

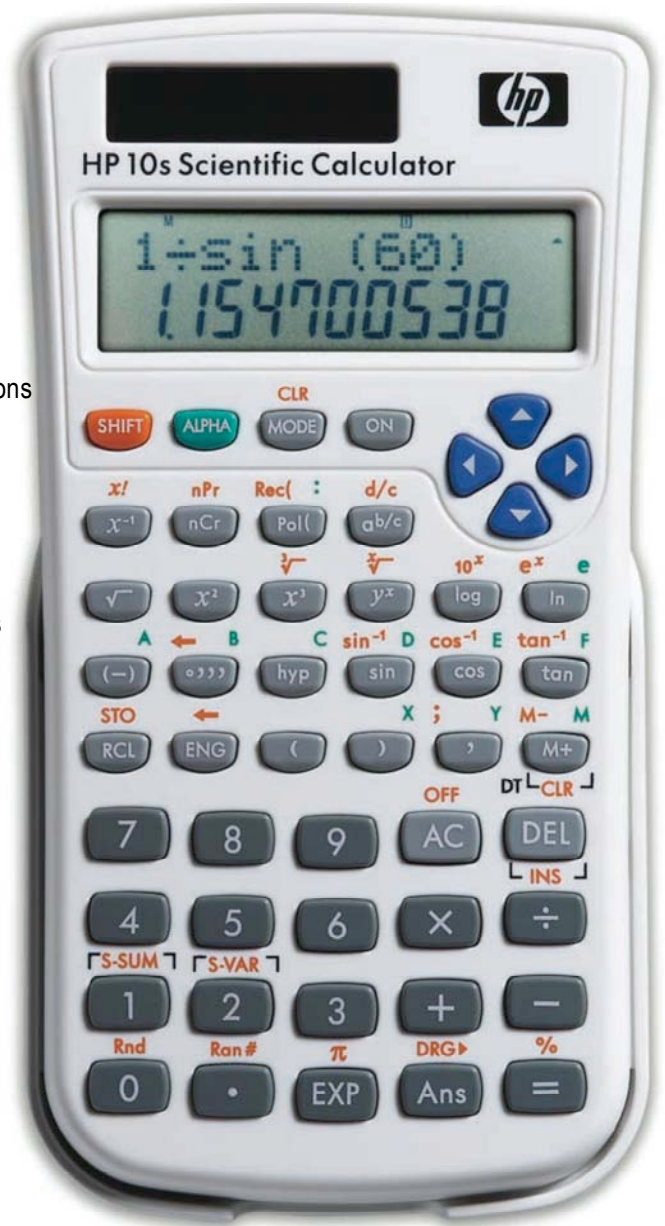


hp calculators

HP 10s Statistics – Averages and Standard Deviations

Average and Standard Deviation

Practice Finding Averages and Standard Deviations



Average and standard deviation

The HP10s provides several functions to calculate statistics, i.e. quantities that describe some properties of a sample or of the whole population (for the latter case, some authors prefer the term parameter), namely:

- ◆ Average or arithmetic mean (symbols: \bar{x} , μ). The average of n quantities x_1, x_2, \dots, x_n is defined as the sum of the quantities divided by the number of quantities:

$$\bar{x} = \frac{\sum x_i}{n}$$

These quantities can have frequencies f_1, f_2, \dots, f_n so that $\sum f_i = n$. In such case the average is $(\sum f_i x_i) / n$. A similar concept is that of the weighted average. The weighted average of n quantities each having weights w_1, w_2, \dots, w_n is $(\sum w_i x_i) / (\sum w_i)$. On the HP 10s averages and the other statistics can be calculated in Statistics mode (MODE 2).

- ◆ Sample and population standard deviations (symbols: S and σ , respectively). The standard deviation is a measure of how dispersed the data values are about the average. The difference between the sample and the population standard deviation is that the former assumes the data is a sampling of a larger, complete set of data, whereas the latter assumes the data constitutes the complete set of data. They can be calculated as follows:




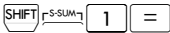
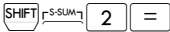
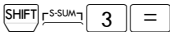
$$\sigma = \sqrt{\frac{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}{n}} = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$$

$$S = \sqrt{\frac{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}{n - 1}} = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}}$$

where n is the number of data points. Note that the sample standard deviation is calculated using $n - 1$ as the divisor. The standard deviation cannot be negative. Its square is known as the variance.

- ◆ $\sum x$ and $\sum x^2$ which are useful in calculating other statistics.

On the HP 10s, the following key sequences can be used to display calculated statistical values.

	Displays the average.
	Displays the population standard deviation.
	Displays the sample standard deviation.
	Displays the sum of the x^2 values.
	Displays the sum of the x values.
	Displays the number of data points.

Practice finding averages and standard deviations

Example 1: The following table shows the number of votes obtained by a political party in all the local elections in Barcelona since the democracy was restored in Spain:

HP 10s Statistics – Averages and Standard Deviations

1979	1983	1987	1991	1995	1999	2003
272512	412991	400280	328282	347083	313623	254223

What is the average of these results? What is the standard deviation?

