Measuring the Quality of the 2003 Residential Reappraisal

Introduction

The main goal when appraising property is to appraise it at 100% of true market value (Section 15-8-111, MCA). An appraised value represents an estimate of the true market value of the property. It is important that these estimates be as accurate as possible. This analysis will provide confidence in the results of reappraisal.

The reappraisal cycle ending December 31, 2002 is now complete. Each residential and commercial property received a new appraised value replacing an appraised value assigned to that property six years ago. The new appraised value represents an estimate of the true market value of the property on January 1, 2002. The old appraised value represents an estimate of the true market value of the property on January 1, 1996.

Property values have been appreciating rapidly in many areas of Montana since January 1, 1996. The new appraised value for many properties in the state is much higher than the old appraised value of the property. For this reason, the department must provide assurance that the reason for increases in appraised values are due to the genuine appreciation of property value and not due to faulty or poor reappraisal performance.

Measuring the Quality of Reappraisal

The most common method of measuring the performance of property reappraisal is ratio studies. Ideally, the ratio study would compare the appraised value with the true market value of a piece of property. In ratio studies true market values are usually represented by sales prices. A ratio study analyzes the relationship between the appraised value and sale value of property.

$$\textbf{Sales Ratio} = \frac{\textbf{Reappraisal Value}}{\textbf{Sales Price}}$$

The key data element in any sales ratio study is the ratio of appraised value to sale value. This ratio is computed by dividing the appraised value of a property by the sale value of the property. This, of course, assumes the sale of the property was an arms length transaction, and the sale value is a reliable estimate of true market value, a ratio of less than 1.00 indicates that the property was under appraised. A ratio of greater than 1.00 indicates that the property was overappraised. In the following example, a property with an assessed value of $80,000 that sold for $100,000 has a ratio expressed as .80 or 80%.

Reappraisal Value

$\frac{\$80,000}{\$100,000}$ = .8 or 80% ← Numeric expression of the relationship

Sales Price

Ratio studies measure two primary aspects of appraisal accuracy: level and uniformity.

Appraisal level: Appraisal level refers to the overall level at which properties are appraised. In Montana the desired appraisal level is 100% of true market value. The appraised values never exactly match the true market values of property. In good appraisal performance the overappraisals and underappraisals will balance such that the overall appraisal level is 100% of true market value.

Appraisal uniformity: Appraisal uniformity refers to the magnitude of overappraisals and underappraisals. The degree to which the appraisals differ from true market value is important. In good appraisal performance the degree to which appraisals differ from true market values is within acceptable standards.

There are standard statistical techniques for measuring and analyzing appraisal level and uniformity. These measures and techniques are outlined in chapter 20 of *Property Appraisal and Assessment Administration*, published by the International Association of Assessing Officers (IAAO).

Measures of Appraisal Level

The three most common measures of appraisal level are the median, mean and weighted mean. Each measure has advantages and disadvantages. It is common practice to compute all three measures. Comparison of the measures provides useful information about the distributions of the ratios. For example, wide differences among the measures indicate undesirable patterns of appraisal performance.

Median: The median is the middle ratio when all ratios are ordered by magnitude. The median is the most common measure of appraisal level. An advantage of the median is that it is easy to compute and easily understood. By nature, the median is not affected by extreme ratios.

Mean: The mean is the average ratio (the sum of the ratios divided by the number of ratios).

Like the median, the mean is easy to compute and understand. However, unlike the median, the mean is impacted by extreme ratios. The mean is the least used measure of assessment level.

Weighted Mean: The weighted mean is an aggregate ratio (the sum of all the appraised values divided by the sum of all the sales values). The weighted mean is the appropriate measure for estimating the total market value of the population.

Measures of Appraisal Uniformity

Part of determining the quality of reappraisal requires measuring uniformity. It is possible for the appraisal level to be good (close to 100%), yet still have unfavorable appraisal performance. This occurs when the appraisal is not uniform. Appraisal uniformity is measured by the frequency distribution of the ratios, standard deviation and the coefficient of dispersion.

