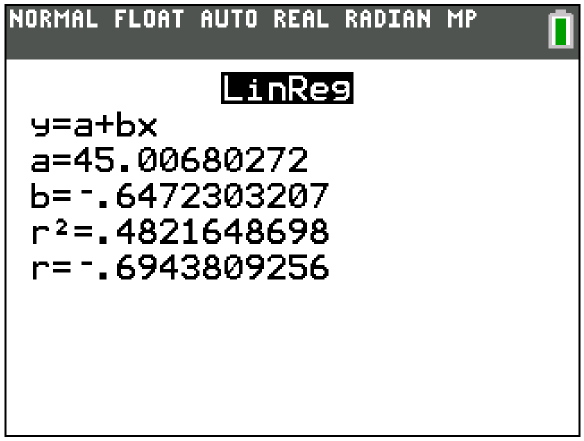

Figure B.18: Information for the Regression Line

The calculator output indicates that the regression line is given by: $\hat{y} = 45.001 - 0.647x$. This data has a correlation of -0.694 and the model has a coefficient of determination of 0.482.

To plot the regression line on the scatterplot of the data, first follow the steps in Section B.16 to create a scatterplot of the data. Graph the regression line by:

1. Press Y= to bring up the equation menu. Verify that the desired Plot is highlighted on the top of the screen - we used Plot1.

2. Enter 45-.647X after the Y= position.

3. Press the ZOOM key, and select the 9:ZoomStat option.

The following figure displays the input screen for graphing the regression line:

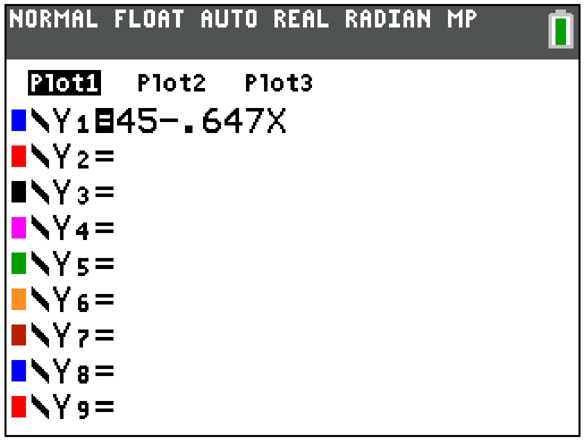

Figure B.19: Input Screen for Graphing the Regression Line

The following figure displays the resulting graph of the regression line:

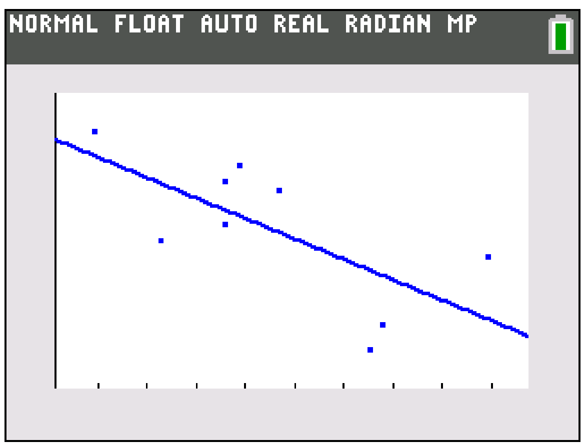

Figure B.20: Graph of the Regression Line

B.18 Hypothesis Test for the Slope

Suppose that we want to conduct the hypothesis test to examine whether there is sufficient evidence to conclude that the slope of the regression line is non-zero. The first steps are to appropriately enter your data and make sure that your TI-84 diagnostics are turned on. You can then conduct the hypothesis test for the slope by:

1. Press STAT, and scroll across to TESTS, scroll down to F:LinRegTTest, and press ENTER.

2. Enter L2 for XList: because we want "High Temperature" to be our explanatory variable, enter L1 for YList: because we want "Coffee Sold" to be our response variable, and enter 1 for Freq:.

3. Using the arrow keys move the cursor over the $\neq 0$ position after the β & ρ: heading, and press ENTER. (Note: Do not enter any information into the RegEQ: position.)

