



Measuring the Quality of Reappraisal

Residential Property – 2009 Reappraisal

Montana Department of Revenue

December 2009

Executive Summary

This report demonstrates that the 2009 reappraisal meets or exceeds the International Association of Assessing Officers (IAAO) standards of appraisal quality. The Department of Revenue met the IAAO standard of having a sample appraisal level within 10 percent of market value. The sample assessment level of 97.51 percent is actually within 2.5 percent of market value. The reappraisal also meets uniformity standards. The increases in appraised values are due to genuine appreciation of property value and not to faulty reappraisal.

The rest of this report discusses the sales ratio study performed by the Department to evaluate the 2009 reappraisal. The first section discusses commonly used sales ratio statistics, followed by a section comparing the most recent appraised values to previous appraised values. Statistics for individual regions, select counties and select municipalities are reported in Tables 1-3 on pages 10 and 11.

Measuring the Quality of the 2009 Residential Reappraisal

Introduction

The main goal when appraising property is to appraise it at 100% of true market value (15-8-111, MCA). An appraised value represents an estimate of the true market value of 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, 2008 is now complete. The Department of Revenue assigned a new appraised value to each residential and commercial property that replaced an appraised value assigned to each property six years ago. The new appraised value represents an estimate of the true market value of the property on July 1, 2008. The old appraised value represents an estimate of the true market value of the property on January 1, 2002.

Property values have been appreciating rapidly in many areas of Montana since January 1, 2002. 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 is 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 a ratio study. Ideally, the ratio study compares the appraised value with the true market value of property. Because market values cannot be directly observed, sales prices usually represent true market values in ratio studies. A ratio study analyzes the relationship between the appraised value and sale value of property.

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

The key data element in any sales ratio study is the ratio of appraised value to sale value. To calculate this ratio, divide the appraised value of the property by the sale value of the property. This, of course, assumes that the sale of the property was an arm's-length transaction, and that the sale value is a reliable estimate of true market value. A ratio of less than 1.00 indicates that the property is underappraised. A ratio of greater than 1.00 indicates that the property is 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%.

$$\frac{\$80,000}{\$100,000} = .8 \text{ or } 80\%$$

Reappraisal Value (points to \$80,000)
 Sales Price (points to \$100,000)
 Numeric expression of the relationship (points to .8 or 80%)

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 close to 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. Chapter 5 of *Mass Appraisal of Real Property*, published by the International Association of Assessing Officers (IAAO), outlines these measures and techniques.

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. The weighted mean gives equal weight to each dollar of value in the sample; the mean and median give equal weight to each parcel.

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 a graph, a large percentage of the ratios close to the overall level of assessment and graph symmetry with respect to the overall level of assessment indicates a good level of uniformity.

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, and is calculated by dividing the average absolute deviation by the median. The average deviation is calculated by subtracting the median from each ratio, summing the absolute values of the computed differences, and dividing this sum by the number of ratios. For example, 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).

The Department's Tax Policy and Research unit 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 previously. Tax Policy and Research calculated these measures on a statewide basis, county basis (where a sufficient number of sales existed), and a municipality basis (where a sufficient number of sales existed).

The Department's Property Assessment Division provided the data for the analysis. The data set contained 3,921 residential properties that sold from July 1 to December 31, 2008 that the Property Assessment Division considered to be valid sales. The Property Assessment Division used standard screening processes to determine the validity of sales. The data set used to calculate the sales ratio statistics included only sales within two standard deviations from the mean of the log of the ratios, eliminating 161 (4.1%) observations. The resulting data set included 3,760 records.

Results

Statewide Analysis

The statewide overall level of assessment, as measured by the median ratio, is 97.51%. 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 97.51% clearly falls within that range.

The statewide coefficient of dispersion is 11.4% for this sample. This is below the 15% level recommended by IAAO and indicates good appraisal uniformity.