Frequency Distribution: A display of the number of ratios falling within specified intervals. The distribution can be displayed as a table or as a graph. When observing the graph, a good level of uniformity is indicated when a large percentage of the ratios are close to the overall level of assessment and the graph is symmetrical with respect to the overall level of assessment.

Standard Deviation: The standard deviation is the primary measure of dispersion in scientific research and can be a powerful measure of appraisal uniformity. In a normal distribution, 68% of data will be 1 standard deviation from the mean, 95% will be within 2 standard deviations, and 99% will be within 3 standard deviations. For example, if a property group has an average mean ratio of 1.01 (101%), and a standard deviation of 0.10 (10%), it is assumed that 68% of data will fall between 0.91 (91%) and 1.11 (110%). In ratio studies, the larger the standard deviation, the wider the range within which a given portion of properties are appraised relative to market value.

Coefficient of Dispersion: The coefficient of dispersion (COD) is the most used measure of uniformity in ratio studies. The COD is the average absolute deviation expressed as a percentage of the level of assessment, calculated by dividing the average absolute deviation by the median. For instance, a COD of 10% means that the average percent deviation from the median is (+ or -) 10%. Good appraisal uniformity is associated with low CODs of 15% or less for older, heterogeneous areas and 10% for newer, homogeneous areas (IAAO).

Price-Related Differential: The price-related differential (PRD) is a statistic for measuring assessment regressivity or progressivity. Assessment regressivity exists if high-value properties are underappraised relative to low-value properties. Conversely, assessment progressivity exists if high-value properties are overappraised relative to low-value properties. The PRD is calculated by dividing the mean by the weighted mean. A PRD greater than 1.00 suggests appraisal regressivity. A PRD less than 1.00 suggests appraisal progressivity. As a general rule, PRDs should range between 0.98 and 1.03 (IAAO).

Tax Policy and Research conducted a study to assess the quality of the recently completed reappraisal. The analysis included computing the measures of assessment

level and uniformity as discussed in the previous section. These measures were calculated on a statewide basis, county basis (where a sufficient number of sales existed), and a municipality basis (where a sufficient number of sales existed).

Data for the analysis was provided by the Property Assessment Division of the department. The data set contained only properties that sold from January 1 to June 30, 2002 and were considered to be valid sales by the Property Assessment Division. Standard screening processes within the division were used to determine the validity of sales. This data set included only sales within two standard deviations of the log of the ratios, which consist of ratios greater than 67.9% and less than 147.0%. There were 5,553 sales of residential property included in the analysis. The screening process excluded 372 sales, or 6.7% of all sales. (Following this analysis, there is a section that includes the results of using all sales.)

Results

Statewide Analysis

The statewide overall level of assessment, as measured by the median ratio, is 99.18%. The *International Association of Assessing Officers Standard on Ratio Studies* (1999) recommends that the overall level of assessment should be within 10% of market value. The measure of 99.18% clearly falls within that range.

The statewide COD was calculated to be 9.7 %. This is below the 15% level recommended by IAAO. This indicates good appraisal uniformity.

