

How do we analyze data?

- Analyze Assessment data and prepare results
- Learn ways to interpret your data using basic statistics



1. Analyze Assessment data and prepare results

MAT 270 Statistics

Outcome 1: Descriptively analyze a set of data.

Measure 1

On Prep Work, Quizzes, and Test One, 70% of the students will be able to correctly analyze data by finding the mean, the standard deviation, the quartiles, the median, the IQR, and outliers with a score of 70% or higher.

Mean and Standard Deviation

Chapter 3 Prep Work, #2. We are going to calculate the standard deviation for the following set of sample data. a. Calculate the mean. b. Fill in the table with the differences of each data value from the mean, then the squared differences, and then the total. c. Calculate the standard deviation using the total.

x	$x - \bar{x}$	$(x - \bar{x})^2$
3		
11		
11		
2		
8		

Total:

In the gradebook in MyOpenMath.com, I find the first student's work.
This student received nine correct answers out of 13 possible.

We are going to calculate the standard deviation for the following set of sample data.

1) First, calculate the mean.

$$\bar{x} = 9.8 \checkmark$$

2) Fill in the table below. Fill in the differences of each data value from the mean, then the squared differences and find the total.

x	$x - \bar{x}$	$(x - \bar{x})^2$
15	5.2 <input type="checkbox"/>	27.04 <input type="checkbox"/>
4	-5.8 <input type="checkbox"/>	-6.6 <input type="checkbox"/>
12	2.2 <input type="checkbox"/>	4.84 <input type="checkbox"/>
11	1.2 <input type="checkbox"/>	1.44 <input type="checkbox"/>
7	-2.8 <input type="checkbox"/>	-6.4 <input type="checkbox"/>
	Total	20.28 <input type="checkbox"/>

3) Calculate the standard deviation by taking the square root of the total.

$$\text{Standard deviation: } s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}} = 5.07 \text{ * Round to two decimal places}$$

	A	B	C	D
1	DATA, O1		M1	3P 2
2				13
3	Blanchett	Cate		9
4	Bledel	Alexis		12
5	Cabello	Camila		13
6	Cooper	Bradley		6
7	Depp	Johnny		9
8	DiCaprio	Leonardo		12
9	Freeman	Morgan		13
10	Hanks	Tom		1
11	Johansson	Scarlett		13
12	Kidman	Nicole		9
13	Lawrence	Jennifer		12
14	Longoria	Eva		7
15	Lopez	Jennifer		13
16	Pacino	Al		10
17	Penn	Sean		12
18	Portman	Natalie		11
19	Rodriguez	Gina		13
20	Swank	Hilary		9
21	Vergara	Sofia		12

I entered the grades for the students for this question into Excel.

My Benchmark: “a score of 70% or higher...”
 Seventy percent of a possible 13 points is 9.1, so the first student’s grade of 9 did not meet the benchmark.

	A	B	C	D	E
1	DATA, O1		M1	3P 2	
2				13	13
3	Blanchett	Cate		9	0
4	Bledel	Alexis		12	1
5	Cabello	Camila		13	1
6	Cooper	Bradley		6	0
7	Depp	Johnny		9	0
8	DiCaprio	Leonardo		12	1
9	Freeman	Morgan		13	1
10	Hanks	Tom		1	0
11	Johansson	Scarlett		13	1
12	Kidman	Nicole		9	0
13	Lawrence	Jennifer		12	1
14	Longoria	Eva		7	0
15	Lopez	Jennifer		13	1
16	Pacino	Al		10	1
17	Penn	Sean		12	1
18	Portman	Natalie		11	1
19	Rodriguez	Gina		13	1
20	Swank	Hilary		9	0
21	Vergara	Sofia		12	1

I assign a 1 for a grade which equals or exceeds the benchmark of 9.1 out of 13 points, and a 0 for a grade which does not.

