



Measuring the Quality of Reappraisal

Residential Property – 2015 Reappraisal

Montana Department of Revenue

November 2015

Executive Summary

This report demonstrates that the 2015 reappraisal meets or exceeds the International Association of Assessing Officers (IAAO) standards of appraisal quality in most cases. The Department of Revenue met the IAAO standard of having a sample appraisal level within 10 percent of market value. The median sample assessment level of 98.21 percent is within 2 percent of market value. The reappraisal also meets uniformity standards on a statewide level. The increases and decreases in appraised values are due to genuine changes of property value and not to faulty reappraisal. There also appears to be areas of appreciation surrounding the Bakken area, while the remainder of the state saw prices decrease or maintain their 2008 appraisal values.

The rest of this report discusses the sales ratio study performed by the Department to evaluate the 2015 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 also reported.

Measuring the Quality of the 2015 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, 2014 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 January 1, 2014. The old appraised value represents an estimate of the true market value of the property on July 1, 2008.

Most property values have recovered a majority of their value in many areas of Montana since July 1, 2008. The exception to this trend is in the Bakken affected areas in the Northeastern portion of the state where properties have generally appreciated since 2008. Although the statewide measures of appraisal are very similar to the measures using the old appraisal values, some over appraised properties will have the effect of 'canceling-out' under appraised properties. As we shall see, significant variation exists in more narrowly defined areas. For these reasons, the Department must provide assurance that the reason for changes in appraised values is due to the genuine change 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 under appraised. A ratio of greater than 1.00 indicates that the property is over appraised. 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 percent.

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

Reappraisal Value

Sales Price

Numeric expression of the relationship

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 percent of true market value. The appraised values rarely exactly match the true market values of property. In good appraisal performance, the over appraisals and under appraisals will balance such that the overall appraisal level is close to 100 percent of true market value.

Appraisal uniformity: Appraisal uniformity refers to the magnitude of over appraisals and under appraisals. 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 sales ratio, mean sales ratio, and weighted mean sales ratio. 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 (as opposed to the mean and median, which 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 percent), yet still have unfavorable appraisal performance. This occurs when the appraisal is not uniform. Appraisal uniformity can be 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 frequency distribution, a large percentage of the ratios close to the overall level of assessment and distribution symmetry with respect to the overall level of assessment indicate 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 percent of data will be one standard deviation from the mean, 95 percent will be within two standard deviations, and 99 percent will be within three standard deviations. For example, if a property group has an average mean ratio of 1.01 (101 percent), and a standard deviation of 0.10 (10 percent), it is assumed that in a normally distributed distribution, 68 percent of data will fall between 0.91 (91 percent) and 1.11 (110 percent). Algebraically, the standard deviation can be calculated with the following formula:

$$\sigma = \sqrt{\left(\frac{\sum_{i=1}^n (Ratio_i - \bar{Ratio})^2}{n - 1}\right)}$$

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%. The COD is expressed algebraically in the following formula:

$$COD = \left(\frac{\left(\frac{\sum_{i=1}^n |Ratio_i - Median|}{n} \right)}{Median} \right) \times 100$$

Good appraisal uniformity for residential properties 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 under appraised relative to low-value properties. Conversely, assessment progressivity exists if high-value properties are over appraised relative to low-value properties. The PRD is calculated by dividing the mean sales ratio by the weighted mean sales ratio. 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).

2015 Reappraisal

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, regional basis, county basis (where a sufficient number of sales existed), and a municipality basis (where a sufficient number of sales existed).

The sales values and corresponding appraisal values were extracted from the Department's Orion database and provided the data for the analysis. The data set contained 7,972 residential properties that sold from January 1 to June 30, 2014 that were extracted from the Orion system and 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 398 (4.9 percent) observations. The resulting data set included 7,574 records.

Results

Statewide Analysis

The overall statewide level of assessment, as measured by the median ratio, is 98.21%. 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 98.21% clearly falls within that range.

The statewide coefficient of dispersion is 12.07 for this sample. This value is below 15, the recommended level IAAO and indicates good appraisal uniformity. The following table displays a summary of the ratio statistics using the 2014 reappraisal values, as well as the same analysis using the prior appraisal values from 2008.