Figure 1

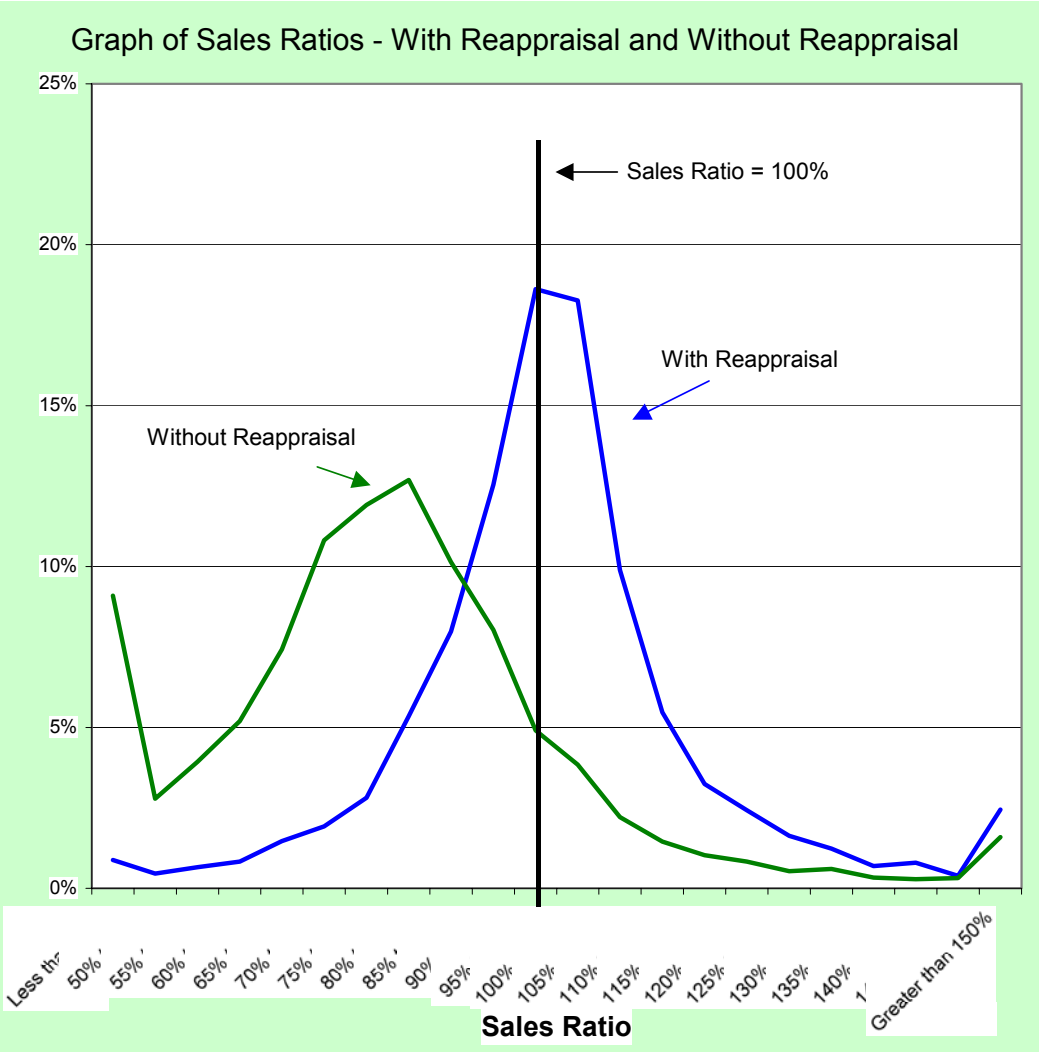
Sales Ratio Frequency Distribution

For Residential Property - With and Without Reappraisal

The table and chart display the distribution of the sales ratio for residential property. The ratio is measured by dividing the property's appraised value by the sales price of the property.

With Reappraisal: Ratio = (2003 Reappraisal Value / Sales Value)
Without Reappraisal: Ratio = (2002 Assessment / Sales Value)

