

THE VALUE CONCLUSION

Rounding and significant figures in appraisal work

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Of the thousands of words and hundreds of numbers in an appraisal report, there is one number that is always read: the value conclusion. This number is the ending of the story that appraisers are educated, trained and paid to tell. How the number is derived and ultimately presented matters. For instance, a value conclusion of \$1,041,900 tells a much different story than one of \$1,040,000 or \$1,050,000.

The first number, \$1,041,900, is the appraiser's way of telling you that they are confident that the market reflects a value of the subject property between \$1,041,850 and \$1,041,949. Having a conclusion so specific is hard to believe. The other conclusion of \$1,040,000 is much more realistic.

Accuracy and Precision

In appraisal, we utilize many different types of numbers, such as measurements, dollar values, percentages and time. We then evaluate these numbers and conclude a dollar value. The accuracy and precision of these numbers vary between and within these groups. These variances directly affect the way an appraiser should round and report numbers. The appraiser must know what these numbers mean, how they were derived and why they were reported as they are. They need to understand what is accurate and how precise these numbers are because mistaking these will compound errors.

Rounding is the application of evidence, significant figures and experience to present a number in the most meaningful way available. Rounding tells the reader how precise the appraiser's value opinion is. It is dictated by the measurement, derivation and rounding of all the other numbers used to estimate market value. While appraisal conclusions are reported in dollar figures, we are not accurate or precise enough to report a number to the penny. But if not to the penny, how do we determine where to round?

When you read a value conclusion of \$1,040,000, does this mean that all the willing buyers and sellers of the subject will accept that amount as the transaction value for their properties? Of course not. That number—which represents the market value conclusion—is telling you that the subject property will *likely* trade at a value of *about* \$1,040,000. The number expresses an estimated precision of more or less than \$5,000, which is half of the smallest significant figure unit value of \$10,000. That is a very precise number given the overall value of the property. While the goal is to be accurate, the appraisal process is more designed to be as precise as possible knowing that the elements of a report—particularly the human elements—can act irrationally, making accuracy more a byproduct of the process.

Generally, the only gauge we have for the accuracy of an appraisal is if we find out a sale price later, and even that leaves us not knowing if that price was in the appropriate range of precision or not. Particularly, when we deal with eminent domain appraisal with hypotheticals, extraordinary assumptions and jurisdictional exceptions, we need to be especially cognizant of our measures of precision. Maintaining a regimented

process of evaluating the precision of the numbers provided will help to ensure an accurate and fair representation of the precision you report as market value.

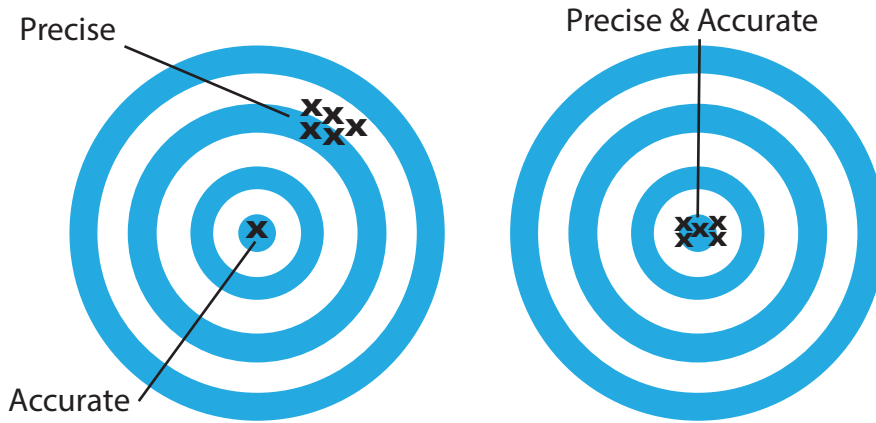
The Process

Real estate is a world of trends, variations and humans interacting, often in a highly stressful state. These do not make for ideal inputs if you demand highly accurate and extremely precise outputs. However, in fluid markets with a reasonable number of similar transactions, an appraiser can provide a relatively accurate opinion of market value with a reasonable degree of certainty if presented properly. The numbers we report represent values and concepts. By using a consistent and universal structure for reporting numbers, we can clearly communicate those ideas and concepts more clearly and efficiently.

There are three important steps to this process. First, identify the significant figures in the values you are provided. Second, apply the correct rules for processing these numbers and finally, report them with the correct significant figures, rounded appropriately.

Significant Figures

The significant figures of a number are digits that carry meaning contributing to its *measurement resolution*. The measurement resolution is effectively the smallest calibration on a measuring device. The number of significant figures in a measured quantity is the number of digits that are known accurately, plus one that is in doubt. For example, if you are measuring a pencil with a ruler that has inches as its smallest graduation, you can report that the pencil is 5.7 inches. Any other digits after the seven are not reported. Conversely, if



Accuracy is hitting the bullseye. Precision is the measure of repeatability.

you read a report and it states the lot area as 2.35 acres, you know for a fact that the area is more than 2.3 acres and less than 2.4 acres and that it is likely near the middle of those two.

In real estate, significant figures are utilized in area calculations (areas), rates and ratios (taxes, damages, etc.), sale prices and the measurement of time. Knowing which digits are significant will tell you how to report your numbers that rely on these figures.