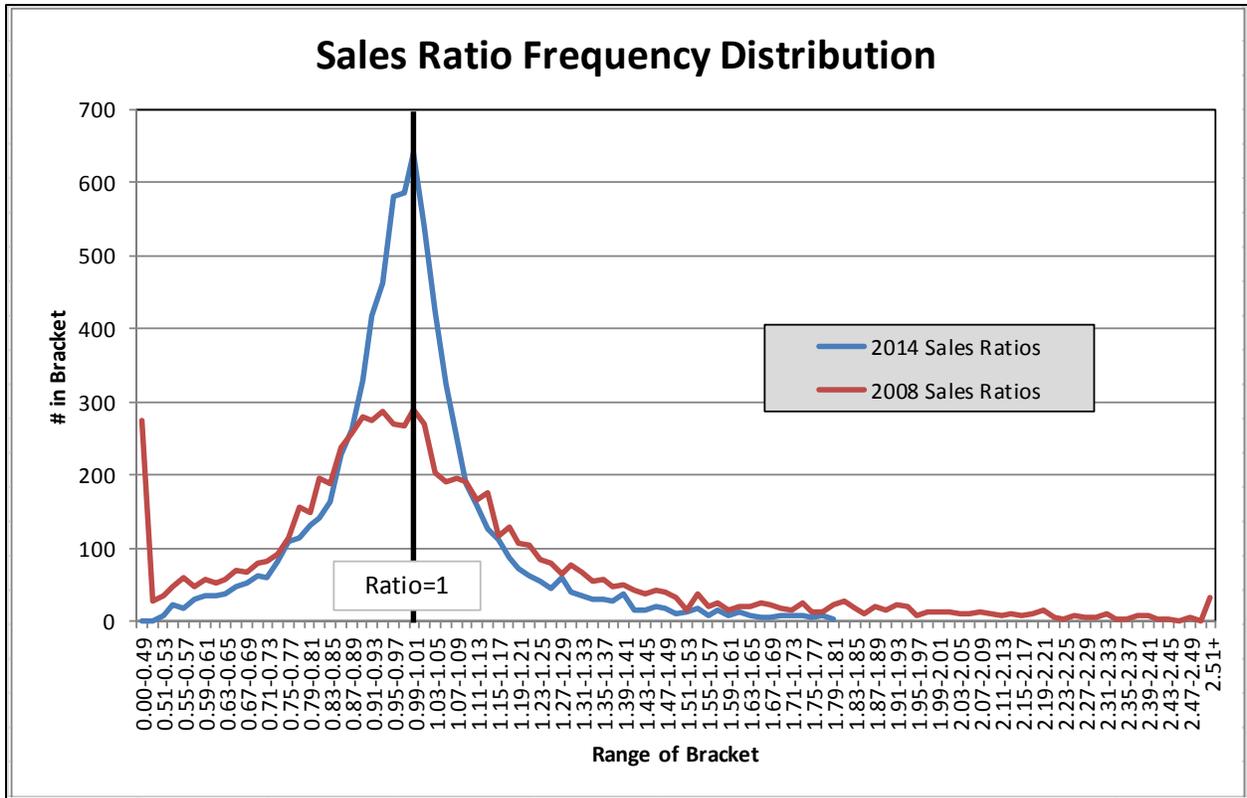
Statewide Sales Ratio Statistics New vs. Old		
	<u>New</u>	<u>Old</u>
N	7,574	7,337
Measures of Appraisal Level		
Median Assessment Ratio	98.21%	98.58%
Mean Assessment Ratio	99.04%	104.66%
Weighted Mean Assessment Ratio	95.80%	97.60%
Measure of Appraisal Uniformity		
Coefficient of Dispersion	12.0712	25.3135
Standard Deviation	0.1741	0.3661
Price Related Differential	1.0338	1.0723

The frequency distribution of the sales ratios is displayed in Figure 1. The distribution is a tight, symmetrical curve centered about the assessment level of 98.21%. This is evidence of good appraisal uniformity, and is further supported by a low standard deviation of 0.1741.

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.

Most of the statewide statistics measuring the appraisal levels may seem to indicate the old reappraisal values were sufficient, however, when looking at the appraisal uniformity, the new appraisal levels are much more accurate and uniform.