(Assessment / Sales) **Sales Ratio Bracket**	**With Reappraisal % of Total Sales In Bracket**		**Without Reappraisal % of Total Sales In Bracket**
Less than 50%	0.9%		9.1%
50% to 55%	0.5%		2.8%
55% to 60%	0.7%		3.9%
60% to 65%	0.8%		5.2%
65% to 70%	1.5%		7.4%
70% to 75%	1.9%		10.8%
75% to 80%	2.8%		11.9%
80% to 85%	5.4%		12.7%
85% to 90%	8.0%		10.1%
90% to 95%	12.5%		8.0%
95% to 100%	18.6%		4.9%
100% to 105%	18.3%		3.8%
105% to 110%	9.9%		2.2%
110% to 115%	5.5%		1.5%
115% to 120%	3.2%		1.0%
120% to 125%	2.4%		0.8%
125% to 130%	1.6%		0.5%
130% to 135%	1.2%		0.6%
135% to 140%	0.7%		0.3%
140% to 145%	0.8%		0.3%
145% to 150%	0.4%		0.3%
Greater than 150%	2.4%		1.6%



Compiled by Tax Policy & Research, MDOR, November 2003

The frequency distribution of the sales ratios is displayed in Figure 1, along with the distribution of ratios using old reappraisal values. The graph is a tight, symmetrical curve centered about the assessment level of 99.18%. This is evidence of good appraisal uniformity, and is furtherer supported by a low standard deviation of 0.1307. (Statewide totals can be found on the bottom of Table 2 on page 9.)

The statewide price-related differential is 1.0195, which is within the 0.98 to 1.03 range suggested by the IAAO. This indicates that neither progressivity or regressivity occurred statewide in the reappraisal. Again, this indicates that higher priced properties were not likely to be underappraised, or overappraised relative to lower price properties.

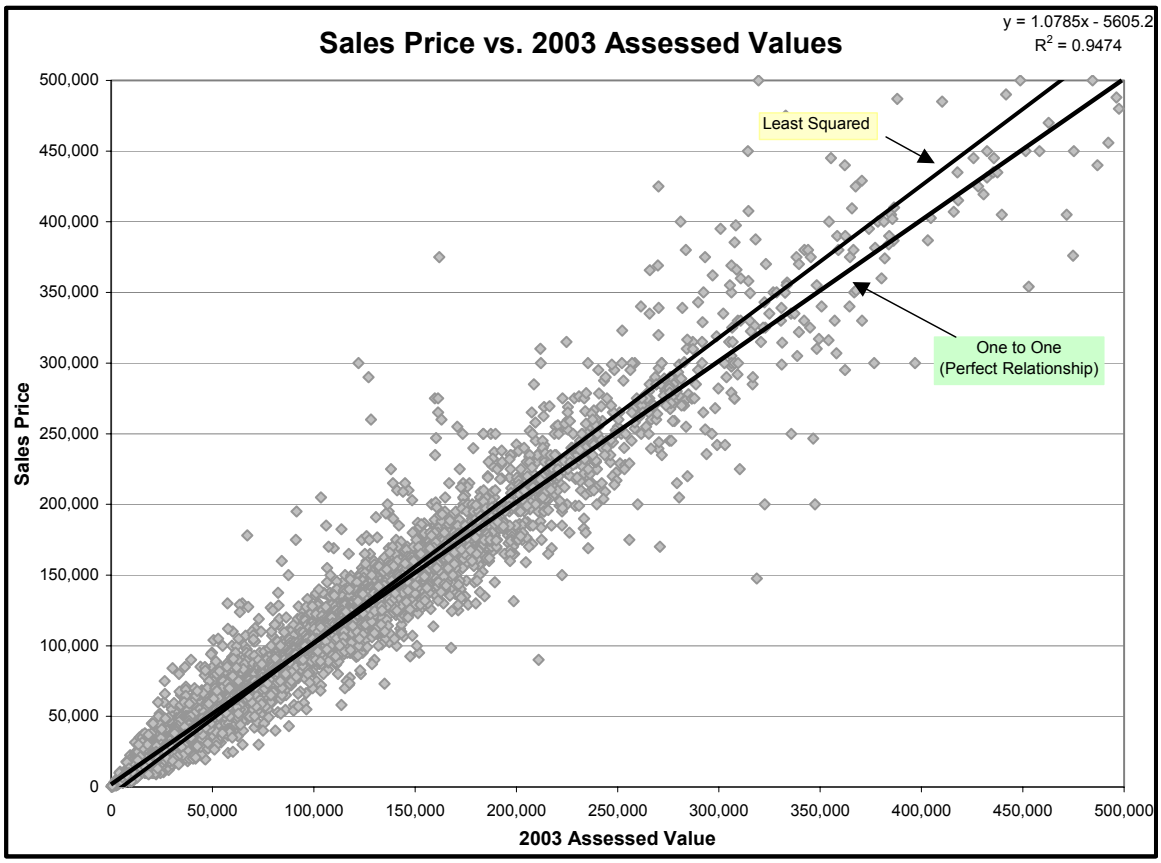
Using the previously described methodology, a sales ratio analysis was also performed using the old appraisals (see Appendix B). Comparing the results of the study using ratios calculated with the new reappraisal value to the results of the study using ratios calculated with the old appraisal value provides insight into the performance of the reappraisal effort. The overall level of assessment (median) using the old appraisals is 80.53%. This is well below the required level of 100%: this indicates that, without reappraisal, residential property is under appraised. The reappraisal effort was successful in attaining a level of assessment close to 100%.