The following figure displays the input screen for regression:

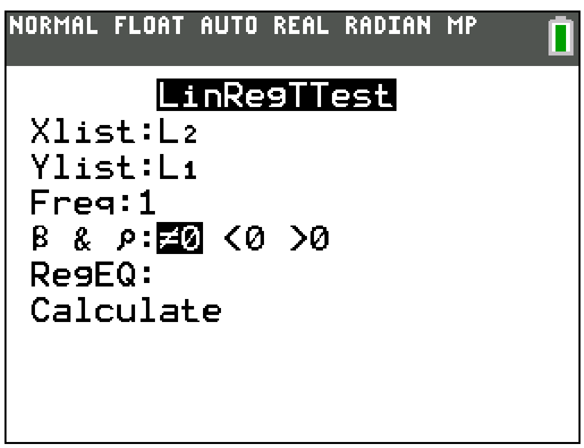

Figure B.21: Input Screen for a Hypothesis Test for Slope of a Regression Line

The following figure displays the information for the hypothesis test for the slope from the TI calculator:

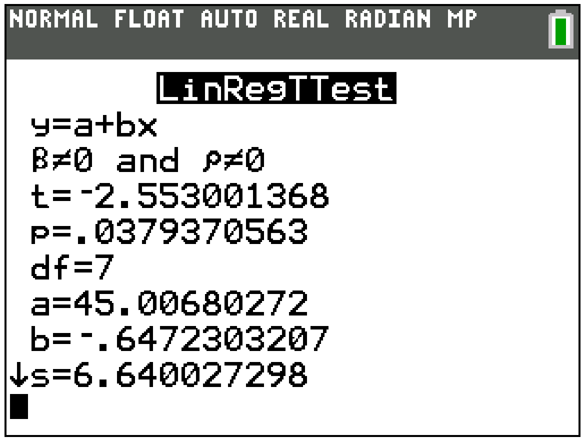

Figure B.22: Information for the Hypothesis Test for Slope of a Regression Line

The calculator output indicates that the test statistic and p-value for the hypothesis test to examine whether the slope of the regression line is non-zero are -2.553 and 0.0379, respectively.

B.19 Confidence Interval for the Slope

Suppose that we want to make a 90% confidence interval for the slope of the regression line. The first steps are to appropriately enter your data and make sure that your TI-84 diagnostics are turned on. You can then make a 90% confidence interval for the slope by:

1. Press STAT, and scroll across to TESTS, scroll down to G:LinRegTInt, and press ENTER.

2. Enter L2 for XList: because we want "High Temperature" to be our explanatory variable, enter L1 for YList: because we want "Coffee Sold" to be our response variable, and enter 1 for Freq:.

3. Using the arrow keys move to the C-Level: position and enter 0.9 after the colon, and press ENTER. (Note: Do not enter any information into the RegEQ: position.)

The following figure displays the input screen for regression:

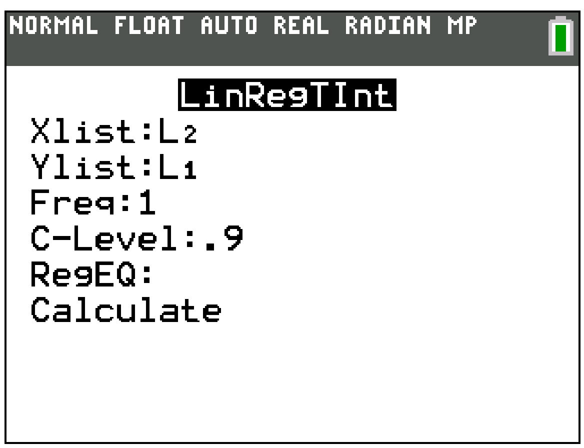

Figure B.23: Input Screen for a Confidence Interval for the Slope of a Regression Line

The following figure displays the information for the confidence interval for the slope from the TI calculator:

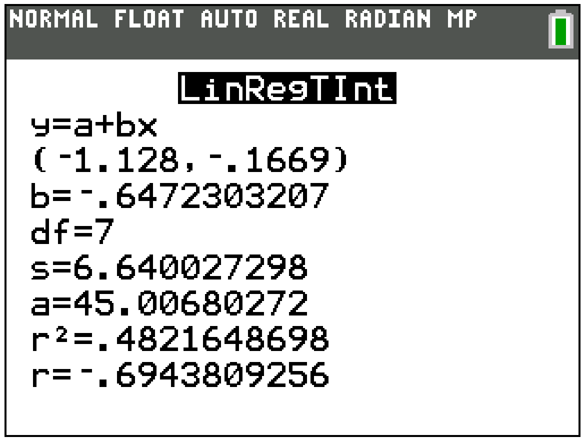

Figure B.24: Information for a Confidence Interval for the Slope of a Regression Line

The calculator output indicates that the lower and upper limits of the 90% confidence interval for the slope of the regression line are −1.128 and −0.1669, respectively.

