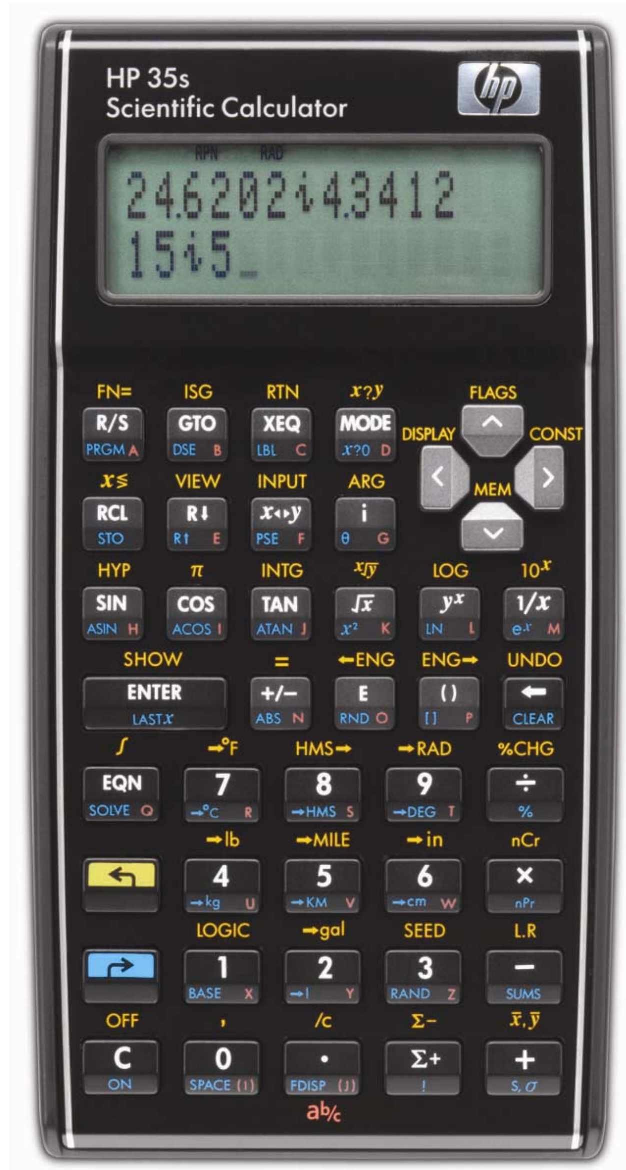
hp calculators

HP 35s Probability – Rearranging items

Rearranging items

Practice solving problems involving factorials, permutations, and combinations



Rearranging items

There are a great number of applications that involve determining the number of ways a group of items can be rearranged. The factorial function, accessed by pressing [↱] [!] (which is the right-shifted function of the [Σ+] key) on the 35s, will determine the number of ways you can rearrange the total number of items in a group. Note that the 35s will interpret the factorial function as the gamma function if the argument for the function is a non-integer real number. The permutation function, accessed by pressing [↱] [nPr] (which is the right-shifted function of the [×] key), will return the number of ways you can select a subgroup of a specified number of items from a larger group, where the order of each of the items in the subgroup is important. The combination function, accessed by pressing [↰] [nCr] (which is the left-shifted function of the [×] key), will return the number of ways you can select a subgroup of a specified number of items from a larger group, where the order of each of the items in the subgroup is not important.

To see the difference between permutations and combinations, consider the set of three items A, B, and C. If we select a subgroup of 2 items, we could select AC and CA as two possible subgroups. These would be counted as different subgroups if computing the number of permutations, but only as one subgroup if computing the number of combinations. Note that the factorial function operates the same in algebraic mode as it does in RPN mode. The number is keyed in and then the factorial function is selected from the keyboard. For permutations and combinations in RPN mode, the two numbers must be entered into the first two levels of the stack and then the function is selected from the keyboard. In algebraic mode, permutations and combinations require the function to be selected, then the first number to be keyed in and then the second number keyed in followed separated from the first by a 35s supplied comma followed by pressing the [ENTER] key to evaluate the function.

Factorials show up throughout mathematics and statistics. Permutations and combinations show up in many discrete probability distribution calculations, such as the binomial and hypergeometric distributions.