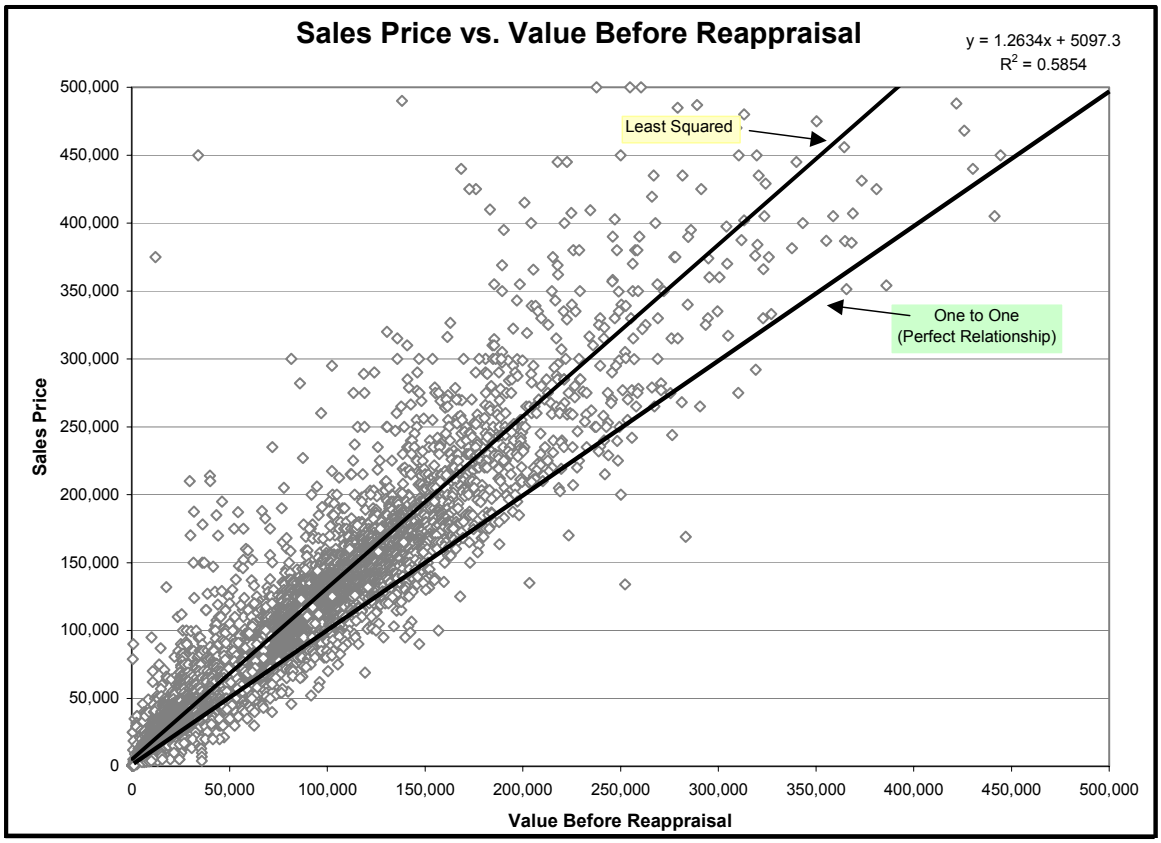
The top portion of Figure 2, on page 7, shows a (scatter) plot of the relationship between sales prices and assessed values using the *current* appraisal. The bottom half of Figure 2 has a similar plot of the sales prices, but is set against assessed values of the *old* reappraisal. Each plot, as labeled, has a (ordinary) least squares line, sometimes referred to as a best fit line, which minimizes the sum of the squared errors. The line labeled 'One to One' in each plot is the line where 100% of market value is attained, or where sales price equals the assessed value. In our example, a 'Least Squared' line above the 'One to One' line means that typically, the sales price is higher than the assessed value. What is important about these lines is how close they lie from one another. For appraisal quality, the closer the 'Least Squared' line is to our 'One to One' line, the closer to 100% the appraisal effort is. As Figure 2 illustrates, the divergence between the two lines, 'Least Squared' and 'One to One' is a much shorter distance using current reappraisals than old. This along with the tighter distribution of the plots themselves tells us that, as expected, the current reappraisal is a much better determinant of current market value than the old reappraisal.