B.20 Hypothesis Test for the Difference in Two Means

We observe one sample of 14 observations with a sample mean of 17.383 and a standard deviation of 9.849, and another sample of 12 observations with a sample mean of 34.760 and a standard deviation of 21.592. Further, suppose that it is of interest to test the hypotheses $Ho : \mu_1 = \mu_2$ vs $Ha : \mu_1 \neq \mu_2$. This test can be performed by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 4:2-SampTTest and press ENTER. This will bring up the 2-SampTTest menu.
3. Use the arrow keys to highlight the Stats option for Inpt:, and press ENTER.
4. Enter 17.383 for $\bar{x}$1:, enter 9.849 for Sx1:, and enter 14 for n1:
5. Enter 34.760 for $\bar{x}$2:, enter 21.592 for Sx2:, and enter 12 for n2:
6. Use the arrow keys to highlight the $\neq \mu 2$ option for $\mu 1$:, and press ENTER.
7. Use the arrow keys to highlight the No option for Pooled:, and press ENTER.
8. Select Calculate or Draw, and press ENTER.

The following display will be the top of the input screen:

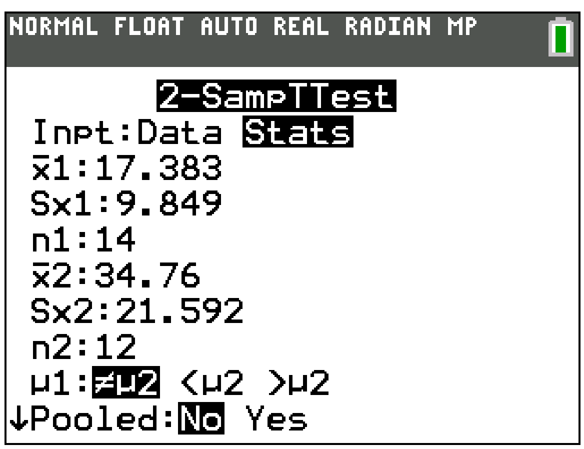

Figure B.25: Input for the Hypothesis Test for Two Means

In the event that you select Draw option, the following display will be the results:

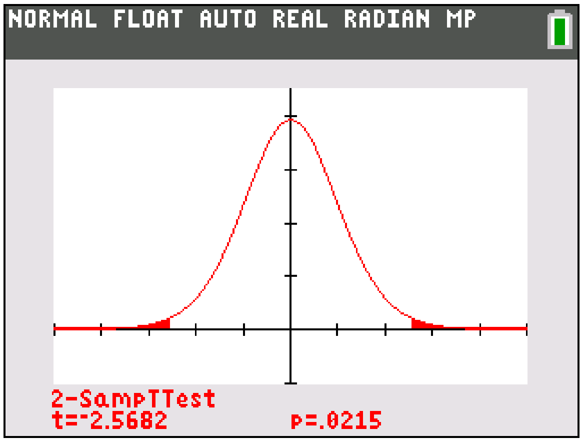

Figure B.26: Output for the Hypothesis Test for Two Means

In the event that you select the Calculate option, the following display will be the results:

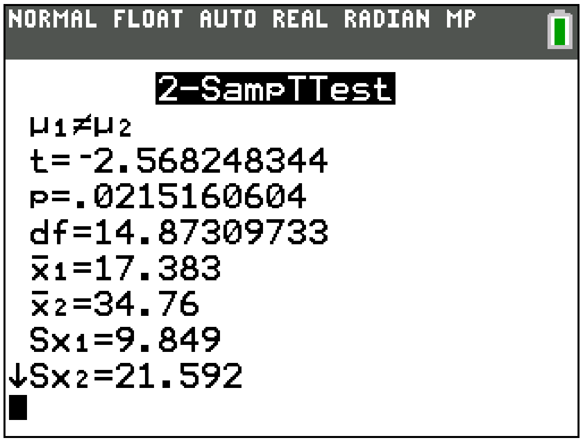

Figure B.27: Calculate Output for the Hypothesis Test for Two Means

Note: You could also enter the data into two separate columns and choose the Data option for Inpt:. The rest of the screen is self-explanatory for this choice.

B.21 Confidence Interval for the Difference of Two Means

We observe one sample of 14 observations with a sample mean of 17.383 and a standard deviation of 9.849, and another sample of 12 observations with a sample mean of 34.760 and a standard deviation of 21.592. Further, suppose that it is of interest to construct a 95% confidence interval for the difference between $\mu_1 - \mu_2$. This confidence interval can be obtained by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 0:2-SampTInt and press ENTER. This will bring up the 2-SampTInt menu.
3. Use the arrow keys to highlight the Stats option for Inpt:, and press ENTER.
4. Enter 17.383 for $\bar{x}$1:, enter 9.849 for Sx1:, and enter 14 for n1:
5. Enter 34.760 for $\bar{x}$2:, enter 21.592 for Sx2:, and enter 12 for n2:
6. Set the confidence level to the desired value by placing .95 for C-Level:.
7. Use the arrow keys to highlight the No option for Pooled:, then select Calculate, and press ENTER.

