If I say I have about 100,000 acorns, that means (if I am being mathematically rigorous) that I have somewhere between 50,000 and 149,999 acorns. Either of those numbers rounds to 100,000. That's not very precise, so scientific notation was born. If I say I have 1x10^5 acorns, I am admitting I am no more certain than before, but I can say I have 1.00x 10^5 acorns, and that lets you know I am sure the number is between 99,500 and 104,999 acorns. That's a lot more precise and gives you a lot more information.
I was at a football game along with about 100,000 fans one night. The exact number was 109, 061, actually. So I could round that to 100,000 and be right, or 110,000 and be right, or 109,000 and still be right. Even 109,100 would be right, as would 109,060. Each rounding is correct for the number of significant digits given, but each leaves some uncertainty as to how precise I am being because of those trailing zeroes. That's my pitch for scientific notation. 8)

If you are asked to round the number 123456 to 3 significant figures, then it is 123000. That doesn't mean the three zeros are "insignificant" because they give the overall scale of the number and actually they tell you that the true number is between 122500 and 123499.
The problem is only what we call those digits 123... The commonly accepted terminology is as above "three significant figures", and when we are rounding a monetary amount say €21.42 → €21 nobody has any issue with it.
In fact, speaking personally, I would probably say "round 123456 to the nearest thousand" anyway.

Related

Since trailing zeros after the decimal point do not change the value of the number, why do trailing zeros after the decimal point count as significant figures? For example, why does 12.34 have 4 sig figs but 12.3400 have 6?

This is the difference between *precision* and *accuracy*, or at least that's how my university science professors taught it.
The reason we need to know significant figures is because it's probably rounded at some point, and we need to know exactly where.
12.34 could really be 12.344 or 12.336, while 12.3400 can be 12.3404 or 12.3396. 12.344 is a *very* different number than 12.3404, even if 12.34 and 12.3400 are equivalent.
As for the precision vs accuracy part, accuracy is how close your result is to the actual measurement. Precision is how close your result is to the results from the other trial(s).
This is easier to explain if I could draw a picture, but imagine a dartboard. If your aim is *accurate*, your darts are consistently close to the center. If your aim is *precise*, your darts are consistently close to *each other*, but it doesn't matter where they end up in relation to the center. Similarly the accurate darts could be far away from each other if they were equidistant from the center.

In serious math and (especially) science - there is the concept of presenting numbers with an implied precision.
So if I say that the top speed of my car is 142 mph - we probably all realize that this isn't an EXACT number - the car maybe does half a mile per hour fast or slower than that.
But if I tell you that it's top speed is 142.3 mph - you probably assume that this is exact to within maybe a tenth of a mile per hour.
If I told you it was 142.326456 mph - you'd have to assume that I had measured it extremely precisely with some ungodly accurate scientific instrument.
OK - seems obvious enough. But suppose the top speed of my car happens to be exactly 142 miles per hour accurate to within 1/100th of a mile per hour…how do you say that?

- 142 mph - doesn't really convey how accurately we know it.
- 142.00 mph - implies that we do know it exactly to within about 1/100th of a mile per hour and it just happens to be a nice round number.

So this is exactly the situation you're imagining it. The extra zeroes are implying extra precision - even though it's a nice round number. In basic arithmetic: 142 = 142.00 - but when we add those extra zeroes we're implying an exactness.
This is somewhat of a formal thing - but it's lacking in many respects. For example, there isn't a convenient way to say that we only know the top speed to be within 130 and 150 mph.
140 implies more precision than there really is. We need a handy way to say something like 14?.
In more formal science - we might say that it's 140 +/- 5 mph - saying that it's between 135 and 145.
But we may go even beyond that and express the certainty at which we know this spread of values.
The business of expressing uncertainty is practically a branch of science all to itself.
But for relatively informal communication - using an appropriate number of digits conveys quite a bit of important meaning.
We kinda have an innate feeling for the wrongness of excessive precision - it really grates when on StarTrek either Spock or Data tells us that there we'll arrive at our destination in 12 hours 43 minutes and 26.95 seconds.