Chapter 3: Statistics Operations

This chapter describes the calculator's built-in statistics functions. You can enter 1- or 2-variable data and then analyze the data by performing any of several statistics calculations.

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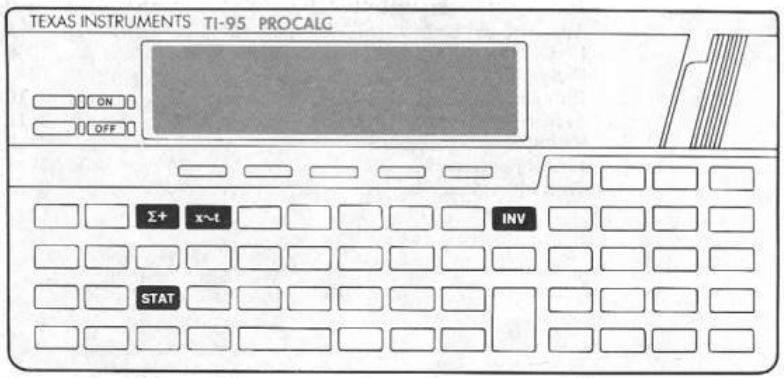
Location of the Statistics Keys

The keys used to perform statistics functions are shown in the figure below. Familiarize yourself with these keys and their location on the keyboard.



The Statistics Keys

You can enter data into the statistics registers by using the Σ+ key. Before you can analyze the data, however, you must press the STAT key to display the STAT FUNCTIONS menu. Pressing STAT redefines the function keys and enables you to select the operation you want to perform.

The Statistics Menu

When you press STAT, the **STAT FUNCTIONS** menu is displayed. You can then use the function keys to select from the statistics functions shown below.

```
STAT FUNCTIONS
CLR FRQ MN  s  -->
```

⟨CLR⟩	Clears the statistics registers and enables you to select 1- or 2-variable statistics
⟨FRQ⟩	Enters number of occurrences of identical data values; entered as data when you press Σ+, or removed when you press INV Σ+
⟨MN⟩	Calculates the mean
⟨s⟩	Calculates sample standard deviation
INV ⟨s⟩	Calculates population standard deviation
⟨-->⟩	Displays the menu selections shown below

```
STAT FUNCTIONS
m-b  r   y'  SHW  -->
```

⟨m-b⟩	Calculates slope/intercept (linear regression)
⟨r⟩	Calculates correlation coefficient (linear regression)
⟨y'⟩	Predicts a y value (linear regression)
INV ⟨y'⟩	Predicts an x value (linear regression)
⟨SHW⟩	Displays sums calculated during data entry
⟨-->⟩	Displays the previous selections shown above

Starting a New Statistics Problem

When you start a new statistics problem that does not use any previously entered data values, begin by clearing the statistics registers and selecting 1- or 2-variable statistics. Clearing the statistics registers does not affect any values stored in the calculator's data register memories. However, the t-register is cleared.

The Number of Variables

In 1-variable statistics, a data value is represented as x_n, where n = 1, 2, ..., N. (N is the total number of data values.)

In 2-variable statistics, a data value is represented as (x_n, y_n). The x value is the independent variable, and the y value is the dependent variable.

Clearing the Registers

To clear the statistics registers and select 1- or 2-variable statistics, use the following procedure.

1. Press [STAT] to display the **STAT FUNCTIONS** menu.
2. Press ⟨CLR⟩. The following menu is then displayed.

```
 SELECT NO. VARS.
CS1  CS2
```

⟨CS1⟩ 1-variable statistics

⟨CS2⟩ 2-variable statistics

3. Select either 1- or 2-variable statistics.

   After you press ⟨CS1⟩ or ⟨CS2⟩, the **STAT FUNCTIONS** menu is displayed.

Entering and Removing 1-Variable Data

Before performing a statistics calculation, you must enter all the data values into the statistics registers. You can enter the data values individually or enter several identical data values at one time. You can also remove any data values that are entered incorrectly. (An example of entering and removing 1-variable data begins on page 3-8.)

Entering 1-Variable Data Values

The [Σ+] key enables you to enter data values and display the number of data values accumulated.

To enter a single data value:

1. Enter the value.
2. Press [Σ+].

To enter several identical data values at one time:

1. Press [STAT], enter the number of data values, and press ⟨FRQ⟩.
2. Enter the data value and press [Σ+].

Removing 1-Variable Data Values

The [INV] [Σ+] key sequence enables you to remove previously entered data values and display the number of data values that remain.

