TI-83/84 Guide for Introductory Statistics

Includes step-by-step instructions,
practice exercises, and links to video
tutorials. Covers all calculator features
needed for AP® Statistics Exam

Instructions excerpted from
Advanced High School Statistics, 2nd ed.
available for FREE at openintro.org/ahss

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Summarizing data

Entering data

TI-83/84: ENTERING DATA

The first step in summarizing data or making a graph is to enter the data set into a list. Use `STAT`, `Edit`.

1. Press `STAT`.
2. Choose `1:Edit`.
3. Enter data into `L1` or another list.

Calculating summary statistics

TI-84: CALCULATING SUMMARY STATISTICS

Use the `STAT`, `CALC`, `1-Var Stats` command to find summary statistics such as mean, standard deviation, and quartiles.

1. Enter the data as described previously.
2. Press `STAT`.
3. Right arrow to `CALC`.
4. Choose `1:1-Var Stats`.
5. Enter `L1` (i.e. `2ND 1`) for List. If the data is in a list other than `L1`, type the name of that list.
6. Leave `FreqList` blank.
7. Choose `Calculate` and hit `ENTER`.

TI-83: Do steps 1-4, then type `L1` (i.e. `2nd 1`) or the list's name and hit `ENTER`.

Calculating the summary statistics will return the following information. It will be necessary to hit the down arrow to see all of the summary statistics.

$\bar{x}$	Mean	n	Sample size or # of data points
Σx	Sum of all the data values	minX	Minimum
Σx^2	Sum of all the squared data values	Q_1	First quartile
Sx	Sample standard deviation	Med	Median
σx	Population standard deviation	maxX	Maximum

Drawing a box plot

TI-83/84: DRAWING A BOX PLOT

1. Enter the data to be graphed as described previously.
2. Hit `2ND Y=` (i.e. `STAT PLOT`).
3. Hit `ENTER` (to choose the first plot).
4. Hit `ENTER` to choose `ON`.
5. Down arrow and then right arrow three times to select box plot with outliers.
6. Down arrow again and make `Xlist: L1` and `Freq: 1`.
7. Choose `ZOOM` and then `9:ZoomStat` to get a good viewing window.

What to do if you cannot find L1 or another list

TI-83/84: WHAT TO DO IF YOU CANNOT FIND L1 OR ANOTHER LIST

Restore lists `L1`-`L6` using the following steps:

1. Press `STAT`.
2. Choose `5:SetUpEditor`.
3. Hit `ENTER`.

Practice exercises

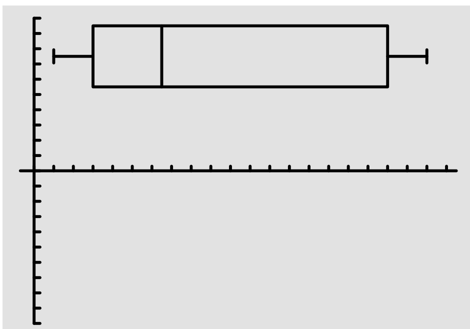
GUIDED PRACTICE 0.1

Enter the following 10 data points into a list on a calculator:

$$5, 8, 1, 19, 3, 1, 11, 18, 20, 5$$

Find the summary statistics and make a box plot of the data.[1]

[1] The summary statistics should be $\bar{x} = 9.1$, $Sx = 7.475$, $Q1 = 3$, etc. The box plot should be as follows.



Probability

Computing the binomial coefficient

TI-83/84: COMPUTING THE BINOMIAL COEFFICIENT, $\binom{n}{k}$

Use MATH, PRB, nCr to evaluate n choose r. Here r and k are different letters for the same quantity.

1. Type the value of n.
2. Select MATH.
3. Right arrow to PRB.
4. Choose 3:nCr.
5. Type the value of k.
6. Hit ENTER.

Example: 5 nCr 3 means *5 choose 3*.

Computing the binomial formula

TI-84: COMPUTING THE BINOMIAL FORMULA, $P(X = k) = \binom{n}{k}p^k(1-p)^{n-k}$

Use 2ND VARS, binompdf to evaluate the probability of *exactly* k occurrences out of n independent trials of an event with probability p.

1. Select 2ND VARS (i.e. DISTR)
2. Choose A:binompdf (use the down arrow).
3. Let trials be n.
4. Let p be p
5. Let x value be k.
6. Select Paste and hit ENTER.