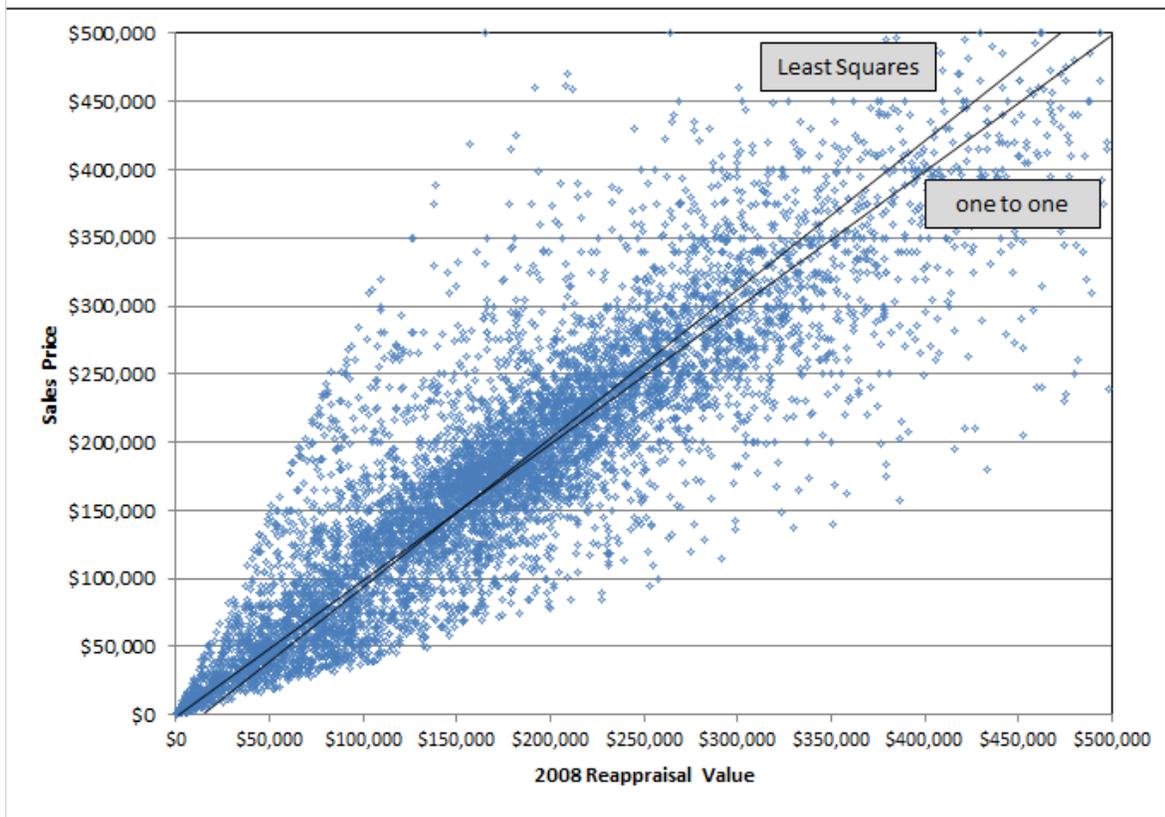
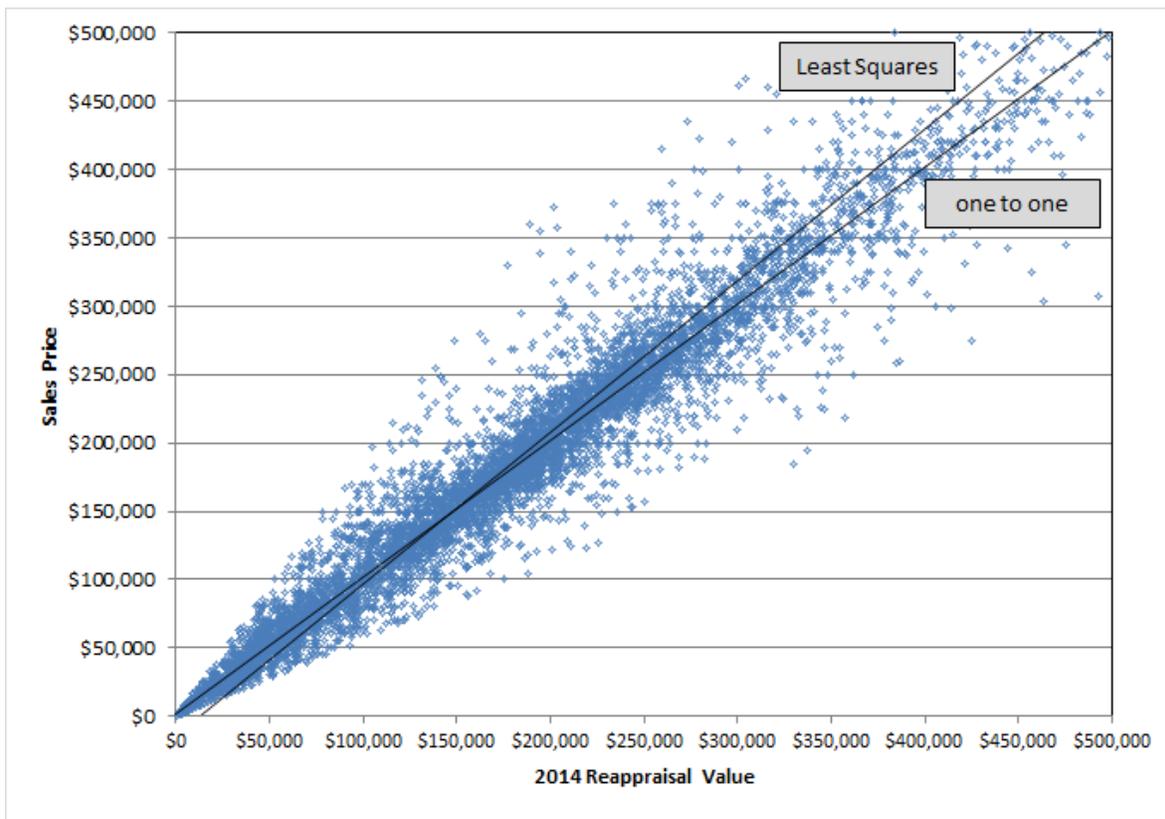
The statewide price-related differential is 1.0338, which is slightly outside the 0.98 to 1.03 range suggested by the IAAO. This indicates that the reappraisal may be somewhat regressive and high-valued properties may be slightly under appraised. However, this is very close to the upper end of the acceptable range and much better than the 1.0723 value calculated using the 2008 appraisal values.