Statewide Sales Ratio Statistics Old vs. New Values		
Measures of Appraisal Level	New Values	Old Values
Median Assessment Ratio	0.9751	0.6035
Mean Assessment Ratio	0.9765	0.5559
Weighted Mean Assessment Ratio	0.9641	0.5310
Measures of Appraisal Uniformity		
Coefficient of Dispersion	11.4082	29.8232
Price Related Differential	1.0129	1.0467

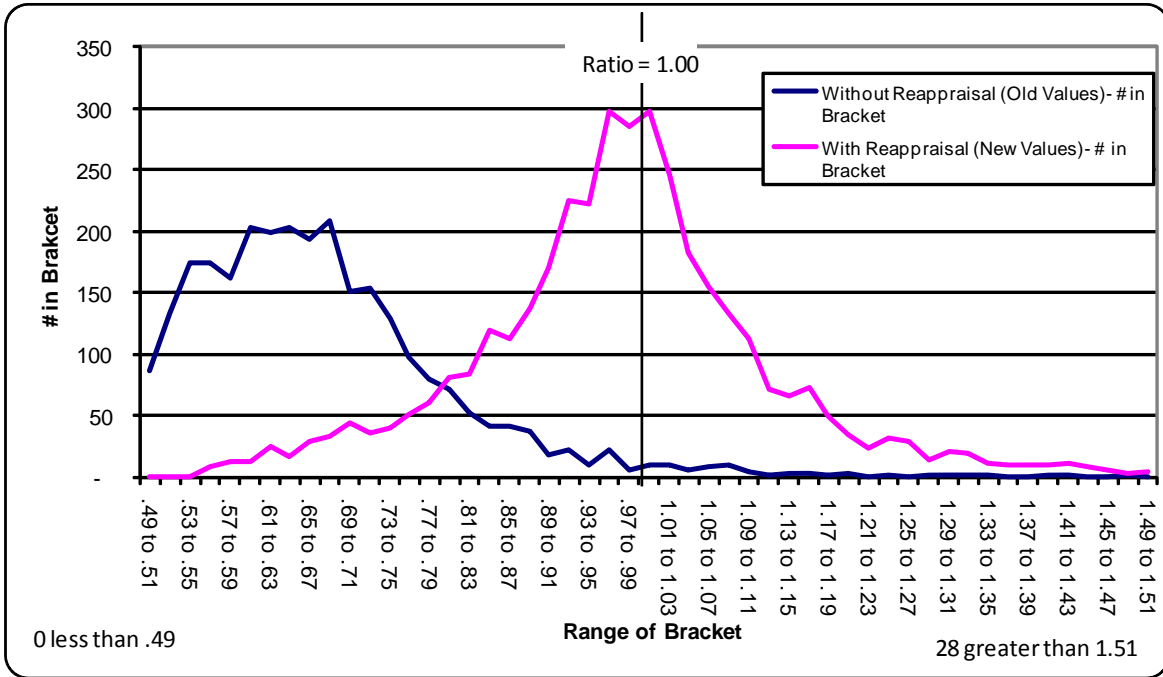
Figure 1

The frequency distribution of the sales ratios is displayed in Figure 1, on page 6, along with the distribution of ratios using old reappraisal values. The distribution is a tight, symmetrical curve centered about the assessment level of 97.51%. This is evidence of good appraisal uniformity, and is further supported by a low standard deviation of 0.1546. (Statewide totals can be found on the top of Table 1 on 10.)

The statewide price-related differential is 1.0129, which is within the 0.98 to 1.03 range suggested by the IAAO. This indicates that neither progressivity nor regressivity occurred statewide in the reappraisal. Again, this shows that higher priced properties were not likely to be underappraised, or overappraised relative to lower price properties.

Department staff performed a sales ratio analysis using the old appraisals with the previously described methodology. 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 (mean) using the old appraisals is 55.59%. This is well below the required level of 100% and indicates that, without reappraisal, residential property is underappraised. The reappraisal effort was successful in attaining a level of assessment close to 100%.