TI-83: Do steps 1-2, then enter n, p, and k separated by commas:
binompdf(n, p, k). Then hit ENTER.

Computing a cumulative binomial probability

TI-84: COMPUTING $P(X \leq k) = \binom{n}{0}p^0(1-p)^{n-0} + ... + \binom{n}{k}p^k(1-p)^{n-k}$

Use `2ND VARS`, `binomcdf` to evaluate the cumulative probability of *at most* k occurrences out of n independent trials of an event with probability p.

1. Select `2ND VARS` (i.e. `DISTR`)
2. Choose `B:binomcdf` (use the down arrow).
3. Let `trials` be n.
4. Let `p` be p
5. Let `x` value be k.
6. Select `Paste` and hit `ENTER`.

TI-83: Do steps 1-2, then enter the values for n, p, and k separated by commas as follows: `binomcdf(n, p, k)`. Then hit `ENTER`.

Practice exercises

G

GUIDED PRACTICE 0.2

Find the number of ways of arranging 3 blue marbles and 2 red marbles.[2]

G

GUIDED PRACTICE 0.3

There are 13 marbles in a bag. 4 are blue and 9 are red. Randomly draw 5 marbles *with replacement*. Find the probability you get exactly 3 blue marbles.[3]

G

GUIDED PRACTICE 0.4

There are 13 marbles in a bag. 4 are blue and 9 are red. Randomly draw 5 marbles *with replacement*. Find the probability you get *at most* 3 blue marbles (i.e. less than or equal to 3 blue marbles).[4]

[2]Here $n = 5$ and $k = 3$. Doing 5 `nCr` 3 gives the number of combinations as 10.

[3]Here, $n = 5$, $p = 4/13$, and $k = 3$, so set `trials` $= 5$, `p` $= 4/13$ and `x value` $= 3$. The probability is 0.1396.

[4]Similarly, set `trials` $= 5$, `p` $= 4/13$ and `x value` $= 3$. The cumulative probability is 0.9662.

Distribution of random variables

Finding area under the normal curve

TI-84: FINDING AREA UNDER THE NORMAL CURVE

Use `2ND VARS`, `normalcdf` to find an area/proportion/probability to the left or right of a Z-score or between two Z-scores.

1. Choose `2ND VARS` (i.e. `DISTR`).
2. Choose `2:normalcdf`.
3. Enter the Z-scores that correspond to the lower (left) and upper (right) bounds.
4. Leave μ as `0` and σ as `1`.
5. Down arrow, choose `Paste`, and hit `ENTER`.

TI-83: Do steps 1-2, then enter the lower bound and upper bound separated by a comma, e.g. `normalcdf(2, 5)`, and hit `ENTER`.

Find a Z-score that corresponds to a percentile

TI-84: FIND A Z-SCORE THAT CORRESPONDS TO A PERCENTILE

Use `2ND VARS`, `invNorm` to find the Z-score that corresponds to a given percentile.

1. Choose `2ND VARS` (i.e. `DISTR`).
2. Choose `3:invNorm`.
3. Let `Area` be the percentile as a decimal (the area to the left of desired Z-score).
4. Leave μ as `0` and σ as `1`.
5. Down arrow, choose `Paste`, and hit `ENTER`.

TI-83: Do steps 1-2, then enter the percentile as a decimal, e.g. `invNorm(.40)`, then hit `ENTER`.

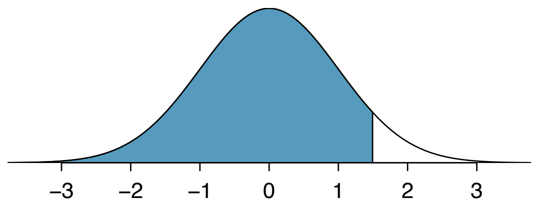
Practice exercises

E

EXAMPLE 0.5

Use a calculator to determine what percentile corresponds to a Z-score of 1.5.

Always first sketch a graph:[5]



To find an area under the normal curve using a calculator, first identify a lower bound and an upper bound. Theoretically, we want all of the area to the left of 1.5, so the left endpoint should be -∞. However, the area under the curve is nearly negligible when Z is smaller than -4, so we will use -5 as the lower bound when not given a lower bound (any other negative number smaller than -5 will also work). Using a lower bound of -5 and an upper bound of 1.5, we get $P(Z < 1.5) = 0.933$.