	A	B	C	D	E
1	DATA, O1		MI	3P 2	
2				13	13
3	Blanchett	Cate		9	0
4	Bledel	Alexis		12	1
5	Cabello	Camila		13	1
6	Cooper	Bradley		6	0
7	Depp	Johnny		9	0
8	DiCaprio	Leonardo		12	1
9	Freeman	Morgan		13	1
10	Hanks	Tom		1	0
11	Johansson	Scarlett		13	1
12	Kidman	Nicole		9	0
13	Lawrence	Jennifer		12	1
14	Longoria	Eva		7	0
15	Lopez	Jennifer		13	1
16	Pacino	Al		10	1
17	Penn	Sean		12	1
18	Portman	Natalie		11	1
19	Rodriguez	Gina		13	1
20	Swank	Hilary		9	0
21	Vergara	Sofia		12	1
22					

To find the total of the grades which met the benchmark, click in the cell below the last student's points.

Click on the *fx* up on the top of the screen to bring up this screen. Click on SUM and OK.

? X

Insert Function

Search for a function:

Or select a category:

Select a function:

- SUM
- AVERAGE
- IF
- HYPERLINK
- COUNT
- MAX
- SIN

SUM(number1,number2,...)
Adds all the numbers in a range of cells.

[Help on this function](#)

	A	B	C	D	E
1	DATA, O1		MI	3P 2	
2				13	13
3	Blanchett	Cate		9	0
4	Bledel	Alexis		12	1
5	Cabello	Camila		13	1
6	Cooper	Bradley		6	0
7	Depp	Johnny		9	0
8	DiCaprio	Leonardo		12	1
9	Freeman	Morgan		13	1
10	Hanks	Tom		1	0
11	Johansson	Scarlett		13	1
12	Kidman	Nicole		9	0
13	Lawrence	Jennifer		12	1
14	Longoria	Eva		7	0
15	Lopez	Jennifer		13	1
16	Pacino	Al		10	1
17	Penn	Sean		12	1
18	Portman	Natalie		11	1
19	Rodriguez	Gina		13	1
20	Swank	Hilary		9	0
21	Vergara	Sofia		12	1
22					

In the space after **Number1**, make sure it says E3 in this case, which is the cell which holds Cate's 0 to E21, which is the cell which holds Sofia's 1.

Function Arguments ? X

SUM

Number1 ↑ = {0;1;1;0;0;1;1;0;1;0;1;0;1;1;1;1;0;1}

Number2 ↑ = number

= 12

Adds all the numbers in a range of cells.

Number1: number1,number2,... are 1 to 255 numbers to sum. Logical values and text are ignored in cells, included if typed as arguments.

Formula result = 12

[Help on this function](#)

	A	B	C	D	E
1	DATA, OI		MI	3P 2	
2				13	13
3	Blanchett	Cate		9	0
4	Bledel	Alexis		12	1
5	Cabello	Camila		13	1
6	Cooper	Bradley		6	0
7	Depp	Johnny		9	0
8	DiCaprio	Leonardo		12	1
9	Freeman	Morgan		13	1
10	Hanks	Tom		1	0
11	Johansson	Scarlett		13	1
12	Kidman	Nicole		9	0
13	Lawrence	Jennifer		12	1
14	Longoria	Eva		7	0
15	Lopez	Jennifer		13	1
16	Pacino	Al		10	1
17	Penn	Sean		12	1
18	Portman	Natalie		11	1
19	Rodriguez	Gina		13	1
20	Swank	Hilary		9	0
21	Vergara	Sofia		12	1
22				12	
23				19	
24				=E22/E23	

To find the percent of students who met the benchmark:

Type in the number of students below the sum. Then in the next cell, E24 in this case, type in =E22/E23

(The equals sign tells Excel that math is required.)

	A	B	C	D	E
1	DATA, OI		MI	3P 2	
2				13	13
3	Blanchett	Cate		9	0
4	Bledel	Alexis		12	1
5	Cabello	Camila		13	1
6	Cooper	Bradley		6	0
7	Depp	Johnny		9	0
8	DiCaprio	Leonardo		12	1
9	Freeman	Morgan		13	1
10	Hanks	Tom		1	0
11	Johansson	Scarlett		13	1
12	Kidman	Nicole		9	0
13	Lawrence	Jennifer		12	1
14	Longoria	Eva		7	0
15	Lopez	Jennifer		13	1
16	Pacino	Al		10	1
17	Penn	Sean		12	1
18	Portman	Natalie		11	1
19	Rodriguez	Gina		13	1
20	Swank	Hilary		9	0
21	Vergara	Sofia		12	1
22					12
23					19
24					0.6316

So 63% of my students got a 70% or higher on this question. They did not meet the benchmark for this problem which was 70% of the students.