The COD using the old appraisals is 18.0%. This is above the recommended measure of 15%. Having a COD of 9.7% versus 18.0% indicates that the reappraisal effort reduced the degree to which the sales ratios differ from the assessment level. When using old reappraisals, it is also worth noting the wide divergence between appraisal measures (median, mean, weighted mean), the large standard deviation, and a PRD above the suggested range, all of which indicate poor measures of assessment. In a nutshell, these measurements and charts demonstrate the need for the 2003 reappraisal to bring the overall appraisal level to 100%.

Figure 2

Plot of Sales Price and Assessed Value - With and Without Reappraisal





County Analysis

The level of assessment and COD were calculated for counties in which there were 30 or more sales. The results of the analysis for the twenty-three counties having 30 or more sales are listed in Table 1. All of the twenty-three counties have assessment levels (medians) which fall within the recommended range of 90%-110%. Twenty-two of the twenty-three counties have CODs below the 15% recommended by the IAAO. The exception being Lake County whose COD is close to the recommended range at 16.1%.

Table 1
Assessment Level and Coefficients of Dispersion
For Counties with 30 or More Sales

County Name	Count of Observations	Median of Ratios	Coefficient of Dispersion
Beaverhead	43	0.9810	9.2%
Carbon	89	0.9537	13.4%
Cascade	498	1.0041	5.3%
Custer	64	1.0211	10.7%
Dawson	34	1.0321	7.6%
Deer Lodge	35	1.0000	14.4%
Fergus	53	0.9900	9.7%
Flathead	722	1.0023	10.7%
Gallatin	810	0.9855	9.6%
Hill	78	1.0114	10.1%
Jefferson	58	0.9536	11.2%
Lake	73	0.9851	16.1%
Lewis & Clark	364	0.9750	9.6%
Lincoln	160	1.0084	8.0%
Madison	131	0.9793	13.2%
Missoula	663	0.9753	8.7%
Park	90	1.0042	13.3%
Ravalli	234	0.9711	9.9%
Sanders	46	1.0018	9.7%
Silver Bow	150	0.9940	6.3%
Stillwater	36	0.9937	8.2%
Valley	38	0.9374	14.9%
Yellowstone	751	0.9765	8.5%

All counties are listed in Table 2. Counties with fewer than 30 sales were grouped such that the total number of sales in the group was 30 or more. Where possible, a group contains counties that are within the same market region (as determined by the department's Property Assessment Division), or share borders. Included in this table are three measures of assessment level: the median, mean and weighted mean for each county and groups of counties. The standard deviation, COD and PRD for each measurement of assessment level is also listed.