The confidence interval (illustrated in the following display) for $\mu_1 - \mu_2$ is $(-31.81, -2.945)$. Since the degrees of freedom used in the computations by the TI calculator is df=14.873, the values differ slightly from those reported in Example 5.18 in the text (because the text used df = 14).

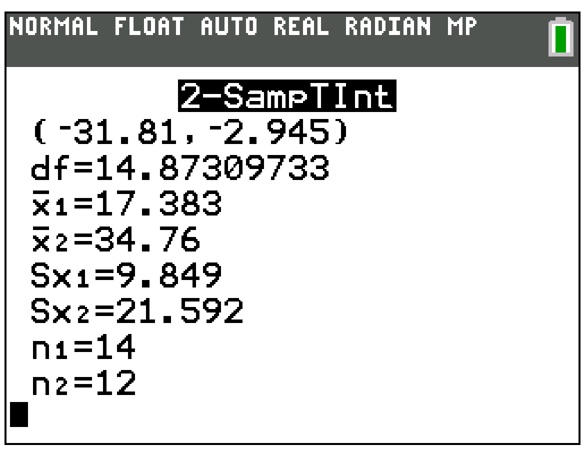

Figure B.28: Output for the Confidence Interval for the Difference of Two Means

Note: You could also enter the data into two separate columns and choose the Data option for Inpt:. The rest of the screen is self-explanatory for this choice.

B.22 Finding Paired Differences

Suppose that a researcher measures the heart rate of 8 subjects before and after taking a one mile walk at a moderate pace (the data is displayed in the table below).

Subj	Before	After
1	79	83
2	77	87
3	70	73
4	65	71
5	81	89
6	73	74
7	68	67
8	67	73

To find the paired differences we begin by entering the paired values into two columns. Following the instructions in steps 1 - 4 in Section B.5, we enter the data in the "After" column in L1 and the "Before" column in L2. (We choose to enter "After" into L1 so that most of the paired differences will be positive.) After entering the tabled data, we can create the matched pairs differences by:

1. Use the arrow keys to highlight the L3 variable label.

2. Press 2ND and 1 (which puts L1 in the formula line), press the - sign, press 2ND and 2 (which puts L2 in the formula line), and then press ENTER.

   Note: Before you hit the ENTER key, the formula below the data table should read L3=L1-L2, and after you hit ENTER the input screen will look like the data screen below.

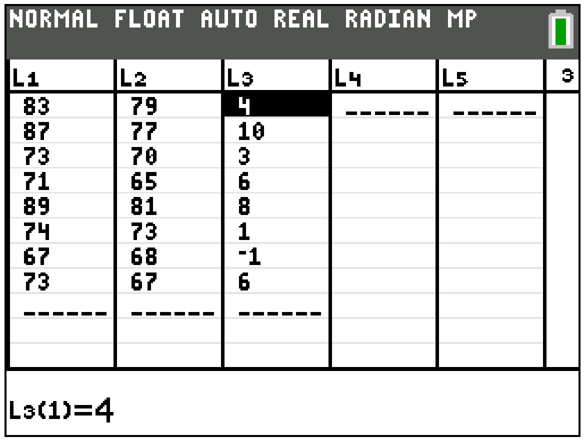

Figure B.29: Input for the Paired Differences Data

B.23 Confidence Interval for Paired Data

Suppose we have entered the data and found the paired differences in Section B.22. It is of interest to construct a 99% confidence interval for the population mean of the paired differences μ_d.

Once data entry is complete and the paired differences have been found, we can find the confidence interval by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 8:TInterval. Press ENTER.
3. Use the arrow keys to highlight the Data option for Inpt:, and press ENTER.
4. Enter L3 for List:, and keep the default of 1 for the Freq:
5. Set the confidence level to the desired value by placing .99 for C-Level:, then select Calculate, and press ENTER.

The desired confidence interval for μ_d is $(0.142, 9.107)$ with a center of $\bar{x} = 4.625$.

B.24 Hypothesis Test for Paired Data

Suppose we have entered the data and found the paired differences in Section B.22. It is of interest to test the hypotheses $Ho : \mu_d = 0$ vs $Ha : \mu_d \neq 0$ with an $\alpha = 0.01$ to determine if heart rate changes after a one mile walk.