I actually put all of the grades for an outcome onto one page...

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	DATA		MI	3P 2	3Q 1	T1 8	3P 3	3Q 2	T1 12	M2	1aO 9	T1 5	T1 17	M3	2Q 1	2Q 2	T1 11	M4	2P 2	2P 3	2Q 3	T1 20
2				13	13	6	5	10	10		8	15	10		5	8	10		18	10	10	10
3	Blanchett	Cate		9	13	4.5	5	10	10		8	14	10		5	8	10		0.5	6	10	10
4	Bledel	Alexis		12	13	5	5	10	8		7	10	0		5	7	0		2.5	6	0	10
5	Cabello	Camila		13	12	5	4	8	5		8	11.5	5		4	8	5		14	10	5	2
6	Cooper	Bradley		6	12	6	4	8	6		8	9.5	2		4	8	2		13.5	7	2	0
7	Depp	Johnny		9	13	5	5	9	8		8	11	8		5	8	8		15.5	10	8	10
8	DiCaprio	Leonardo		12	13	5.5	3	9	8		8	5	7		3	8	7		14	8	7	9
9	Freeman	Morgan		13	13	4.5	5	10	8		7	4	9		5	7	9		16.5	9	9	9
10	Hanks	Tom		1	12	5.5	0	10	9		8	8	9		0	8	9		13	6	9	9
11	Johansson	Scarlett		13	13	5	2	10	10		8	9	10		2	8	10		15	9	10	10
12	Kidman	Nicole		9	13	6	2	10	10		8	5.5	9		2	8	9		12.5	10	9	8.5
13	Lawrence	Jennifer		12	0	6	5	10	8		8	10.5	9.5		5	8	9.5		14	8	9.5	10
14	Longoria	Eva		7	13	6	5	9	6.5		7	14.5	1		5	7	1		7	5	1	8
15	Lopez	Jennifer		13	12	4.5	5	6	9		6	13	6		5	6	6		10	9.5	6	6
16	Pacino	Al		10	12	4.5	5	8	8		8	13.5	8		5	8	8		17	10	8	9.5
17	Penn	Sean		12	12	5	5	10	10		8	15	0		5	8	0		18	10	0	10
18	Portman	Natalie		11	13	6	0	9	10		7	1	7.5		0	7	7.5		18	10	7.5	8.5
19	Rodriguez	Gina		13	13	2	3	10	9		8	1	8.5		3	8	8.5		18	10	8.5	7
20	Swank	Hilary		9	13	6	5	10	7.5		0	1	5		5	0	5		17	9	5	5
21	Vergara	Sofia		12	12	4	4	7	6.5		6	1	8.5		4	6	8.5		9.5	10	8.5	6.5