G

GUIDED PRACTICE 0.6

Find the area under the normal curve to right of $Z = 2$. [6]

G

GUIDED PRACTICE 0.7

Find the area under the normal curve between -1.5 and 1.5. [7]

E

EXAMPLE 0.8

Use a calculator to find the Z-score that corresponds to the 40th percentile.

Letting Area be 0.40, a calculator gives -0.253. This means that $Z = -0.253$ corresponds to the 40th percentile, that is, $P(Z < -0.253) = 0.40$.

G

GUIDED PRACTICE 0.9

Find the Z-score such that 20 percent of the area is to the right of that Z-score.[8]

---

[5]normalcdf gives the result without drawing the graph. To draw the graph, do 2nd VARS, DRAW, 1:ShadeNorm. However, beware of errors caused by other plots that might interfere with this plot.

[6]Now we want to shade to the right. Therefore our lower bound will be 2 and the upper bound will be 5 (or a number bigger than 5) to get $P(Z > 2) = 0.023$.

[7]Here we are given both the lower and the upper bound. Lower bound is -1.5 and upper bound is 1.5. The area under the normal curve between -1.5 and 1.5 = $P(-1.5 < Z < 1.5) = 0.866$.

E

EXAMPLE 0.10

In a large study of birth weight of newborns, the weights of 23,419 newborn boys were recorded.[9] The distribution of weights was approximately normal with a mean of 7.44 lbs (3376 grams) and a standard deviation of 1.33 lbs (603 grams). The government classifies a newborn as having low birth weight if the weight is less than 5.5 pounds. What percent of these newborns had a low birth weight?

We find an area under the normal curve between -5 (or a number smaller than -5, e.g. -10) and a Z-score that we will calculate. There is no need to write calculator commands in a solution. Instead, continue to use standard statistical notation.

$$\begin{aligned} Z &= \frac{5.5 - 7.44}{1.33} \\ &= -1.49 \\ P(Z < -1.49) &= 0.068 \end{aligned}$$

Approximately 6.8% of the newborns were of low birth weight.

G

GUIDED PRACTICE 0.11

Approximately what percent of these babies weighed greater than 10 pounds?[10]

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[8] If 20% of the area is the right, then 80% of the area is to the left. Letting area be 0.80, we get $Z = 0.841$.

[9] www.biomedcentral.com/1471-2393/8/5

[10] $Z = \frac{10-7.44}{1.33} = 1.925$. Using a lower bound of 2 and an upper bound of 5, we get $P(Z > 1.925) = 0.027$. Approximately 2.7% of the newborns weighed over 10 pounds.

Inference for categorical data

1-proportion Z-interval and Z-test

TI-83/84: 1-PROPORTION Z-INTERVAL

Use `STAT`, `TESTS`, `1-PropZInt`.

1. Choose `STAT`.
2. Right arrow to `TESTS`.
3. Down arrow and choose `A:1-PropZInt`.
4. Let `x` be the *number* of yes's (must be an integer).
5. Let `n` be the sample size.
6. Let `C-Level` be the desired confidence level.
7. Choose `Calculate` and hit `ENTER`, which returns

`(__,__)`	the confidence interval
$\hat{p}$	the sample proportion
`n`	the sample size

TI-83/84: 1-PROPORTION Z-TEST

Use STAT, TESTS, 1-PropZTest.

1. Choose STAT.
2. Right arrow to TESTS.
3. Down arrow and choose 5:1-PropZTest.
4. Let p_0 be the null or hypothesized value of p.
5. Let x be the *number* of yes's (must be an integer).
6. Let n be the sample size.
7. Choose $\neq$, $<$, or $>$ to correspond to H_A.
8. Choose Calculate and hit ENTER, which returns

   z Z-statistic
   p p-value
   $\hat{p}$ the sample proportion
   n the sample size

Practice exercises

GUIDED PRACTICE 0.12

Using a calculator, evaluate the confidence interval from the example on intelligent life. Recall that we wanted to find a 95% confidence interval for the proportion of U.S. adults who think there is intelligent life on other planets. The sample percent was 68% and the sample size was 1,033.[11]

GUIDED PRACTICE 0.13

Using a calculator, find the test statistic and p-value for the example on nuclear energy. Recall that we were looking for evidence that more than half of U.S. adults oppose nuclear energy. The sample percent was 54%, and the sample size was 1019.[12]

[11]Navigate to 1-PropZInt on the calculator. To find x, the number of yes responses in the sample, we multiply the sample proportion by the sample size. Here $0.68 \times 1033 = 702.44$. We must round this to an integer, so we use x $= 702$. Also, n $=1033$ and C-Level $= 0.95$. The 95% confidence interval is (0.651, 0.708).