Table 2

Assessment Level, Coefficient of Dispersion *(COD)*, and Price Related Difference *(PRD)*
Counties with 30 or More Sales and Grouped Counties

PRD = Mean / Wtd. Mean

County Name	Count of Sales	Median	Mean	Wtd. Mean	Standard Deviation	*(COD)* Coefficient of Dispersion	*(PRD)* Price Related Difference
Beaverhead	43	0.9810	1.0003	0.9921	0.1397	9.2%	1.0083
Carbon	89	0.9537	0.9816	0.9588	0.1687	13.4%	1.0237
Cascade	498	1.0041	1.0135	1.0040	0.0822	5.3%	1.0095
Custer	64	1.0211	1.0519	1.0399	0.1468	10.7%	1.0115
Dawson	34	1.0321	1.0392	1.0275	0.1032	7.6%	1.0114
Deer Lodge	35	1.0000	1.0086	0.9355	0.1888	14.4%	*1.0782*
Fergus	53	0.9900	1.0173	0.9889	0.1414	9.7%	1.0288
Flathead	722	1.0023	1.0135	0.9945	0.1403	10.7%	1.0191
Gallatin	810	0.9855	0.9801	0.9669	0.1226	9.6%	1.0137
Hill	78	1.0114	1.0357	1.0118	0.1437	10.1%	1.0236
Jefferson	58	0.9536	0.9728	0.9600	0.1431	11.2%	1.0133
Lake	73	0.9851	1.0267	0.9944	0.1992	16.1%	*1.0325*
Lewis & Clark	364	0.9750	0.9870	0.9738	0.1265	9.6%	1.0136
Lincoln	160	1.0084	1.0029	0.9928	0.1025	8.0%	1.0102
Madison	131	0.9793	0.9885	0.9071	0.1642	13.2%	*1.0898*
Missoula	663	0.9753	0.9796	0.9724	0.1224	8.7%	1.0073
Park	90	1.0042	1.0208	0.9794	0.1659	13.3%	*1.0422*
Ravalli	234	0.9711	0.9729	0.9688	0.1251	9.9%	1.0043
Sanders	46	1.0018	0.9875	0.9715	0.1370	9.7%	1.0164
Silver Bow	150	0.9940	1.0053	0.9916	0.0931	6.3%	1.0138
Stillwater	36	0.9937	1.0137	0.9894	0.1268	8.2%	1.0246
Valley	38	0.9374	0.9675	0.9621	0.1756	14.9%	1.0056
Yellowstone	751	0.9765	0.9799	0.9833	0.1098	8.5%	0.9966
Granite, Mineral, Powell	44	1.0612	1.0921	1.0340	0.1815	13.2%	*1.0562*
Broadwater, Golden Valley, Meagher, Musselshell, Sweet Grass, Wheatland	47	1.0144	1.0149	1.0132	0.1619	10.6%	1.0017
Blaine, Chouteau, Glacier, Judith Basin, Liberty, Pondera, Teton, Toole	90	1.0253	1.0421	1.0135	0.1636	11.4%	1.0282
Big Horn, Garfield, Petroleum, Phillips, Rosebud, Treasure	56	1.0025	1.0231	0.9820	0.1703	13.0%	*1.0419*
Carter, Fallon, McCone, Powder River, Prairie, Richland, Wibaux	50	0.9924	1.0109	0.9767	0.1742	11.7%	*1.0350*
Daniels Roosevelt, Sheridan	46	1.0738	1.0953	1.0849	0.1707	12.5%	1.0096
Statewide	**5,553**	**0.9918**	**0.9970**	**0.9779**	**0.1307**	**9.7%**	**1.0195**

Generally, increasing the geographic size of a study area (group of counties) will tend to increase the COD of the study area. This is due to the property being analyzed becoming less similar or homogeneous. In spite of this, all median levels of the groupings fall in the accepted range of 90%-110%, along with all CODs within the recommended level of 15% or less.