Solution: First of all, let's enter Statistics mode by pressing MODE $\boxed{2}$. Every time we select another mode, the statistics data is cleared so that we can be confident that no data remains from previous calculations. Now, let's input the number of votes:

$\boxed{2}$	$\boxed{7}$	$\boxed{2}$	$\boxed{5}$	$\boxed{1}$	$\boxed{2}$	M^+	$\boxed{4}$	$\boxed{1}$	$\boxed{2}$	$\boxed{9}$	$\boxed{9}$	$\boxed{1}$	M^+
$\boxed{4}$	$\boxed{0}$	$\boxed{0}$	$\boxed{2}$	$\boxed{8}$	$\boxed{0}$	M^+	$\boxed{3}$	$\boxed{2}$	$\boxed{8}$	$\boxed{2}$	$\boxed{8}$	$\boxed{2}$	M^+
$\boxed{3}$	$\boxed{4}$	$\boxed{7}$	$\boxed{0}$	$\boxed{8}$	$\boxed{3}$	M^+	$\boxed{3}$	$\boxed{1}$	$\boxed{3}$	$\boxed{6}$	$\boxed{2}$	$\boxed{3}$	M^+
$\boxed{2}$	$\boxed{5}$	$\boxed{4}$	$\boxed{2}$	$\boxed{2}$	$\boxed{3}$	M^+							

Note that the M^+ key is the same thing as the LDTJ key.

To calculate the average press SHIFT F-S-VAR $\boxed{1}$ $\boxed{=}$. The data can be considered as a population because it comprises all the local elections called since the restoration of the democracy in that country. Therefore, we are interested in the population standard deviation, which can be found by pressing SHIFT F-S-VAR $\boxed{2}$ $\boxed{=}$. The sample standard deviation can be found by pressing SHIFT F-S-VAR $\boxed{3}$ $\boxed{=}$.

Answer: Rounding to the nearest vote, the average of the number of votes is 332713 and the population standard deviation is 55272. Note that *at least* $100 \cdot (1 - \frac{1}{2^2}) = 75\%$ of the results of this party will fall within two standard deviations on either side of this average, i.e. between 222169 and 443257, unless the population (i.e. the society) changes!

Example 2: Below is a chart of daily high and low temperatures for a week of July in Buenos Aires, Argentina. What were the average high and low temperatures for that week?

	Sunday	Monday	Tuesday	Wed.	Thurs.	Friday	Sat.
High	11	14	10	8	9	8	7
Low	1	0	-1	-6	-5	-4	-3

Solution: We must solve this problem in two steps since there's no "2-VAR" mode on the HP 10s. First, we'll calculate the average high temperature. Press MODE $\boxed{2}$ to clear the data entered in the previous example. And then press:

$\boxed{1}$ $\boxed{1}$ M^+ $\boxed{1}$ $\boxed{4}$ M^+ $\boxed{1}$ $\boxed{0}$ M^+ $\boxed{8}$ M^+ $\boxed{9}$ M^+ $\boxed{8}$ M^+ $\boxed{7}$ M^+

The average is displayed by pressing SHIFT F-S-VAR $\boxed{1}$ $\boxed{=}$. Now, clear the data again and enter the low temperatures:

MODE $\boxed{2}$ $\boxed{1}$ M^+ $\boxed{0}$ M^+ $\boxed{-}$ $\boxed{1}$ M^+ $\boxed{-}$ $\boxed{6}$ M^+ $\boxed{-}$ $\boxed{5}$ M^+ $\boxed{-}$ $\boxed{4}$ M^+ $\boxed{-}$ $\boxed{3}$ M^+

¹ Remember that this is true regardless of the way the data is distributed. Depending on the distribution, this percentage can actually increase. For example, if the data is normally distributed (which seems unlikely in this example), 95.5% of the data points will fall within $\mu \pm 2\sigma$.

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HP 10s Statistics – Averages and Standard Deviations

Once again, press $\text{SHIFT} \text{F-S-VAR} \text{1} =$ to find the average.

Answer: The average high and low temperatures were 9.6 and -2.6, respectively.

Example 3: Emma has bought gas this week while showing houses at four gasoline stations as follows:

Gallons	15	7	10	17
Cost per gallon	\$1.56	\$1.64	\$1.70	\$1.58

What is the average price of the gasoline purchased?

Solution: In this case we have to calculate a weighted average. You won't find a function on the HP 10s keyboard to calculate weighted averages; but the weighted average calculation is mathematically equivalent to the calculation of the average of grouped data (i.e. data that occurs with given frequencies). Therefore, the average price can be calculated as follows:

$\text{MODE} \text{2}$ (to clear the statistics data):

$\text{1} \cdot \text{5} \text{6} \text{SHIFT} :$	$\text{1} \text{5}$	M^+	(data items 1 through 15 are equal to 1.56),
$\text{1} \cdot \text{6} \text{4} \text{SHIFT} :$	7	M^+	(data items 16 through 22 are 1.64),
$\text{1} \cdot \text{7} \text{0} \text{SHIFT} :$	$\text{1} \text{0}$	M^+	(data items 23 through 32 are 1.70),
$\text{1} \cdot \text{5} \text{8} \text{SHIFT} :$	$\text{1} \text{7}$	M^+	(data items 33 through 49 are 1.58)

There are 49 items in total: $n = \sum w_i = 15 + 7 + 10 + 17 = 49$. Simply press $\text{SHIFT} \text{F-S-VAR} \text{1} =$ to display the answer.

Answer: The average price per gallon Emma has paid this week while showing houses is slightly less than \$1.61.