To remove a value just after you entered it, press [INV] [Σ+].

To remove a data value after pressing any key other than [2nd] or [INV]:

1. Reenter the value.
2. Press [INV] [Σ+].

To remove several identical data values at one time after pressing any key other than [2nd] or [INV]:.

1. Press [STAT], reenter the number of data values, and press ⟨FRQ⟩.
2. Reenter the data value and press [INV] [Σ+].

Note: If you remove more values than you intend, the resulting sum can be negative. To correct this, either reenter the points removed in error or begin again.

Performing 1-Variable Statistics Calculations

After entering data into the statistics registers, you can calculate the mean and standard deviation of the data values. You can also calculate intermediate sums or check the data in the registers. (An example of these calculations begins on page 3-8.)

Calculating the Mean

The [STAT] ⟨MN⟩ key sequence calculates the mean (average) of the data values according to the following equation.

$$MN = \frac{\Sigma x}{n}$$

Calculating the Standard Deviation

The [STAT] ⟨s⟩ key sequence calculates the sample (n – 1 weighted) standard deviation according to the following equation.

$$s_{n-1} = \sqrt{\frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}}$$

The [STAT] [INV] ⟨s⟩ key sequence calculates the population (n weighted) standard deviation according to the following equation.

$$s_n = \sqrt{\frac{n\Sigma x^2 - (\Sigma x)^2}{n^2}}$$

The Show Selection

The [STAT] ⟨-->⟩ ⟨SHW⟩ key sequence displays a menu that enables you to display intermediate sums or to check the data in the registers.

```
SHOW STAT REGS
n   Sx  Sxx Lfr Lx
```

⟨n⟩ Displays number of data values

⟨Sx⟩ Displays sum of data values

⟨Sxx⟩ Displays sum of the squares

⟨Lfr⟩ Displays last entered frequency

⟨Lx⟩ Displays last entered value

Example of 1-Variable Statistics

The following example shows you how to apply the information given in the previous three sections concerning 1-variable data. The example is divided into two parts. Part 1 shows you how to enter and remove the data. Part 2 shows you how to perform calculations and review the data.

Example (Part 1)

Enter the data values listed below. (Be sure to remove any values that are entered incorrectly.)

75 86 93 93 93 93 98 100

Procedure	Press		Display
Clear display	[CLEAR]		0.
Clear registers and select 1-variable	[STAT] ⟨CLR⟩ ⟨CS1⟩	STAT FUNCTIONS	
Begin data entry	75 [Σ+]	n=	1.
Enter incorrect value for later removal	85 [Σ+]	n=	2.
Enter correct value	86 [Σ+]	n=	3.
Enter incorrect repeated values	4 ⟨FRQ⟩ 94 [Σ+]	n=	7.
Remove values	[INV] [Σ+]	n=	3.
Enter repeated values correctly	4 ⟨FRQ⟩ 93 [Σ+]	n=	7.
Enter remaining data	98 [Σ+]	n=	8.
	100 [Σ+]	n=	9.
Remove earlier incorrect value	85 [INV] [Σ+]	n=	8.

Example (Part 2)

Calculate the mean, population standard deviation, sum, and sum of the squares of the data entered in Part 1. Then check the data to find the total number of data values, the last data value entered, and the frequency of the last data value entered.

Procedure	Press		Display
Mean	⟨MN⟩	MNx=	91.375
Population standard deviation	[INV] ⟨s⟩	sx=	7.296189074
Select show option	⟨-->⟩ ⟨SHW⟩	SHOW STAT REGS	
Sum	⟨Sx⟩	Sx=	731.
Sum of squares	⟨Sxx⟩	Sxx=	67221.
Number of data values	⟨n⟩	n=	8.
Last entered value	⟨Lx⟩	Lx=	100.
Last entered frequency	⟨Lfr⟩	Lfr=	1.

Entering and Removing 2-Variable Data

You enter 2-variable data in much the same way as previously described for 1-variable data. With two variables, however, you must use the [x⇌t] key to store the x value. Before starting a new problem, be sure to select the number of variables and clear the statistics registers as described on page 3-4.

Entering 2-Variable Data Values

Each time you enter a data pair, the calculator displays the number of pairs accumulated.

