[6.42] stdDev() and variance() find sample (not population) statistics

The variance and standard deviation statistics measure the deviation of data about the mean. If the data consists of the entire population of *n* elements, the statistics are

Population standard deviation: $\sigma = \sqrt{\dfrac{\sum_{i=1}^{n}(x_i-\mu)^2}{n}}$, where μ is the population mean

Population variance: σ^2

Sample standard deviation: $s = \sqrt{\dfrac{\sum_{i=1}^{n}(x_i-x_m)^2}{n-1}}$, where x_m is the sample mean

Sample variance: s^2

For example, suppose I have the data {5,5,6,7,8,9}. Then σ = 1.4907 and s = 1.6330.

The built-in command *OneVar* calculates both the population and sample standard deviations, however, only the sample standard deviation (called *Sx*) is displayed with the *ShowStat* command. To display the population standard deviation (called σx) after using *OneVar*, you must manually recall σx as follows:

TI-89: [DIAMOND] [( ] [alpha] [S] [x] [ENTER]
TI-92+: [2ND] [G] [S] [x] [ENTER]

The *stdDev()* and *variance()* functions of the 89/92+ return the sample statistics, not the population statistics. However, these functions can be used to calculate the population statistics if the results are multiplied by a suitable correction factor:

$\sigma = s\sqrt{\dfrac{n-1}{n}}$ and $\sigma^2 = s^2\left(\dfrac{n-1}{n}\right)$

which can be written as

$\sigma = s\sqrt{1-\dfrac{1}{n}}$ and $\sigma^2 = s^2\left(1-\dfrac{1}{n}\right)$

so that *n* is referenced only once, instead of twice; this slightly simplifies the calculation. The correction factor is found by equating the equivalent expressions for σ and s. Let

$$SS_X = \sum_{i=1}^{n}\left(x_i - m\right)^2$$

where *m* is either the population mean or the sample mean, then

$\sigma^2 = \dfrac{SS_x}{n}$ and $s^2 = \dfrac{SS_x}{n-1}$ or $SS_X = s^2 \cdot (n-1)$ then

$\sigma^2 = s^2\left(\dfrac{n-1}{n}\right)$ and $\sigma = s\sqrt{\dfrac{n-1}{n}}$

The last line shows the identities we want, in which the desired population variance and standard deviation are functions of the sample variance and standard deviation.

If desired, these definitions can be coded as simple functions:

Population standard deviation:

```
stddevp(x)
Func
©(list) population std dev of list
©28aprØ1/dburkett@infinet.com

stddev(x)*√(1-1/dim(x))

EndFunc
```

Population variance:

```
variancp(x)
Func
©(list) population variance of list
©28aprØ1/dburkett@infinet.com

variance(x)*(1-1/dim(x))

EndFunc
```

The built-in *stddev()* and *variance()* functions can both accept an optional second argument which is a list of the frequencies of the first list elements. This feature is easily added with these two functions:

Population standard deviation, with frequencies:

```
stddevpf(x,f)
Func
©(list,freq) population std dev of list with element frequency 'freq'
©28aprØ1/dburkett@infinet.com

stddev(x,f)*√(1-1/sum(f))

EndFunc
```

Population variance, with frequencies:

```
varianpf(x,f)
Func
©(list,freq) population variance of list with element frequency 'freq'
©28aprØ1/dburkett@infinet.com

variance(x,f)*(1-1/sum(f))

EndFunc
```

In these last two functions, the number of data points is found by summing the elements of the frequency list.