The following graph shows a (scatter) plot of the relationship between sales prices and assessed values using the *current* appraisal. The next graph 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 percent 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 percent. 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.

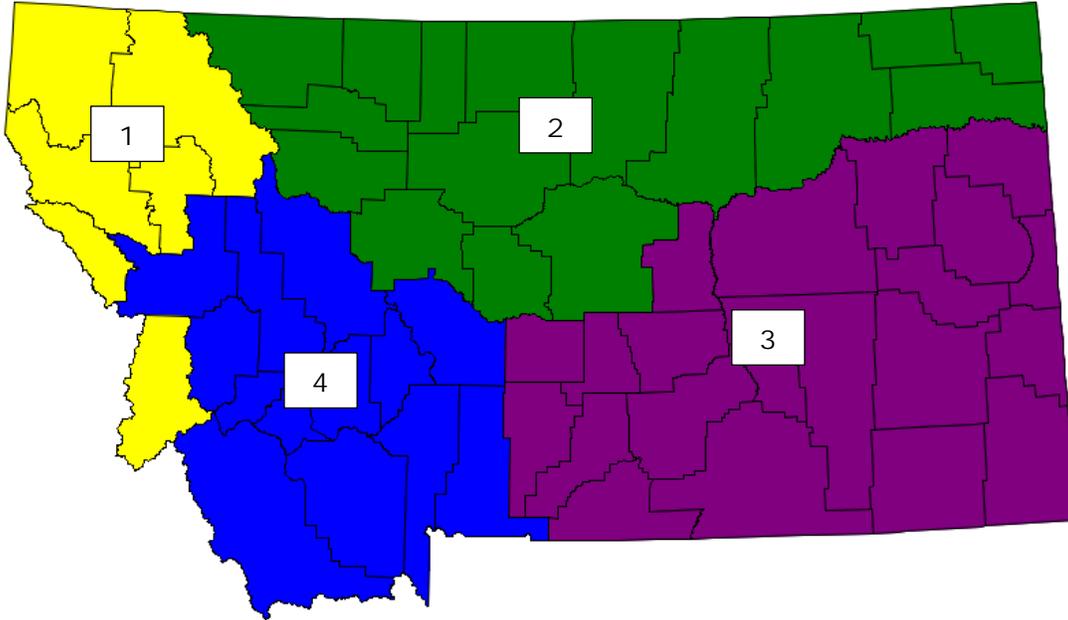
The COD using the old appraisals is 25.31 percent. This is above the IAAO recommended measure of 15 percent. Having a COD of 12.07 percent versus 25.31 percent indicates that the reappraisal effort reduced the degree to which the sales ratios differ from the assessment level. When using old reappraisals, 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 2015 reappraisal to bring the overall appraisal levels closer to 100percent.