Rules for Significant Figures

When determining which and how many digits in a number are significant, we read the digits like we read the letters to spell a word—from left to right.

1. All non-zero digits are significant

- a. 245 has three significant figures
- b. 123,457 has six significant figures

2. Zeros located between non-zero digits are significant.

- a. 303 has three significant figures
- b. 20,001 has five significant figures

3. All zeroes that end numbers (trailing zeroes) are insignificant, unless the number contains a decimal *or* if you are expressly provided information to the contrary.

- a. 310,000.0 has seven significant figures
- b. 3.20 has three significant figures
- c. 310,000 has two significant figures (unless you are told otherwise)

4. Zeroes to the left of the first non-zero are insignificant

- a. 0.56 has two significant figures
- b. 0.005001 has four significant figures
- c. 0.00000020 has two significant figures

Processing Significant Figures

When operating on numbers, adding, subtracting, multiplying and dividing, we report the resulting number with the same amount of significant figures as the number with the fewest significant figures. We can only be as precise as our least precise value. Spurious digits are introduced by calculations carried out to greater precision than that of the original data. Numbers are usually rounded to avoid the reporting of spurious digits or insignificant figures. For instance, let's say an appraiser's measuring wheel reports distances to the nearest inch. She measures a building to be 42 feet 1.6 inches by 30 feet 3.7 inches. Written as decimals, the building measures 42.1333 feet by 30.3083 feet. We would write those as 42.13 by 30.31 to avoid the spurious figures because the original measurements also had four significant figures.

Now, what is the gross area of the building? It's 42.13 feet times 30.31 feet or 1,276.9603 square feet. How significant is the 0.9603 here? We suggest that with four significant figures in each of the measured distances, one would not want to have more than that in the result, so that the gross area is best reported as 1,276 square feet.

What if our appraiser's wheel is reportedly accurate to plus or minus one inch? That means that while the gradient of the wheel has inches on it, you cannot determine an extra significant figure beyond the inch. In this case, the appraiser would report the measurements as 42.1 feet and 30.3 feet, calculate the product as 1,275.6300 and report the area to the appropriate significant figure of 1,280 square feet. The building could be anything

between 1,275 and 1,284 square feet. Can anyone really say that 1,280 square feet is not reasonably accurate, given the data and devices used? In terms of precision, couldn't we measure it five times and get five different answers between 1,275 square feet and 1,284 square feet? In this sense, 1,280 square feet is as precise as our measuring instrument allows and therefore, *reasonably* accurate.

Imagine a property reportedly sells for \$25 per square foot. You speak with the buyer, the seller, the broker and the buyer's attorney and they all report the sale was \$25 per square foot for an acre lot. However, you look up the property records and discover that sale price was \$1,089,000, which is one acre at \$25, but the lot size is actually 1.04 acres. Does that mean that the market value indicated by that sale is \$25 or \$24 (\$24.04)? In this case, we propose that the measurement resolution indicates the \$25 per square foot figure. This was the number the buyer and seller had in mind and the 0.04 acres is insignificant in this instance. It is recommended that the appraiser clearly state the circumstances behind the figure utilized before they are asked about this math by their reviewer.

Rounding

We all know how to round. Round up when it's over five and down when it's less than five, right? What about when it is five? There are no set rules about the proper rounding methodology, so it's entirely up to you. As long as you use the appropriate significant figures in your calculations prior to rounding and then round to the appropriate significant figure, you may round up or down, but be consistent.



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Although “double rounding” is a method of rounding (9.46 becomes 9.5, which becomes 10), this is not an appropriate method to round in appraisal and incorrect when adjusting to significant figures. This method is often used in computer architecture.

Right of Way

There are special considerations for right of way acquisition as well. These are the *non-appraisal* realities of acquisition. Perhaps your client has reporting requirements that suggest how one rounds or reports items like site improvements. Do you round up when working for the property owner and down when working for the condemning authority? How does it look when the before value happens to be rounded down and the after value up? Can that appear like one is favoring one party over the other? What about rounding and allocations? Is there an appropriate *minimum* compensation to meet agency requirements or to even make negotiation for acquisition possible?

There are often multiple goals that need reconciling. These include being as accurate and precise as possible, assuring that a property owner understands how they are being compensated for their loss, and complying with the agency’s reporting requirements. If an agency has a policy that certain items are to be compensated for, like any trees lost get paid for, then you will need to allocate for these. We suggest that these be treated separately from the other components when considering significant figures and rounding.

Let’s revisit the \$1,041,900 appraisal. Is that figure reported appropriately if the \$1,040,000 represents the permanent just compensation for the taking and the \$1,900 is the rent for the temporary easement? This is where we depart from the rules and use our experience. If the \$1,900 and the \$1,040,000 values were calculated using proper methodology, then a

total compensation of \$1,041,900 would not be a misleading figure given the context of the analysis and explained as such. This is a simple addition of two values calculated independently, based upon two sets of different values and using different significant figures.

In Summary

We now see how the story of the \$1,041,900 is unlikely. The question is often more difficult when you know to round appropriately and your client prefers a more or less precise number than is appropriate. Like most things, this should be discussed as early as possible. Explaining a process that is reasonable, supportable and repeatable will go a long way towards clearing up their misconceptions and keeping those pleasantries between appraiser and reviewer to a minimum. ✪



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