and the 1's and 0's on another page.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	DATA, O1		M1	3P 2	3Q 1	TI 8	3P 3	3Q 2	TI 12	M2	1aO 9	T1 5	T1 17	M3	2Q 1	2Q 2	T1 11	M4	2P 2	2P 3	2Q 3	T1 20
2				13	13	6	5	10	10		8	15	10		5	8	10		18	10	10	10
3	Blanchett	Cate		0	1	1	1	1	1		1	1	1		1	1	1		1	1	1	1
4	Bledel	Alexis		1	1	1	1	1	1		1	1	1		0	0	1		1	1	0	1
5	Cabello	Camila		1	1	1	1	1	0		1	1	1		1	1	1		0	0	1	0
6	Cooper	Bradley		0	1	1	1	1	0		1	1	0		1	0	0		0	0	1	0
7	Depp	Johnny		0	1	1	1	1	1		1	1	1		1	1	1		1	0	1	1
8	DiCaprio	Leonardo		1	1	1	0	1	1		1	0	1		1	0	1		0	0	1	1
9	Freeman	Morgan		1	1	1	1	1	1		1	1	1		1	1	0		1	0	1	1
10	Hanks	Tom		0	1	1	0	1	1		1	1	0		1	0	1		1	1	1	1
11	Johansso	Scarlett		1	1	1	0	1	1		1	1	1		1	1	1		1	1	1	1
12	Kidman	Nicole		0	1	1	0	1	1		0	1	1		1	0	1		1	1	1	1
13	Lawrence	Jennifer		1	0	1	1	1	1		1	0	1		1	1	1		0	1	1	1
14	Longoria	Eva		0	1	1	1	1	0		1	0	0		1	1	1		1	0	0	1
15	Lopez	Jennifer		1	1	1	1	0	1		1	1	1		1	0	1		0	0	0	0
16	Pacino	Al		1	1	1	1	1	1		1	1	1		1	1	1		1	1	1	1
17	Penn	Sean		1	1	1	1	0	1		1	1	1		0	1	1		0	0	1	1
18	Portman	Natalie		1	1	1	0	1	1		1	1	1		1	1	1		1	0	1	1
19	Rodriguez	Gina		1	1	0	0	1	1		1	1	1		1	0	0		0	1	1	1
20	Swank	Hilary		0	1	1	1	1	1		0	1	1		1	1	0		0	1	1	0
21	Vergara	Sofia		1	0	0	0	1	1		1	1	0		1	1	1		1	1	0	1
22				12	17	17	12	17	16		17	16	15		17	12	15		11	10	15	15
23				19	19	19	19	19	19		19	19	19		19	19	19		19	19	19	19
24				0.63	0.89	0.89	0.63	0.89	0.84		0.89	0.84	0.79		0.89	0.63	0.79		0.58	0.53	0.79	0.79
25			M1	3P 2	3Q 1	TI 8	3P 3	3Q 2	TI 12	M2	1aO 9	T1 5	T1 17	M3	2Q 1	2Q 2	T1 11	M4	2P 2	2P 3	2Q 3	T1 20

Now I can see the results of each problem in each objective to carry them over into TK20.

An example from Test 1 #8

8. (6 pts) Find the standard deviation of the sample 1, 9, 6, 5, 8, 1 **by hand** – show your work. Round the standard deviation to two decimal places.

x	$x - \bar{x}$	$(x - \bar{x})^2$
1	$1 - 5 = -4$	$(1 - 5)^2 = 16$
9	4	16
6	2	4
5	1	0
8	3	9
1	-4	16

$\frac{1}{30} = 5$
 $\frac{30}{6} = 5$

$\frac{6}{5} - 1 = \frac{5}{5}$
 $n \text{ not } \bar{x}$

$\sqrt{\frac{58}{4.5}} = \sqrt{14.5} = 3.801 = 3.81$
 $s \approx 3.81$

(-1.5)

	12	17	17
	19	19	19
	0.63	0.89	0.89
M1	3P 2	3Q 1	T1 8

Results: *Mean and Standard Deviation:* 63% of the students passed this question on the Prep Work, 89% on the Quiz, and 89% on the exam.

In my findings in the RESULT box in TK20, I can discuss my use of Prep Work questions which students do from reading the book before coming to class and how the in-class discussion and quiz work help them understand the material enough to pass the benchmark on the proctored exam.

2. Learn ways to interpret your data using basic statistics

I wanted to compare a question from this year's students to students a year ago to see if my improvements to the textbook and use of prep work helped with a particularly difficult question type. I had the data in Excel so just copied the scores from each year. This is a portion of the scores from an 18-point question.

T2 #12. Approximately 10% of all people are left-handed. Suppose 80 people from the community are chosen at random. a. State the random variable. b. Argue that this is a binomial experiment. Remember there are four parts. c. Find the probability that exactly ten of the people are left-handed. d. Find the probability that at least 25 of the people are left-handed.

The scores are from two independent samples, so I could perform a two-proportion z test on the proportions of students who passed the question or a two-sample t test on the scores.

Fall18	Fall19
1	17
7.5	12
12.5	17
11	9
4.5	18
13	16
14	12
16	8.5
17.5	17
12	14
1.5	14
17	16
16.5	16
14.5	9.5
17.5	18
16	16
14.5	4
17	16

Two-Proportion z Test:

Last year, 58.46% of the students received at least 12.6 points which is a 70% or better on this question. This year the percent was 80%. Using a two-proportion z test on my TI-84 calculator to test if these proportions are significantly different, $z = -2.6604$ with a p-value of 0.0078. So there is enough evidence to show that 80% this year is different from 58% last year.