Figure 2: Plot of Sales Price and Assessed Value



Region Analysis

The Department of Revenue staff calculated reappraisal statistics for the state as a whole and for each of the Department's management regions shown in the following map.

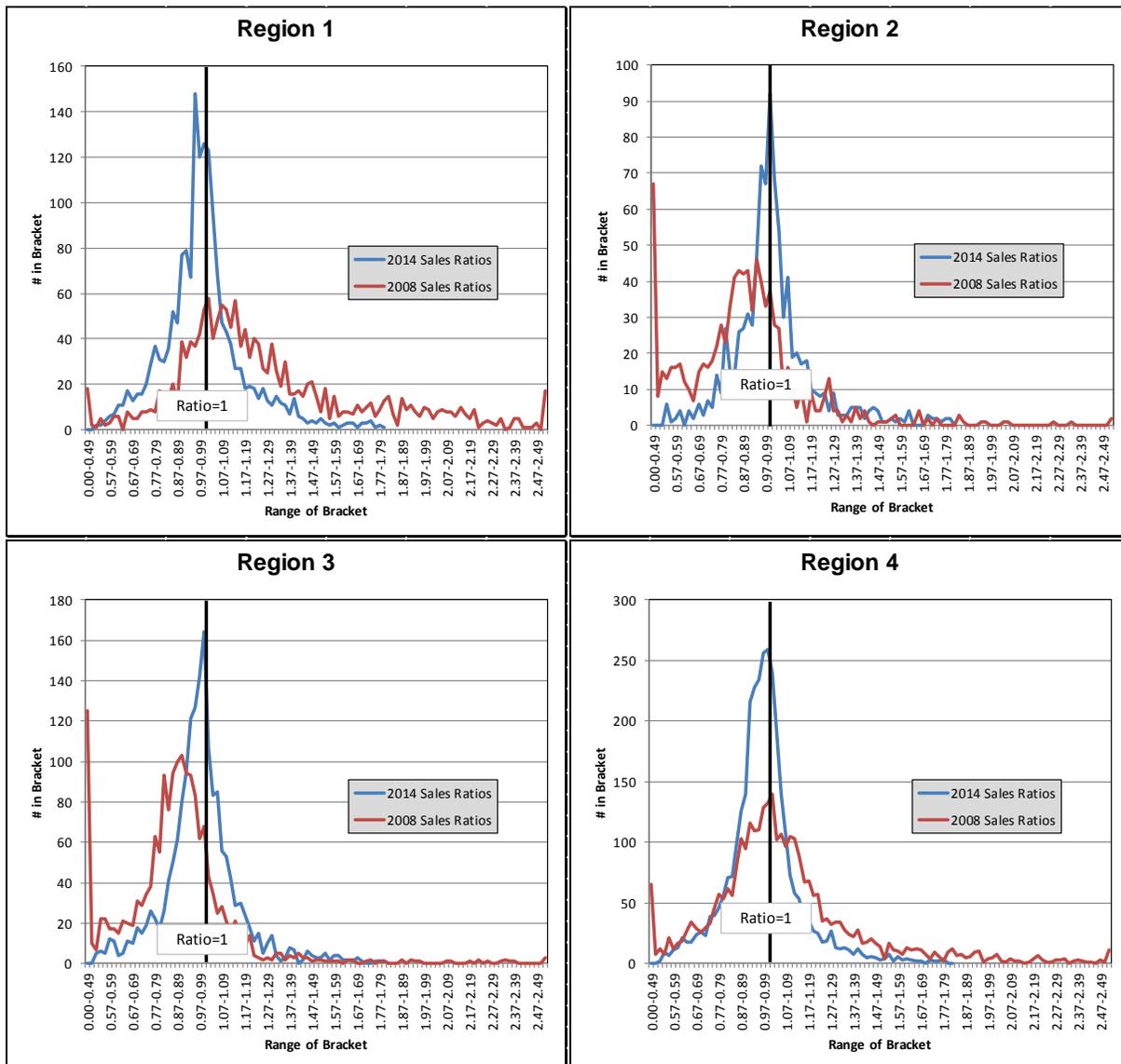


The following tables show the number of verified sales, statistics of central tendencies, and statistics concerning the distribution of the sales assessment ratios.

Region 1 Sales Ratio Statistics New vs. Old			Region 2 Sales Ratio Statistics New vs. Old		
	<u>New</u>	<u>Old</u>		<u>New</u>	<u>Old</u>
N	1,700	1,601	N	888	909
Measures of Appraisal Level			Measures of Appraisal Level		
Median Assessment Ratio	98.62%	117.03%	Median Assessment Ratio	99.61%	87.74%
Mean Assessment Ratio	99.89%	127.98%	Mean Assessment Ratio	101.29%	87.80%
Weighted Mean Assessment Ratio	98.22%	115.33%	Weighted Mean Assessment Ratio	99.07%	84.64%
Measure of Appraisal Uniformity			Measure of Appraisal Uniformity		
Coefficient of Dispersion	13.3112	26.4258	Coefficient of Dispersion	12.3705	22.0660
Standard Deviation	0.1895	0.4209	Standard Deviation	0.1863	0.2806
Price Related Differential	1.0170	1.1097	Price Related Differential	1.0224	1.0373
Region 3 Sales Ratio Statistics New vs. Old			Region 4 Sales Ratio Statistics New vs. Old		
	<u>New</u>	<u>Old</u>		<u>New</u>	<u>Old</u>
N	1,743	1,714	N	3,243	3,113
Measures of Appraisal Level			Measures of Appraisal Level		
Median Assessment Ratio	98.00%	87.91%	Median Assessment Ratio	97.73%	101.96%
Mean Assessment Ratio	98.69%	87.47%	Mean Assessment Ratio	98.16%	107.06%
Weighted Mean Assessment Ratio	97.69%	84.71%	Weighted Mean Assessment Ratio	93.79%	98.29%
Measure of Appraisal Uniformity			Measure of Appraisal Uniformity		
Coefficient of Dispersion	11.7422	18.9150	Coefficient of Dispersion	11.4707	22.3065
Standard Deviation	0.1694	0.2589	Standard Deviation	0.1638	0.3344
Price Related Differential	1.0102	1.0326	Price Related Differential	1.0466	1.0891