[12]Navigate to 1-PropZTest on the calculator. Let $p_0 = 0.5$. To find x, do $0.54 \times 1019 = 550.26$. This needs to be an integer, so round to the closest integer. Here x $= 550$. Also, n $= 1019$. We are looking for evidence that greater than half oppose, so choose $> p_0$. When we do Calculate, we get the test statistic: Z = 2.64 and the p-value: p = 0.006.

2-proportion Z-interval and Z-test

TI-83/84: 2-PROPORTION Z-INTERVAL

Use STAT, TESTS, 2-PropZInt.

1. Choose STAT.
2. Right arrow to TESTS.
3. Down arrow and choose B:2-PropZInt.
4. Let x1 be the *number* of yes's (must be an integer) in sample 1 and let n1 be the size of sample 1.
5. Let x2 be the *number* of yes's (must be an integer) in sample 2 and let n2 be the size of sample 2.
6. Let C-Level be the desired confidence level.
7. Choose Calculate and hit ENTER, which returns:

(__,__)	the confidence interval		
$\hat{p}_1$	sample 1 proportion	n_1	size of sample 1
$\hat{p}_2$	sample 2 proportion	n_2	size of sample 2

TI-83/84: 2-PROPORTION Z-TEST

Use STAT, TESTS, 2-PropZTest.

1. Choose STAT.
2. Right arrow to TESTS.
3. Down arrow and choose 6:2-PropZTest.
4. Let x1 be the *number* of yes's (must be an integer) in sample 1 and let n1 be the size of sample 1.
5. Let x2 be the *number* of yes's (must be an integer) in sample 2 and let n2 be the size of sample 2.
6. Choose $\neq$, $<$, or $>$ to correspond to H_A.
7. Choose Calculate and hit ENTER, which returns:

z	Z-statistic	p	p-value
$\hat{p}_1$	sample 1 proportion	$\hat{p}$	pooled sample proportion
$\hat{p}_2$	sample 2 proportion		

Practice exercises

GUIDED PRACTICE 0.14

A quality control engineer collects a sample of gears, examining 1000 gears from each company and finds that 879 gears pass inspection from the current supplier and 958 pass inspection from the prospective supplier. Use a calculator to find a 95% confidence interval for the difference (current − prospective) in the proportion that would pass inspection.[13]

GUIDED PRACTICE 0.15

Use a calculator to find the test statistic, p-value, and pooled proportion for a test with: H_A: p for fish oil $<$ p for placebo.[14]

	heart attack	no event	Total
fish oil	145	12788	12933
placebo	200	12738	12938

[13] Navigate to `2-PropZInt` on the calculator. Let `x1` = 879, `n1` = 1000, `x2` = 958, and `n2` = 1000. `C-Level` is .95. This should lead to an interval of (-0.1027, -0.0553), which matches what we found previously.

[14] Navigate to `2-PropZTest` on the calculator. Correctly going through the calculator steps should lead to a solution with the test statistic `z` = -2.977 and the p-value `p` = 0.00145. These two values match our calculated values from the previous example to within rounding error. The pooled proportion is given as `p̂` = 0.0133. Note: values for `x1` and `x2` were given in the table. If, instead, proportions are given, find `x1` and `x2` by multiplying the proportions by the sample sizes and rounding the result to an *integer*.

Finding areas under the chi-square curve

TI-84: FINDING AN UPPER TAIL AREA UNDER THE CHI-SQUARE CURVE

Use the χ^2`cdf` command to find areas under the chi-square curve.

1. Hit `2ND VARS` (i.e. `DISTR`).
2. Choose `8:`χ^2`cdf`.
3. Enter the lower bound, which is generally the chi-square value.
4. Enter the upper bound. Use a large number, such as 1000.
5. Enter the degrees of freedom.
6. Choose `Paste` and hit `ENTER`.

TI-83: Do steps 1-2, then type the lower bound, upper bound, and degrees of freedom separated by commas. e.g. χ^2`cdf(5, 1000, 3)`, and hit `ENTER`.

Chi-square goodness of fit test

TI-84: CHI-SQUARE GOODNESS OF FIT TEST

Use `STAT`, `TESTS`, χ^2`GOF-Test`.