To enter a single data pair:

1. Enter the x value and press [x⇌t].
2. Enter the y value and press [Σ+].

To enter several identical data pairs at one time:

1. Press [STAT], enter the number of pairs, and press ⟨FRQ⟩.
2. Enter the x value and press [x⇌t], and then enter the y value and press [Σ+].

Removing 2-Variable Data Values

To remove a pair just after you enter it, press [INV] [Σ+]. All pairs determined by the last frequency are removed, and the number of pairs remaining is displayed.

To remove a pair after pressing a key other than [2nd] or [INV]:

1. Reenter the x value and press [x⇌t].
2. Reenter the y value and press [INV] [Σ+].

To remove several identical data pairs at one time after pressing any key other than [2nd] or [INV]:

1. Press [STAT], reenter the number of pairs, and press ⟨FRQ⟩.
2. Reenter the x value and press [x⇌t].
3. Reenter the y value and press [INV] [Σ+].

Note: If you remove more values than you intend, the resulting sum can be negative. To correct this, either reenter the points removed in error or begin again.

Performing 2-Variable Statistics Calculations

After entering the statistics data values, you can analyze the data in the statistics registers by performing any of the calculations shown below. (An example of these calculations is given on page 3-13.)

Calculating the Mean

To calculate the mean (average) of the data values, press [STAT] ⟨MN⟩.

- The mean of the y values appears in the display.
- The mean of the x values is stored in the t-register. Press [x⇌t] to display the number.

Calculating the Standard Deviation

To calculate the sample (n – 1 weighted) standard deviation, press [STAT] ⟨s⟩.

- The sample standard deviation of the y values appears in the display.
- The sample standard deviation of the x values is stored in the t-register. Press [x⇌t] to display the number.

To calculate the population (n weighted) standard deviation, press [STAT] [INV] ⟨s⟩.

- The population standard deviation of the y values appears in the display.
- The population standard deviation of the x values is stored in the t-register. Press [x⇌t] to display the number.

(continued)

The Show Selection

The [STAT] ⟨-->⟩ ⟨SHW⟩ key sequence displays a menu that enables you to display intermediate sums or to check the data in the registers.

```
SHOW STAT REGS
n   Sy   Syy  Ly   -->
```

```
SHOW STAT REGS
Sxy  Sx   Sxx  Lfr  -->
```

⟨n⟩	Displays total number of data pairs
⟨Sy⟩	Displays sum of the y values
⟨Syy⟩	Displays sum of the squares of the y values
⟨Ly⟩	Displays last entered y value and places last entered x value in t-register
⟨Sxy⟩	Displays sum of the products of x and y
⟨Sx⟩	Displays sum of the x values
⟨Sxx⟩	Displays sum of the squares of the x values
⟨Lfr⟩	Displays last entered frequency

Example of 2-Variable Statistics

The following example shows you how to apply the information given in the previous sections concerning 2-variable data.

Example

Enter the following data pairs, and then calculate the mean and sample standard deviation.

(101.3, 609)	(103.7, 626)	(98.6, 586)
(99.9, 594)	(97.2, 579)	(100.1, 605)

Procedure	Press		Display
Clear display	[CLEAR]		0.
Clear registers and select 2-variable	[STAT] ⟨CLR⟩ ⟨CS2⟩	STAT FUNCTIONS	
Begin data entry	101.3 [x⇌t] 609 [Σ+]	n =	1.
	103.7 [x⇌t] 626 [Σ+]	n =	2.
	98.6 [x⇌t] 586 [Σ+]	n =	3.
	99.9 [x⇌t] 594 [Σ+]	n =	4.
	97.2 [x⇌t] 579 [Σ+]	n =	5.
	100.1 [x⇌t] 605 [Σ+]	n =	6.
Mean of y values	⟨MN⟩	MNy =	599.8333333
Mean of x values	[x⇌t]		100.1333333
Sample standard deviation of y values	⟨s⟩	sy =	17.05774506
Sample standard deviation of x values	[x⇌t]		2.240238083

Linear regression analysis calculates a straight line that best represents the relationship between two variables for which measurements are made in ordered pairs.

Calculating Slope and Intercept

To calculate the slope (m) and the y-intercept (b) of the representative line, press [STAT] ⟨m-b⟩.

- The slope appears in the display.
- The y-intercept is stored in the t-register. Press [x⇌t] to display the number.

The representative line is:

$y = mx + b$

Calculating the Correlation Coefficient

To calculate the correlation coefficient, press [STAT] ⟨r⟩. The correlation coefficient is a measure of how well the representative line fits the two sets of data values.