Since the price-related difference (PRD) is calculated about the weighted mean, it is susceptible to being influenced significantly by large valued property, especially in small samples. Large sample sizes will reduce the amount of shifting in the PRD due to significantly large valued property. When the sample size is small, like in many of the counties, the PRD may not be a reliable determinate of regressivety. It may be necessary to remove large valued property and recalculate the PRD to get a sense of how it is reacting to such property.

On the far right hand side of Table 2, is the calculated price-related differential (PRD) for each county and groups of counties. Looking at the PRD of the twenty-three counties with 30 or more sales, only four counties have a PRD outside the suggested 0.98-1.03 range. Two of those four counties with PRDs of 1.0325 (Lake), and 1.0422 (Park), are not far enough outside that range to indicate strong regressivity. Deer Lodge and Madison County with a PRDs of 1.0898 and 1.0782, respectively are noticeably higher than the allowable range of 0.98 to 1.03. However, in these two counties the higher than normal PRD can be attributable to three or four high value transactions that are greatly lowering the weighted mean ratio and increasing the PRD. Removing these transactions, and recalculating Deer Lodge's and Madison's PRD, results in PRDs that fall within the acceptable PRD range.

Among the grouped counties, three of the groups have a PRD that is above the suggested range of 0.98 to 1.03, but two of the groups only slightly. One of the grouped counties, consisting of Granite, Mineral and Powell had a PRD considerably beyond the suggested range at 1.0562. It was found that removing two sales from this group reduced the PRD from 1.0562 to below 1.04. 1.04 is not a significant enough divergence from the acceptable range to make any firm conclusion regarding regressiveness (or progressiveness) given the small number of sales in a large geographic area, in conjunction with a few sales having significant influence on the PRD.

Municipality Analysis

The level of assessment and COD were calculated for municipalities in which there were 30 or more sales. The results are listed in Table 3. All municipalities have medians in the recommended range (within 10%). All CODs for the municipalities also fall in the recommended range for CODs (15% or less).

Table 3
Assessment Level and Coefficients of Dispersion
For Incorporated City / Towns with 30 or More Sales

City/Town	Count of Observations	Median of Ratios	Coefficient of Dispersion
Belgrade	54	0.9837	8.5%
Billings	583	0.9814	8.0%
Bozeman	281	0.9873	8.4%
Columbia Falls	33	1.0218	10.4%
Great Falls	403	1.0045	4.7%
Hamilton	31	0.9612	8.0%
Havre	64	1.0105	9.7%
Helena	180	0.9913	7.9%
Kalispell	216	1.0362	8.5%
Laurel	32	0.9453	9.8%
Lewistown	43	0.9928	8.8%
Livingston	48	1.0116	10.9%
Miles City	53	1.0234	10.6%
Missoula	395	0.9713	7.4%
Red Lodge	43	0.9520	13.5%
Whitefish	69	0.9327	12.5%

Conclusion

Based on widely recognized norms and standards, the 2003 reappraisal can be characterized as being of high quality, as evidenced by this study. The goal of having a sample appraisal level within 10% of market value is met. The sample assessment level of 99.18% is actually within 0.9% of market value.

The reappraisal also meets uniformity standards, as evidenced by the coefficients of dispersion and the price-related differential. The statewide COD of 9.7% is well below the recommended 15%. The PRD of 1.0195 does not indicate progressivity or regressivity in the reappraisal. The increases in appraised values are due to genuine appreciation of property value and not to faulty reappraisal.