1. Enter the observed counts into list `L1` and the expected counts into list `L2`.
2. Choose `STAT`.
3. Right arrow to `TESTS`.
4. Down arrow and choose `D:`χ^2`GOF-Test`.
5. Leave `Observed: L1` and `Expected: L2`.
6. Enter the degrees of freedom after `df`:
7. Choose `Calculate` and hit `ENTER`, which returns:

χ^2	chi-square test statistic
`p`	p-value
`df`	degrees of freedom

TI-83: Unfortunately the TI-83 does not have this test built in. To carry out the test manually, make list `L3 = (L1 - L2)`^{2} `/ L2` and do `1-Var-Stats` on `L3`. The sum of `L3` will correspond to the value of χ^2 for this test.

Chi-square test for two-way tables

TI-83/84: ENTERING DATA INTO A TWO-WAY TABLE

1. Hit `2ND` $\mathtt{x}^{-1}$ (i.e. `MATRIX`).
2. Right arrow to `EDIT`.
3. Hit `1` or `ENTER` to select matrix `A`.
4. Enter the dimensions by typing #rows, `ENTER`, #columns, `ENTER`.
5. Enter the data from the two-way table.

TI-83/84: CHI-SQUARE TEST OF HOMOGENEITY AND INDEPENDENCE

Use `STAT`, `TESTS`, χ^2`-Test`.

1. First enter two-way table data as described in the previous box.
2. Choose `STAT`.
3. Right arrow to `TESTS`.
4. Down arrow and choose `C:`χ^2`-Test`.
5. Down arrow, choose `Calculate`, and hit `ENTER`, which returns

χ^2	chi-square test statistic
`p`	p-value
`df`	degrees of freedom

TI-83/84: FINDING THE EXPECTED COUNTS

1. First enter two-way table data as described previously.
2. Carry out the chi-square test of homogeneity or independence as described in previous box.
3. Hit `2ND` $\mathtt{x}^{-1}$ (i.e. `MATRIX`).
4. Right arrow to `EDIT`.
5. Hit `2` to see matrix `B`.

This matrix contains the expected counts.

Practice exercises

GUIDED PRACTICE 0.16

Use a calculator to find the upper tail area for the the chi-square distribution with 5 degrees of freedom and a $\chi^2 = 5.1$. [15]

GUIDED PRACTICE 0.17

Use the table below and a calculator to find the χ^2-statistic and p-value for chi-square goodness of fit test.[16]

	Blue	Orange	Green	Yellow	Red	Brown
observed counts:	133	133	139	103	108	96
expected counts:	170.9	142.4	113.9	99.6	92.6	92.6

GUIDED PRACTICE 0.18

The table below shows approval numbers, based on a random sample conducted by the Pew Research poll. Use a calculator to find the expected values and the χ^2-statistic, df, and p-value for the chi-square test for independence.[17]

		Congress		
	Obama	Democrats	Republicans	Total
Approve	842	736	541	2119
Disapprove	616	646	842	2104
Total	1458	1382	1383	4223

[15] Use a lower bound of 5.1, an upper bound of 1000, and $df = 5$. The upper tail area is 0.4038.

[16] Enter the observed counts into `L1` and the expected counts into `L2`. the `GOF` test. Make sure that `Observed:` is `L1` and `Expected:` is `L2`. Let `df:` be 5. You should find that $\chi^2 = 17.36$ and p-value $= 0.004$.

[17] First create a 2×3 matrix with the data. The final summaries should be $\chi^2 = 106.4$, p-value is $p = 8.06 \times 10^{-24} \approx 0$, and $df = 2$. Below is the matrix of expected values:

	Obama	Congr. Dem.	Congr. Rep.
Approve	731.59	693.45	693.96
Disapprove	726.41	688.55	689.04

Inference for numerical data

1-sample t-test and t-interval

TI-83/84: 1-SAMPLE T-TEST

Use `STAT`, `TESTS`, `T-Test`.

1. Choose `STAT`.
2. Right arrow to `TESTS`.
3. Down arrow and choose `2:T-Test`.
4. Choose `Data` if you have all the data or `Stats` if you have the mean and standard deviation.
5. Let μ_0 be the null or hypothesized value of μ.
   - If you choose `Data`, let `List` be `L1` or the list in which you entered your data (don't forget to enter the data!) and let `Freq` be `1`.
   - If you choose `Stats`, enter the mean, SD, and sample size.
6. Choose $\neq$, $<$, or $>$ to correspond to H$_A$.
7. Choose `Calculate` and hit `ENTER`, which returns:

`t`	t statistic	`Sx`	the sample standard deviation
`p`	p-value	`n`	the sample size
`x̄`	the sample mean		

TI-83/84: 1-SAMPLE T-INTERVAL

Use STAT, TESTS, TInterval.

