

ROUND

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Chksum = CFAEh, Bytes = 680

The calculator's rounding simply rounds up if the last digit to be dropped is 5 or more. This is fine, except for the case when the last dropped digit equals 5. As explained below, this must be addressed, in a way that will round in either direction with an even probability.

This program will round a given number in level 2 to the number of digits specified in level 1. This uses the rules given below in Rounding, by the bookkeeper's method. It examines the number, checks if the last digit being dropped is 5, if not, it rounds by the usual method, up if greater than 5, truncates if less. If 5, it checks the number before, and rounds up if it is odd, and drops the last digit if even.

Input – number to be rounded level 2, number of significant digits level 1

Output – rounded number

SIGNIFICANT FIGURES - (sig figs) (1) All digits are significant except zeros at the beginning of the number, and possibly terminal zeros. (2) Terminal zeros ending at the right of the decimal point are significant. (3) Terminal zeros ending to the left of the decimal point may or may not be significant. Any uncertainty can be removed by expressing the measurement in scientific notation. (4) When multiplying or dividing measured quantities, there should be as many significant figures in the answer as in the measurement with the least number of significant figures. (5) When adding or subtracting measured quantities, there should be the same number of decimal places in the answer as in the measurement with the least number of decimal places. (Ebbing, 7).

ROUNDING - Look at the left most digit to be dropped. (1) If this is greater than 5, or 5 followed by nonzeros, add 1 to the last digit to be retained, and drop all digits further to the right. (2) If this digit is less than 5, simply drop it and all digits further to the right. (3) If this digit is simply 5, or 5 followed by all zeros, and if the last digit to be retained is even, just drop the 5 and any zeros after it. If the last digit to be retained is odd add 1 to it, and drop the 5 and any zeros after it. (Ebbing, 10).

$1.2151 = 1.22$

$1.21501 = 1.22$

$1.2143 = 1.21$

$1.22500 = 1.22$

$1.21500 = 1.22$

Note that to round a negative number “up” it would actually be rounded towards zero.

$-1.2151 = -1.20$

This method of rounding (called the bookkeeper's method) gives essentially the same number as the original for most reasonable distributions of the number being rounded. One exception would be rounding numbers that change slowly with time and those being converted from analog to digital. The best method for this is called ‘dithering’. This rounds the number upwards with probability equal to its fraction, and rounded downwards with the complement of that probability. 23.17 round up to 24 with probability of 0.17 and truncated to 23 with 0.83 probability.

To reduce inaccuracies caused by rounding, any numbers used in subsequent calculations should normally retain at least one significant figure more than is finally justified. At the end of the calculation, the final answer should be rounded to remove these extra, insignificant digits. This is usually not practical with a calculator, (unless this program is employed) therefore carry all of the digits to the final answer, and then round out the insignificant digits. (Wikipedia, 'Rounding').

BIBLIOGRAPHY

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