Once data entry is complete and the paired differences have been found, we conduct the paired t test by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS and scroll down to 2:T-Test and press ENTER. This will bring up the T-Test menu.
3. Use the arrow keys to highlight the Data option for Inpt:, and press ENTER.
4. Enter 0 for $\mu 0$:, enter L3 for List:, and keep the default of 1 for Freq:
5. Use the arrow keys to highlight the $\neq \mu 0$ option for μ:, and press ENTER.
6. Select Calculate or Draw, and press ENTER.

The output from the calculator is displayed below:

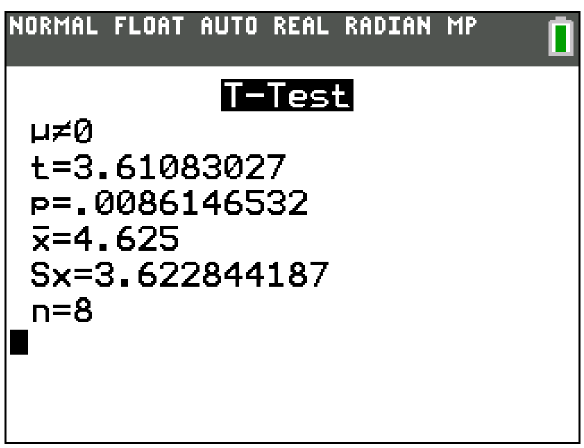

Figure B.30: Output for the Hypothesis Test for the Paired T Test

B.25 One-way ANOVA

Suppose that a researcher collects a small data set consisting of 5 observations from three independent samples. The data is displayed in the table below. It is of interest to test the hypotheses $Ho : \mu_A = \mu_B = \mu_C$ vs Ha : at least one μ_i differs with an $\alpha = 0.05$.

Group A	Group B	Group C
17	14	18
19	19	16
19	24	24
18	19	17
14	19	18

To perform one-way ANOVA, we must first enter the observations of the independent samples in separate columns. Following the instructions in steps 1 - 4 in Section B.5, we enter the data in the "Group A" column in L1, the "Group B" column in L2, and the "Group C" column in L3.

After you have entered the tabled data, one-way ANOVA can be performed by:

1. Press STAT for the statistics menu.
2. Scroll across to TESTS, scroll down to H:ANOVA(, and press ENTER.
3. Enter L1,L2,L3) after ANOVA(, such that the TI calculator screen reads ANOVA(L1,L2,L3), and press ENTER.

The following two figures display the resulting output:

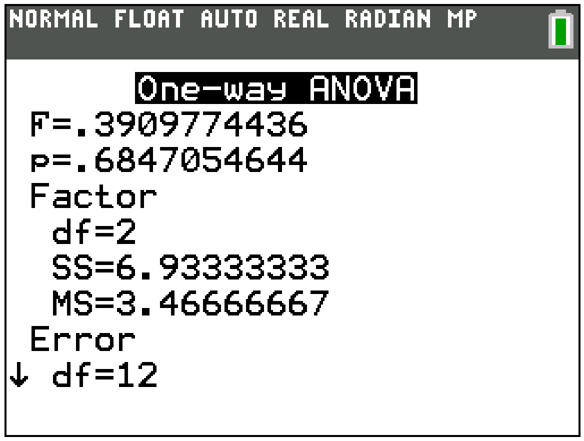

Figure B.31: Output 1 for One-way ANOVA

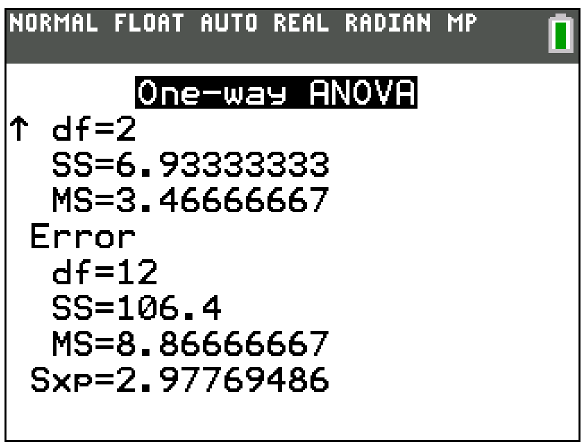

Figure B.32: Output 2 for One-way ANOVA

The desired F statistic and $p-$value are $F = 0.391$ and $p - \text{value} = 0.685$. The TI calculator also outputs the DFB, DFW, SSB, SSW, MSB, and MSW which allows you to complete the ANOVA table..