1. Choose STAT.
2. Right arrow to TESTS.
3. Down arrow and choose 8:TInterval.
4. Choose Data if you have all the data or Stats if you have the mean and standard deviation.
   - If you choose Data, let List be L1 or the list in which you entered your data (don't forget to enter the data!) and let Freq be 1.
   - If you choose Stats, enter the mean, SD, and sample size.
5. Let C-Level be the desired confidence level.
6. Choose Calculate and hit ENTER, which returns:

(__,__)	the confidence interval
x̄	the sample mean
Sx	the sample SD
n	the sample size

Practice exercises

GUIDED PRACTICE 0.19

The average time for all runners who finished the Cherry Blossom Run in 2006 was 93.3 minutes. In 2017, the average time for 100 randomly selected participants was 97.3, with a standard deviation of 17.0 minutes. Use a calculator to find the T-statistic and p-value for the appropriate test to see if the average time for the participants in 2017 is different than it was in 2006.[18]

GUIDED PRACTICE 0.20

Use a calculator to find a 95% confidence interval for the mean mercury content in croaker white fish (Pacific). The sample size was 15, and the sample mean and standard deviation were computed as 0.287 and 0.069 ppm (parts per million), respectively.[19]

[18]Navigate to T-Test. Let μ_0 be 93.3. x̄ is 97.3, S_x is 17.0, and n $= 100$. Choose $\neq$ to correspond to H_A. We get t $= 2.353$ and the p-value p $= 0.021$. The *df* $= 100 - 1 = 99$.

[19]Navigate to TInterval. We do not have all the data, so choose Stats. Enter x̄ and Sx. Note: Sx is the sample standard deviation (0.069), not the SE of the sample mean. Let n $= 15$ and C-Level $= 0.95$. This should give the interval $(0.249,\ 0.325)$. The *df* $= 15 - 1 = 14$

Matched pairs t-test and t-interval

TI-83/84: MATCHED PAIRS T-TEST

Use STAT, TESTS, T-Test.

1. Choose STAT.
2. Right arrow to TESTS.
3. Down arrow and choose 2:T-Test.
4. Choose Data if you have all the data or Stats if you have the mean and standard deviation.
5. Let μ_0 be the null or hypothesized value of μ_{diff}.
   - If you choose Data, let List be L3 or the list in which you entered the differences (don't forget to enter the differences!) and let Freq be 1.
   - If you choose Stats, enter the mean, SD, and sample size of the differences.
6. Choose $\neq$, <, or > to correspond to H_A.
7. Choose Calculate and hit ENTER, which returns:

t	t statistic
p	p-value
x̄	the sample mean of the differences
Sx	the sample SD of the differences
n	the sample size of the differences

TI-83/84: MATCHED PAIRS T-INTERVAL

Use STAT, TESTS, TInterval.

1. Choose STAT.
2. Right arrow to TESTS.
3. Down arrow and choose 8:TInterval.
4. Choose Data if you have all the data or Stats if you have the mean and standard deviation.
   - If you choose Data, let List be L3 or the list in which you entered the differences (don't forget to enter the differences!) and let Freq be 1.
   - If you choose Stats, enter the mean, SD, and sample size of the differences.
5. Let C-Level be the desired confidence level.
6. Choose Calculate and hit ENTER, which returns:

(__,__)	the confidence interval for the mean of the differences
x̄	the sample mean of the differences
Sx	the sample SD of the differences
n	the number of differences in the sample

Practice exercises

GUIDED PRACTICE 0.21

G

In our UCLA textbook example, we had 68 paired differences. Because $df = 67$ was not on our t-table, we rounded the df down to 60. This gave us a 95% confidence interval (0.325, 6.834). Use a calculator to find the more exact 95% confidence interval based on 67 degrees of freedom. How different is it from the one we calculated based on 60 degrees of freedom?[20]

n_{diff}	$\bar{x}_{diff}$	s_{diff}
68	3.58	13.42

GUIDED PRACTICE 0.22

G

Use the data in the table above to find the test statistic and p-value for a test of H_0: $\mu_{diff} = 0$ versus H_A: $\mu_{diff} \neq 0$.[21]

[20] Navigate to `TInterval`. We do not have all the data, so choose `Stats`. Enter $\bar{x} = 3.58$ and $Sx = 13.42$. Let $n = 68$ and C-Level $= 0.95$. This should give the interval (0.332, 6.828). The intervals are equivalent when rounded to two decimal places.