Figure 1: Sales Ratio Frequency Distribution
With and Without Reappraisal



Bracket	Without Reappraisal - # in Bracket	With Reappraisal - # in Bracket	Range
1	1,016	-	less than .49
2	87	-	.49 to .51
3	133	-	.51 to .53
4	175	-	.53 to .55
5	175	8	.55 to .57
6	162	13	.57 to .59
7	203	12	.59 to .61
8	199	25	.61 to .63
9	203	17	.63 to .65
10	194	29	.65 to .67
11	208	33	.67 to .69
12	151	44	.69 to .71
13	154	36	.71 to .73
14	129	40	.73 to .75
15	98	51	.75 to .77
16	79	60	.77 to .79
17	72	81	.79 to .81
18	52	84	.81 to .83
19	41	120	.83 to .85
20	41	113	.85 to .87
21	37	137	.87 to .89
22	18	170	.89 to .91
23	22	225	.91 to .93
24	10	222	.93 to .95
25	22	298	.95 to .97
26	6	285	.97 to .99
27	10	298	.99 to 1.01

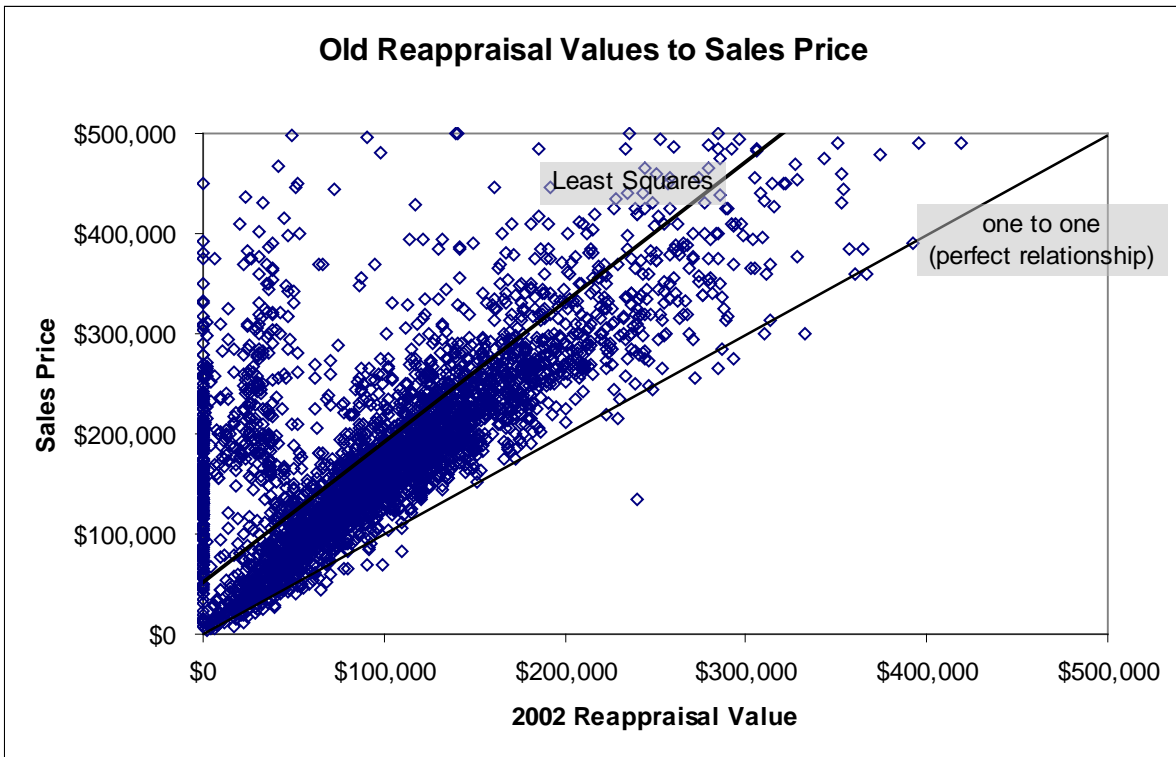
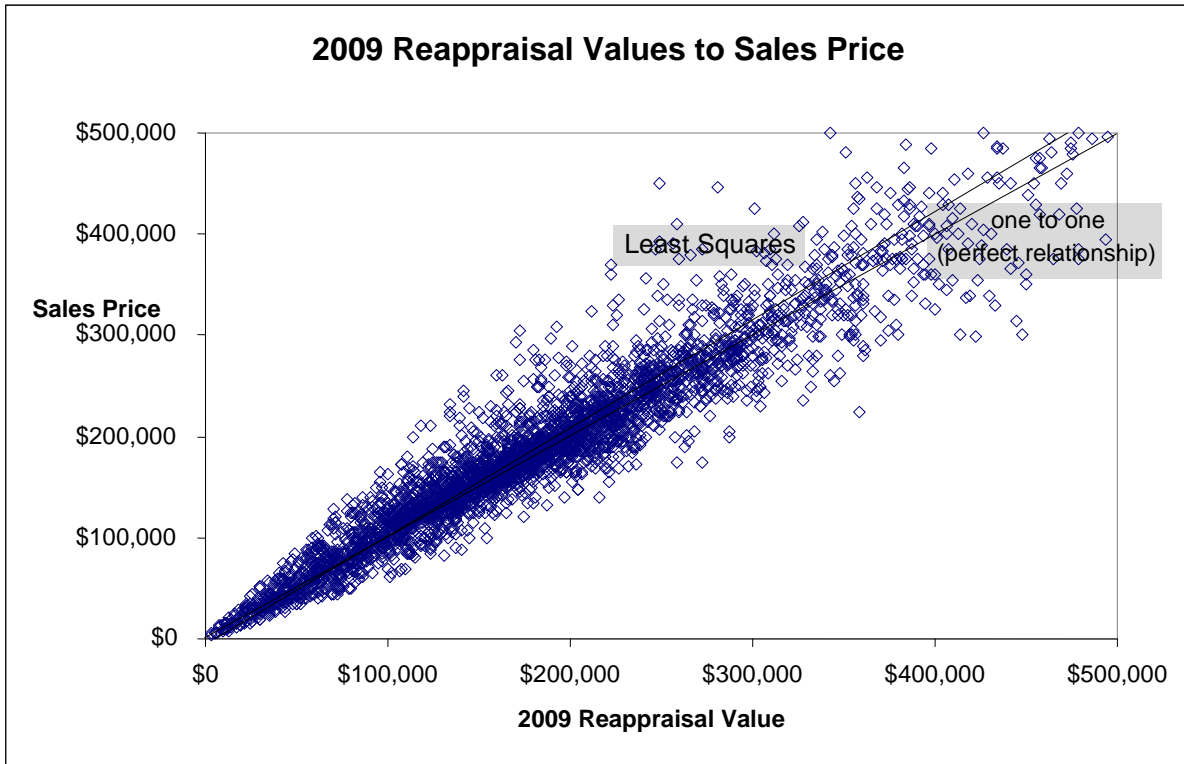
Bracket	Without Reappraisal - # in Bracket	With Reappraisal - # in Bracket	Range
28	9	246	1.01 to 1.03
29	5	182	1.03 to 1.05
30	8	155	1.05 to 1.07
31	9	133	1.07 to 1.09
32	4	113	1.09 to 1.11
33	2	71	1.11 to 1.13
34	3	66	1.13 to 1.15
35	3	73	1.15 to 1.17
36	1	50	1.17 to 1.19
37	3	35	1.19 to 1.21
38	-	24	1.21 to 1.23
39	2	31	1.23 to 1.25
40	-	29	1.25 to 1.27
41	1	14	1.27 to 1.29
42	2	20	1.29 to 1.31
43	2	19	1.31 to 1.33
44	1	11	1.33 to 1.35
45	-	10	1.35 to 1.37
46	-	9	1.37 to 1.39
47	1	9	1.39 to 1.41
48	2	11	1.41 to 1.43
49	-	8	1.43 to 1.45
50	-	5	1.45 to 1.47
51	1	3	1.47 to 1.49
52	-	4	1.49 to 1.51
53	4	28	greater than 1.51