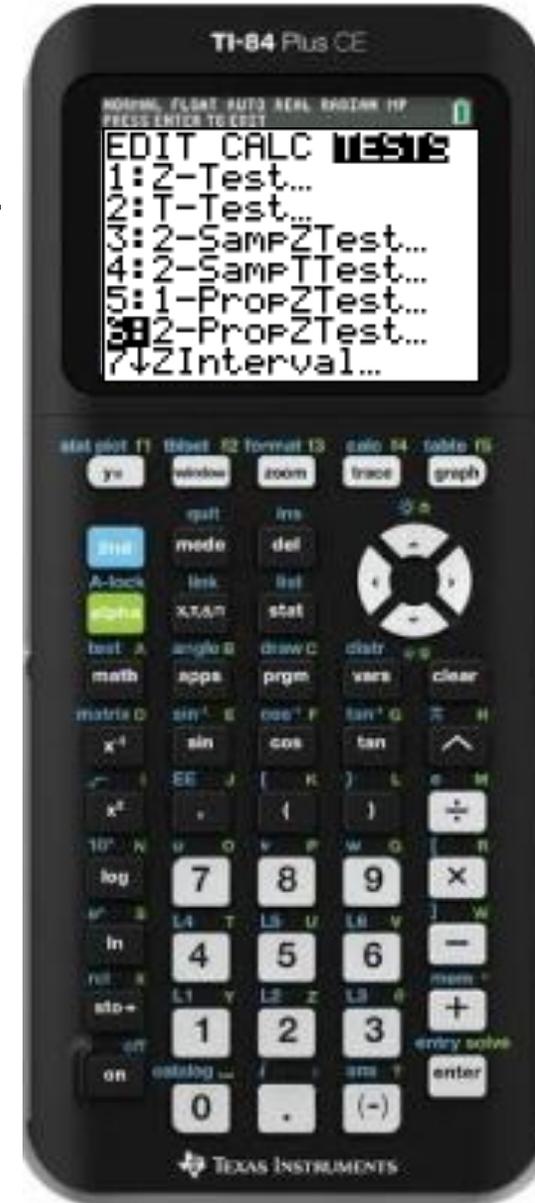
```
EDIT CALC TESTS
1:Z-Test...
2:T-Test...
3:2-SampZTest...
4:2-SampTTest...
5:1-PropZTest...
6:2-PropZTest...
7:ZInterval...
```

```
2-PropZTest
x1:38
n1:65
x2:52
n2:65
P1:0.5846 <P2 >P2
Calculate Draw
```

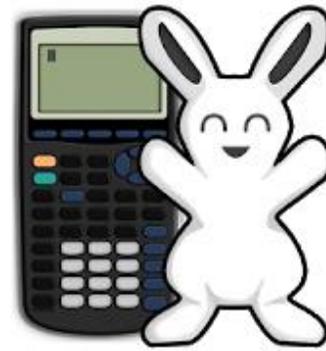
```
2-PropZTest
P1≠P2
Z=-2.660409325
P=.0078046611
P1=.5846153846
P2=.8
↓P=.6923076923
n1=65
n2=65
```

The assumptions which need to be met or at least discussed:

1. Large enough samples – the number of successes and the number of fails for each sample must be greater than 5.
2. Random samples to reduce bias – the samples should be good representations of your populations.



If you don't have a TI-84 calculator to use, you can borrow one from me or another math teacher, or you can get an emulator called Wabbitemu for free at Google Play Store.



Wabbitemu

BuckeyeDude Education

★★★★★ 26,991

E Everyone

Contains Ads

This app is compatible with all of your devices.