[21] Navigate to `T-Test`. We do not have all the data, so choose `Stats`. Enter $\mu_0 = 0$, $\bar{x} = 3.58$, $Sx = 13.42$, $n = 68$, and choose $\neq \mu_0$ since the alternative hypothesis is two-sided. This should give the interval $t = 2.2$ and $p = 0.031$.

2-sample t-test and t-interval

TI-83/84: 2-SAMPLE T-TEST

Use `STAT`, `TESTS`, `2-SampTTest`.

1. Choose `STAT`.
2. Right arrow to `TESTS`.
3. Choose `4:2-SampTTest`.
4. Choose `Data` if you have all the data or `Stats` if you have the means and standard deviations.
   - If you choose `Data`, let `List1` be `L1` or the list that contains sample 1 and let `List2` be `L2` or the list that contains sample 2 (don't forget to enter the data!). Let `Freq1` and `Freq2` be `1`.
   - If you choose `Stats`, enter the mean, SD, and sample size for sample 1 and for sample 2
5. Choose $\neq$, $<$, or $>$ to correspond to H_A.
6. Let `Pooled` be `NO`.
7. Choose `Calculate` and hit `ENTER`, which returns:

`t`	t statistic	`Sx1`	SD of sample 1
`p`	p-value	`Sx2`	SD of sample 2
`df`	degrees of freedom	`n1`	size of sample 1
$\bar{x}_1$	mean of sample 1	n2	size of sample 2
$\bar{x}_2$	mean of sample 2		

TI-83/84: 2-SAMPLE T-INTERVAL

Use `STAT`, `TESTS`, `2-SampTInt`.

1. Choose `STAT`.
2. Right arrow to `TESTS`.
3. Down arrow and choose `0:2-SampTTInt`.
4. Choose `Data` if you have all the data or `Stats` if you have the means and standard deviations.
   - If you choose Data, let `List1` be `L1` or the list that contains sample 1 and let `List2` be `L2` or the list that contains sample 2 (don't forget to enter the data!). Let `Freq1` and `Freq2` be `1`.
   - If you choose `Stats`, enter the mean, SD, and sample size for sample 1 and for sample 2.
5. Let `C-Level` be the desired confidence level and let `Pooled` be `No`.
6. Choose `Calculate` and hit `ENTER`, which returns:

`(__,__)`	the confidence interval	`Sx1`	SD of sample 1
`df`	degrees of freedom	`Sx2`	SD of sample 2
$\bar{x}_1$	mean of sample 1	`n1`	size of sample 1
$\bar{x}_2$	mean of sample 2	`n2`	size of sample 2

Practice exercises

GUIDED PRACTICE 0.23

G

Use the data below and a calculator to find the test statistics and p-value for a one-sided test, testing whether there is evidence that embryonic stem cells (ESCs) help improve heart function for sheep that have experienced a heart attack.[22]

	n	$\bar{x}$	s
ESCs	9	3.50	5.17
control	9	-4.33	2.76

GUIDED PRACTICE 0.24

G

Use the data below and a calculator to find a 95% confidence interval for the difference in average scores between Version A and Version B of the exam from the previous example.[23]

Version	n	$\bar{x}$	s	min	max
A	30	79.4	14	45	100
B	30	74.1	20	32	100

[22]Navigate to `2-SampTTest`. Because we have the summary statistics rather than all of the data, choose `Stats`. Let `x̄1`=3.50, `Sx1`=5.17, `n1`=9, `x̄2`=-4.33, `Sx2` = 2.76, and `n2` = 9. We get `t` = 4.01, and the p-value `p` = $8.4 \times 10^{-}4 = 0.00084$. The degrees of freedom for the test is `df` = 12.2.

[23]Navigate to `2-SampTInt`. Because we have the summary statistics rather than all of the data, choose `Stats`. Let `x̄1`=79.41, `Sx1`=14, `n1`=30, `x̄2`=74.1, `Sx2` = 20, and `n2` = 30. The interval is $(-3.6, 14.2)$ with $df = 51.9$.

Introduction to linear regression

Finding b_0, b_1, R^2, and r for a linear model

TI-84: FINDING b_0, b_1, R^2, AND r FOR A LINEAR MODEL

Use `STAT`, `CALC`, `LinReg(a + bx)`.