Practice solving problems involving factorials, permutations, and combinations

<u>Example 1:</u> How many different ways could 4 people be seated at a table?

<u>Solution:</u> In RPN or algebraic mode: [4] [↱] [!]

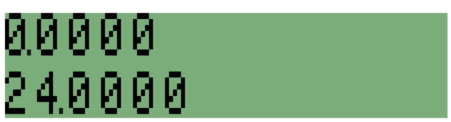


Figure 1

<u>Answer:</u> 24. Figure 1 shows the display assuming RPN mode.

<u>Example 2:</u> How many different hands of 5 cards could be dealt from a standard deck of 52 cards? Assume the order of the cards in the hand does not matter.

<u>Solution:</u> Since the order of the cards in the hand does not matter, the problem is solved as a Combination.

In RPN mode: [5] [2] [ENTER] [5] [↰] [nCr]

In algebraic mode: [↰] [nCr] [5] [2] [>] [5] [ENTER]

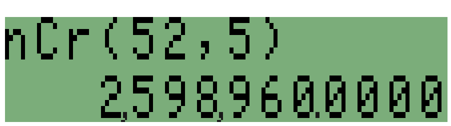


Figure 2

Answer: 2,598,960 different hands. Figure 2 shows the display assuming algebraic mode.

Example 3: John has had a difficult week at work and is standing in front of the doughnut display at the local grocery store. He is trying to determine the number of ways he can fill his bag with his 5 doughnuts from the 20 varieties in the display case. He considers the order in which the doughnuts are placed into the bag to be unimportant. How many different ways can he put them in his bag?

Solution: Since the order in which the doughnuts are placed in the bag does not matter, the problem is solved as a combination.

In RPN mode: [2] [0] [ENTER] [5] [↰] [nCr]

In algebraic mode: [↰] [nCr] [2] [0] [>] [5] [ENTER]

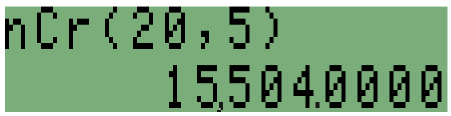


Figure 3

Answer: 15,504 different ways. Figure 3 shows the display assuming RPN mode.

Example 4: John has had a difficult week at work and is standing in front of the doughnut display at the local grocery store. He is trying to determine the number of ways he can fill his bag with his 5 doughnuts from the 20 varieties in the display case. He considers the order in which the doughnuts are placed into the bag to be quite important. How many different ways can he put them in his bag?

Solution: Since the order in which the doughnuts are placed in the bag matters, the problem is solved as a permutation.

In RPN mode: [2] [0] [ENTER] [5] [↱] [nPr]

In algebraic mode: [↱] [nPr] [2] [0] [>] [5] [ENTER]

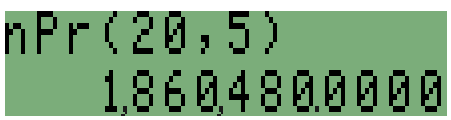


Figure 4

Answer: 1,860,480 different ways. John may be in front of the display case for some time. Figure 4 shows the display assuming algebraic mode.

Example 5: If you flip a coin 10 times, what is the probability that it comes up tails exactly 4 times?

Solution: This is an example of the binomial probability distribution. The formula to find the answer is given by:

$$P(X)=nCx \cdot p^{X} \cdot (1-p)^{(n-X)}$$

Figure 5

where P(X) is the probability of having X successes observed, nCx is the combination of n items taken x at a time, and p is the probability of a success on each trial.

In RPN mode: [1] [0] [ENTER] [4] [↰] [nCr] [0] [.] [5] [ENTER] [4] [y^x] [×] [1] [ENTER] [0] [.] [5] [−] [1] [0] [ENTER] [4] [−] [y^x] [×]

In algebraic mode: [↰] [nCr] [1] [0] [>] [4] [>] [×] [0] [.] [5] [y^x] [4] [×] [( )] [1] [−] [0] [.] [5] [>] [y^x] [( )] [1] [0] [−] [4] [ENTER]

Figure 6

<u>Answer:</u> If you flip a coin 10 times, there is a 20.51% chance of seeing heads 4 times. Figure 6 indicates the display if solved in algebraic mode.