Figure 2

The top portion of Figure 2, on page 8, 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 'Least Squares' line, which is the (ordinary) least squares line, sometimes referred to as the best fit, 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 Squares' 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 to one another. For appraisal quality, the closer the 'Least Squares' line is to the 'One to One' line, the closer the appraisal effort is to 100%. As Figure 2 illustrates, the divergence between the two lines, 'Least Squares' and 'One to One' is a much shorter distance using current reappraisals than old reappraisals. This, along with the tighter distribution of the plots themselves, shows 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 29.8%. This is above the recommended measure of 15%. Having a COD of 11.4% versus 29.8% 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 2009 reappraisal to bring the overall appraisal level to 100%.

**Figure 2: Plot of Sales Price and Assessed Value
With and Without Reappraisal**



Region Analysis

Table 1

Department of Revenue staff calculated reappraisal statistics for the state as a whole and for each of the Department's administrative regions. Table 1 on page 10 shows the number of residential parcels, the number of verified sales and statistics of central tendencies. There are also statistics concerning the distribution of the sales assessment ratios and the price related differential.

The reappraisal statistics for the entire state are within the standards set by the IAAO. Region 3 and region 5 have a COD of greater than 15.0, above the IAAO standard. Those regions also have a PRD of greater than 1.03. The COD and PRD are expected to be higher when the property in the regions is more heterogeneous.

County Analysis

Table 2

There were 16 counties with at least 30 verified sales between July 1 and December 31, 2008 for these purposes.

Table 2 on page 10 shows the number of residential parcels in each county, the number of verified sales and statistics of central tendencies. There are also statistics concerning the distribution of the sales assessment ratios and the price related differential.

The level of assessment and the COD were calculated for each of these groupings. The results of the analysis for the 16 counties having 30 or more sales are listed in Table 2. Fourteen of the sixteen individual counties have assessment levels (medians) that fall within the recommended range of 90%-110%. Silver Bow and Jefferson counties have median ratios slightly below 90%. Ten of the sixteen counties have CODs below the 15% recommended by the IAAO.

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.

The far right column in Table 2 shows the price related differential (PRD). This is a measure of equality of reappraisal with regard to high- and low-value properties. The IAAO standard is that the PRD should be between 0.98 and 1.03. This requirement is met in twelve of the sixteen individual counties.

Table 1: Assessment Level and Coefficient of Dispersion

For Administrative Regions

	Number of Parcels	Number of Sales	Measures of Central Tendencies			Measures of Dispersion		Price Related Differential
			Weighted Mean	Mean	Median	Standard Deviation	Coefficient of Dispersion	
Statewide Totals	558,342	3,760	0.9641	0.9765	0.9751	0.1546	11.1447	1.0129
Region								
Region 1	99,303	353	0.9825	1.0035	0.9931	0.1424	10.2553	1.0214
Region 2	81,416	648	0.9819	0.9902	0.9838	0.1441	9.9003	1.0084
Region 3	38,810	162	0.9100	0.9688	0.9459	0.2253	19.0497	1.0646
Region 4	113,331	996	0.9671	0.9760	0.9755	0.1446	10.7857	1.0092
Region 5	113,548	533	0.9426	0.9730	0.9738	0.2167	17.7810	1.0322
Region 6	111,934	1,068	0.9559	0.9626	0.9620	0.1173	8.9043	1.0070