1. Choose `STAT`.
2. Right arrow to `CALC`.
3. Down arrow and choose `8:LinReg(a+bx)`.
   - Caution: choosing `4:LinReg(ax+b)` will reverse a and b.
4. Let `Xlist` be `L1` and `Ylist` be `L2` (don't forget to enter the x and y values in L1 and `L2` before doing this calculation).
5. Leave `FreqList` blank.
6. Leave `Store RegEQ` blank.
7. Choose Calculate and hit `ENTER`, which returns:

`a`	b_0, the y-intercept of the best fit line
`b`	b_1, the slope of the best fit line
`r`^{2}	R^2, the explained variance
`r`	r, the correlation coefficient

TI-83: Do steps 1-3, then enter the x list and y list separated by a comma, e.g. `LinReg(a+bx) L1, L2`, then hit `ENTER`.

What to do if r^2 and r do not show up on a TI-83/84

WHAT TO DO IF r^2 AND r DO NOT SHOW UP ON A TI-83/84

If r^2 and r do now show up when doing `STAT`, `CALC`, `LinReg`, the *diagnostics* must be turned on. This only needs to be once and the diagnostics will remain on.

1. Hit `2ND 0` (i.e. `CATALOG`).
2. Scroll down until the arrow points at `DiagnosticOn`.
3. Hit `ENTER` and `ENTER` again. The screen should now say:

```
DiagnosticOn
                    Done
```

What to do if a TI-83/84 returns: ERR: DIM MISMATCH

WHAT TO DO IF A TI-83/84 RETURNS: ERR: DIM MISMATCH

This error means that the lists, generally L1 and L2, do not have the same length.

1. Choose `1:Quit`.
2. Choose `STAT`, `Edit` and make sure that the lists have the same number of entries.

Practice exercises

GUIDED PRACTICE 0.25

G

The data set `loan50`, introduced in Chapter 1, contains information on randomly sampled loans offered through the Lending Club. A subset of the data matrix is shown in Figure 1. Use a calculator to find the equation of the least squares regression line for predicting loan amount from total income.[24]

	total_income	loan_amount
1	59000	22000
2	60000	6000
3	75000	25000
4	75000	6000
5	254000	25000
6	67000	6400
7	28800	3000

Figure 1: Sample of data from `loan50`.

[24] a $= 11121$ and b $= 0.0043$, therefore $\hat{y} = 11121 + 0.0043x$.

Linear regression t-test and t-interval

TI-83/84: LINEAR REGRESSION T-TEST ON β_1

Use `STAT`, `TESTS`, `LinRegTTest`.

1. Choose `STAT`.
2. Right arrow to `TESTS`.
3. Down arrow and choose `F:LinRegTest`. (On TI-83 it is `E:LinRegTTest`).
4. Let `Xlist` be `L1` and `Ylist` be `L2`. (Don't forget to enter the x and y values in `L1` and `L2` before doing this test.)
5. Let `Freq` be `1`.
6. Choose $\neq$, $<$, or $>$ to correspond to H_A.
7. Leave `RegEQ` blank.
8. Choose `Calculate` and hit `ENTER`, which returns:

`t`	t statistic	`b`	b_1, slope of the line
`p`	p-value	`s`	st. dev. of the residuals
`df`	degrees of freedom for the test	`r`^{2}	R^2, explained variance
`a`	b_0, y-intercept of the line	`r`	r, correlation coefficient

TI-84: T-INTERVAL FOR β_1

Use `STAT`, `TESTS`, `LinRegTInt`.

1. Choose `STAT`.
2. Right arrow to `TESTS`.
3. Down arrow and choose `G: LinRegTest`.
   - This test is not built into the TI-83.
4. Let `Xlist` be `L1` and `Ylist` be `L2`. (Don't forget to enter the x and y values in `L1` and `L2` before doing this interval.)
5. Let `Freq` be `1`.
6. Enter the desired confidence level.
7. Leave `RegEQ` blank.
8. Choose `Calculate` and hit `ENTER`, which returns:

`(__,__)`	the confidence interval
`b`	b_1, the slope of best fit line of the sample data
`df`	degrees of freedom associated with this confidence interval
`s`	standard deviation of the residuals
`a`	b_0, the y-intercept of the best fit line of the sample data
`r`^{2}	R^2, the explained variance
`r`	r, the correlation coefficient