When the |r| is close to 1, most of the data is on or very near the line, in which case the line is highly representative of the data. However, the validity of the line diminishes as |r| decreases.

Calculating a Predicted Value

If |r| is close to 1, you can use the equation of the line to make valid predictions about additional data.

- To predict a y value, enter an x value and press ⟨y'⟩.
- To predict an x value, enter a y value and press [INV] ⟨y'⟩.

Example

A life insurance company has found that the volume of sales varies according to the number of salespeople employed, as shown below.

Number of salespeople (x)	7	12	4	5	11	9
Sales in thousands/mo. (y)	99	152	81	98	145	112

(continued)

Example (Continued)

Perform a linear regression analysis and predict the number of salespeople needed to produce $115,000 in monthly sales. Then estimate the amount of sales that should be generated by 10 salespeople.

Procedure	Press		Display
Clear display	[CLEAR]		0.
Clear registers and select 2-variable	[STAT] ⟨CLR⟩ ⟨CS2⟩	STAT FUNCTIONS	
Begin data entry	7 [x⇌t] 99 [Σ+]	n =	1.
	12 [x⇌t] 152 [Σ+]	n =	2.
	4 [x⇌t] 81 [Σ+]	n =	3.
	5 [x⇌t] 98 [Σ+]	n =	4.
	11 [x⇌t] 145 [Σ+]	n =	5.
	9 [x⇌t] 112 [Σ+]	n =	6.
Slope (m)	⟨-->⟩ ⟨m-b⟩	m =	8.423076923
y-intercept (b)	[x⇌t]		47.11538462
Correlation coeff.	⟨r⟩	r =	.9630910446
Projected sales for 10 people	10 ⟨y'⟩	y' =	131.3461538
Number of people needed for $115,000	115 [INV] ⟨y'⟩	x' =	8.059360731

The equation $8.42x + 47.12$ describes the representative line, with a correlation coefficient of 0.96.

Trend-line Analysis

In a trend-line analysis, you are performing a linear regression calculation on data that is collected at regular, sequential intervals. Each new x value is one greater than the previous x value. The calculator automatically increments the initial value of x so that you do not have to enter subsequent x values.

Entering the Data

To enter data for a trend-line analysis:

1. Enter the first data value as described in "Entering and Removing 2-Variable Data."
   - ► Enter x and press [x~t].
   - ► Enter y and press [Σ+].
2. Enter only the y value for the remaining data values. The calculator automatically enters the corresponding x.

Note: If any of the remaining data values are not sequential, be sure to reenter the new x value.

A trend line applies only to single occurrence data, so the ⟨FRQ⟩ key is not part of trend line data entry.

Removing Data

To remove a data pair just after it is entered, press [INV] [Σ+]. The calculator removes the last x and y values and automatically decrements the contents of the t-register in preparation for the next entry.

To remove an entry at a later time, use the procedure described in "Entering and Removing 2-Variable Data."

Example

A company has the following annual profits:

Year (x)	Profit in Millions (y)
1971	−2.1
1972	−0.3
1973	0.8
1974—80	inactive
1981	2.9
1982	2.8
1983	3.6
1984	4.0
1985	4.7

(continued)

Example (Continued)

Use the data on the previous page to perform a trend-line analysis. How much profit can the company expect to make in 1986, and when will it break the $6 million mark?

Procedure	Press		Display
Clear display	[CLEAR]		0.
Clear registers and select 2-variable	[STAT] ⟨CLR⟩ ⟨CS2⟩	STAT FUNCTIONS	
Initial value of x (1971)	1971 [x~t] 2.1 [+/−] [Σ+]	n =	1.
1972 profit	.3 [+/−] [Σ+]	n =	2.
1973 profit	.8 [Σ+]	n =	3.
Skip to 1981	1981 [x~t] 2.9 [Σ+]	n =	4.
1982 profit	2.8 [Σ+]	n =	5.
Incorrect 1983 profit	3.4 [Σ+]	n =	6.
Remove last entry	[INV] [Σ+]	n =	5.
1983 profit	3.6 [Σ+]	n =	6.
1984 profit	4 [Σ+]	n =	7.
1985 profit	4.7 [Σ+]	n =	8.
Correlation	⟨--->⟩ ⟨r⟩	r =	.9652421505
1986 prediction	1986 ⟨y'⟩	y' =	4.82244898
Year of $6 million profits	6 [INV] ⟨y'⟩	x' =	1989.026224