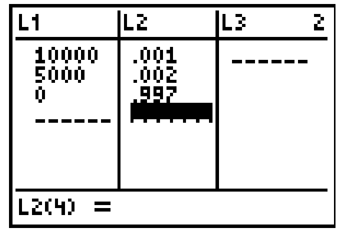
Chapter 7 – Random Variables

TI Calculators can help find the mean and standard deviation for random variables, given a probability distribution. This basically uses `1-Var Stats` as described in Chapter 2 using the frequencies as probabilities.

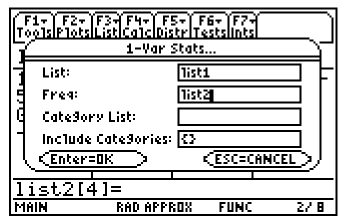
Suppose, for example, that the death rate in any year is 1 out of every 1000 people, and that another 2 out of 1000 suffer some kind of disability. An insurance company will pay $10,000 for a death and $5000 for a disability. To see what the company can expect to pay, we will first enter the payouts in `L1` and the probabilities in `L2`.



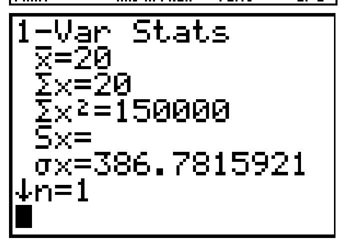
Note that nothing should happen 997 times in 1000, and the company has to pay nothing.

From the `STAT`, `CALC` menu, select option `1:1Var Stats`. Specify the two lists: first the list of the values, and then the list of the probabilities.

If you are using a TI-89, from the [F4] `Calc` menu, select `1:1-Var Stats`. In the input boxes, I have specified that the values are in `list1` and the probabilities (frequencies) are in `list2`.



The results show that the company can expect to have to pay $20 per policy, on average. The standard deviation of this value is $386.78. Why the large standard deviation? Consider the spread from a payout of $0 to $10,000 – that's a lot!



Notice that the calculator doesn't give a sample standard deviation – working with decimal (or fractional) frequencies, it understands we are looking at relative frequencies (probabilities).

If you want the variance, square the standard deviation. Here, we would find that $(386.78)^2 = 149598.7684$. The text gives the variance as 149600 – the minor difference is due to my rounding the calculator's standard deviation before squaring – if in doubt, as always, use all the digits for intermediate calculations, then round at the end!

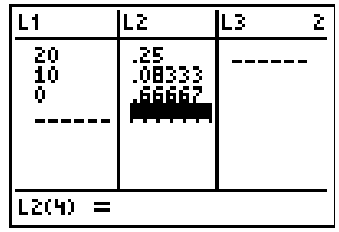
Be sure that the total frequency (*n*) is 1. If not, you have made an error entering your probabilities.

The Lucky Lover's Special

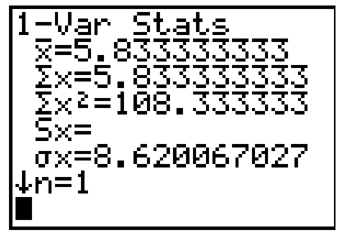
On Valentine's Day, the *Quiet Nook* Restaurant offers a *Lucky Lover's Special* that could save couples on their dinner. Diners draw at random from a deck containing only four aces. If the first card drawn in the ace of hearts, they get a $20 discount. If the first card drawn is the ace of diamonds, they will get another chance. If the second card is the ace of hearts, they get a $10 discount. If their first card drawn is one of the black aces, they get no discount. What might couples expect the average discount to be, and how variable is it?

The hardest part of this problem will be finding the probabilities for most people. Clearly, since we are only dealing with the four aces, P(Ace of Hearts) = 1/4 which gets the $20 discount. Getting the ace of diamonds on the first card also has probability 1/4; if this card is drawn, you get another chance to draw. At this point, there are 3 cards left, so the probability of following with the Ace of hearts is 1/3, but we need to multiply the two probabilities for the sequence of events. Therefore, P(Ace of diamonds followed by Ace of hearts) = (1/4)(1/3) = 1/12 which gets a $10 discount. Lastly, anything else gets no discount. Recognizing that getting no discount is the complement of either of the two preceding situations, we have P(No Discount) = 1 – (1/4 + 1/12) = 2/3.

Here, I've entered the possible discounts and the probabilities into lists `L1` and `L2`. Because of the repeating decimals in 1/12 and 2/3, I entered them as the fractions, letting the calculator convert to fractions. What displays is rounded, but the calculator will really use the fractional equivalent.



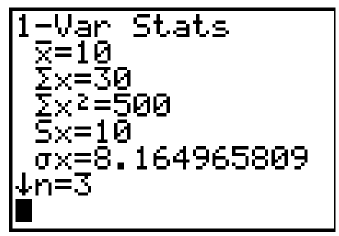
Here are the results. The typical (average) discount will be about $5.83. The standard deviation of the discounts is $8.62. The standard deviation is still larger than the average as in the preceding example, but not so dramatic as before, because the range of possible discounts is much smaller.



WHAT CAN GO WRONG?

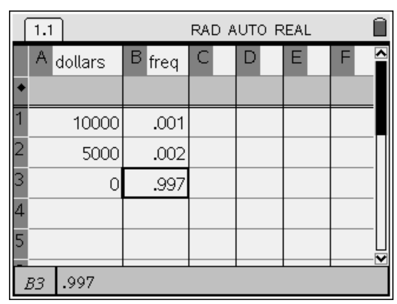
My answer's not the same!

Errors when dealing with distributions like this usually come from forgetting to specify the second list of probabilities. Notice that on this screen we have `n=3`, not `n=1`. The correct form of the command is `1-Var Stats xlist,plist`, where `xlist` is where the actual values were stored and `plist` is where the frequencies are.

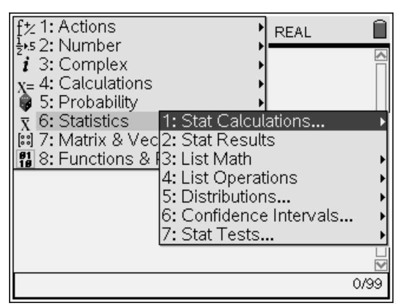


Commands for the TI-Nspire™ Handheld Calculator

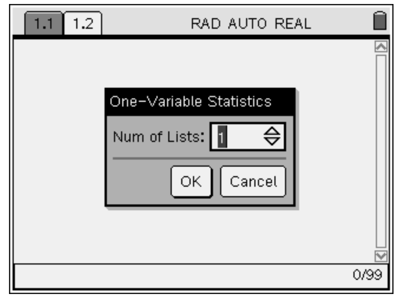
To compute statistics for a random variable, place the values for the variable in a list and the probabilities (relative frequencies) in another list. For the insurance company example, you could create two lists named *dollars* and *freq* as shown.



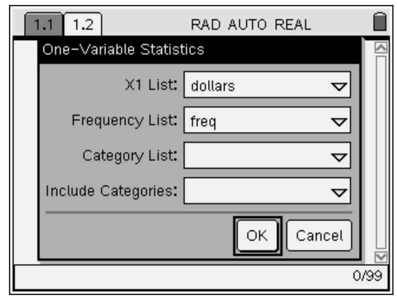
Open a new Calculator page. Press (menu), select Statistics, Stat Calculations, and One-Variable Statistics.



In the input box, select one for the number of lists, tab to OK and enter.



Select the name of the list for the random variable values and the relative frequencies. tab to OK and enter.



You can scroll through the display to see additional information.