Table 2: Assessment Level and Coefficient of Dispersion

For Individual Counties

County	Number of Parcels in County	Number of Sales	Measures of Central Tendencies			Measures of Dispersion		Price Related Differential
			Weighted Mean	Mean	Median	Standard Deviation	Coefficient of Dispersion	
Yellowstone	65,651	890	0.9673	0.9732	0.9675	0.1066	8.1282	1.0060
Missoula	46,204	546	0.9849	0.9908	0.9840	0.1272	8.8316	1.0060
Cascade	36,419	525	0.9887	0.9945	0.9873	0.1249	8.5815	1.0059
Lewis and Clark	32,730	364	0.9357	0.9500	0.9403	0.1600	13.1630	1.0153
Flathead	57,572	275	0.9919	1.0124	0.9943	0.1269	9.0238	1.0206
Silver Bow	18,956	221	0.8924	0.9495	0.8924	0.2402	21.6301	1.0641
Gallatin	47,347	144	1.0324	1.0578	1.0556	0.1545	10.5829	1.0247
Ravalli	23,224	81	0.9672	0.9897	0.9926	0.1556	11.8793	1.0232
Lake	17,330	74	0.9419	0.9748	0.9654	0.1832	14.8540	1.0350
Stillwater	5,941	54	0.8726	0.8884	0.9083	0.1079	9.5194	1.0181
Jefferson	601	48	0.8814	0.9075	0.8862	0.2314	20.5042	1.0296
Fergus	9,033	42	0.9137	0.9445	0.9551	0.1605	11.7643	1.0337
Deer Lodge	3,202	41	0.8504	0.9541	0.9037	0.2463	22.7815	1.1219
Carbon	9,121	38	0.8681	0.8997	0.9107	0.1692	15.1027	1.0364
Valley	7,304	32	0.9733	1.0059	0.9352	0.2140	19.7729	1.0335
Broadwater	5,961	31	0.9059	0.9344	0.9045	0.1900	15.9967	1.0315

Since the price-related difference (PRD) is calculated about the weighted mean, it is susceptible to being influenced significantly by high-valued property, especially in small samples. Large sample sizes will reduce the amount of shifting in the PRD because of very high-valued property. When the sample size is small, like in many of the counties, the PRD may not be a reliable determinate of regressivity and it may be appropriate to remove the highest value properties and recalculate the PRD.

Municipality Analysis

Table 3

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 (i.e. within 10%). All CODs for the municipalities also fall in the recommended range for CODs (15% or less), except for Anaconda.

Town	Number of Sales	Measures of Central Tendencies			Measures of Dispersion		Price Related Differential
		Weighted Mean	Mean	Median	Standard Deviation	Coefficient of Dispersion	
Billings	701	0.9740	0.9791	0.9722	0.1039	7.8609	1.0053
Great Falls	428	0.9937	0.9997	0.9885	0.1066	7.5053	1.0060
Missoula	387	0.9810	0.9856	0.9815	0.1267	8.7635	1.0047
Helena	189	0.9357	0.9454	0.9403	0.1432	11.6879	1.0103
Kalispell	77	1.0382	1.0374	1.0127	0.1199	8.7604	0.9992
Bozeman	62	1.0258	1.0457	1.0520	0.1307	8.9616	1.0195
Polson	42	0.9237	0.9556	0.9654	0.1703	13.0968	1.0345
Whitefish	42	0.9749	0.9842	0.9630	0.1101	9.2268	1.0095
Laurel	34	0.9797	0.9885	0.9601	0.0981	7.7859	1.0089
Anaconda	32	0.9169	0.9956	1.0122	0.2414	19.3422	1.0858

Conclusion

Based on widely recognized norms and standards, the 2009 reappraisal is 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 97.51% is actually within 2.5% 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 11.4% is well below the recommended 15%. The PRD of 1.0129 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.