Installed

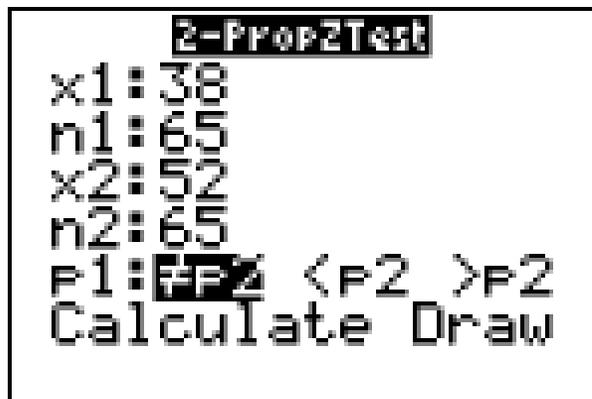
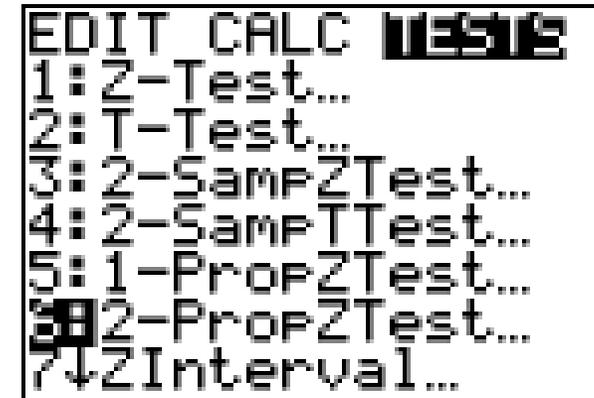


Wabbitemu creates a Texas Instruments graphing calculator right on your Android device. Wabbitemu supports the TI-73, TI-81, TI-82, TI-83, TI-83 Plus, TI-83 Plus Silver Edition, TI-84 Plus, TI-84 Plus Silver Edition, TI-85, and TI-86. Fast and convenient, Wabbitemu allows you to always have your trusty calculator with you. Because Wabbitemu is an emulator, the calculator it creates will act exactly like the real thing.

To do the test, click on STAT



Then arrow over to TESTS and click on 6:2-PropZTest



Enter the number of students who passed the question in your first sample into x_1 , the total number of students in your first sample in n_1 , the number of students who passed the question in your second sample into x_2 , and the total number of students in your second sample in n_2 . Click on $\neq p_2$ to get a two-sided test which is most often used. And then click on Calculate.

Two Independent Samples t Test:

I could go back to the original scores instead of test for a significant change in the grades. I copy and paste the data into SPSS.

The screenshot shows the SPSS interface. The 'Analyze' menu is open, and 'Independent-Samples T Test...' is selected. The data table below has two columns: 'Scores' and 'Group'. The 'Scores' column contains values from 106 to 125, and the 'Group' column contains values from 1 to 2.

	Scores	Group
106	16	2
107	12	2
108	18	2
109	18	2
110	6	2
111	14	2
112	16	2
113	17	2
114	17	2
115	18	2
116	17	2
117	18	2
118	18	2
119	16	2
120	14	2
121	14	2
122	18	2
123	12	2
124	14	2
125	18	2

The dialog box for 'Independent-Samples T Test' is shown. The 'Test Variable(s)' field contains 'Scores' and the 'Grouping Variable' field contains 'Group(1 2)'. The 'Define Groups...' button is visible.

Fall18	Fall19
1	17
7.5	12
12.5	17
11	9
4.5	18
13	16
14	12
16	8.5
17.5	17
12	14
1.5	14
17	16
16.5	16
14.5	9.5
17.5	18
16	16
14.5	4
17	16

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Scores	1	65	12.44	4.499	.558
	2	65	14.92	3.091	.383

I have handouts which explains how to input the data into SPSS and perform the test if anyone would like them.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Scores	Equal variances assumed	8.776	.004	-3.674	128	.000	-2.488	.677	-3.827	-1.148
	Equal variances not assumed			-3.674	113.412	.000	-2.488	.677	-3.829	-1.146

Equal variances not assumed, so $t = -3.674$ with a p-value of 0.000. The t is negative because SPSS subtracts group one minus group two – so we know that the mean of group one is lower.

A very small p-value shows that we have significance. The level of significance is normally 0.05 and the p-value is smaller than that level.

The assumptions which need to be met or at least discussed:

1. Large enough samples – at least 25 in each sample.
2. Random samples to reduce bias – should be good representations of your populations.