All four regions have COD values and median assessment ratios that are within the IAAO recommendation for a quality appraisal. Regions one through three also have PRD values that are within the acceptable IAAO standards. Region four's PRD value would indicate high value properties may be slightly under appraised, although the PRD is very close to IAAO's recommendations, and much less than the PRD using the 2008 values. The COD and PRD are expected to be higher when the property in the regions is more heterogeneous which may be the case in region four.

The following graphs show the distribution analysis of sales ratios for the four regions using the new appraisal values and the 2008 appraisal values.



In all for regions, the 2015 distribution has become tighter and more symmetrically centered on one, indicating a good and uniform reappraisal in all four regions. When

the prior distribution is centered to the right of the current distribution this is indicative of depreciation, as can be seen in region one. When the prior distribution is to the left of the current distribution, this is an indication of appreciation, as is the case in Region two and three. In region four, the old distribution centered very close to one but is slightly to the right of the new distribution; in addition, the new distribution is clearly less dispersed.

County Analysis

There were 25 counties with at least 30 verified sales between January 1 and June 30, 2014. The following table shows the number of verified sales, statistics of central tendencies, and statistics concerning the distribution of the sales assessment ratios.

Assessment Levels and Coefficients of Dispersion for Select Counties								
County	Number of Sales	Measures of Appraisal Level			Measure of Appraisal Uniformity			
		Median Assessment Ratio	Mean Assessment Ratio	Weighted Mean Assessment Ratio	COD 2014 Appraisal	COD 2008 Appraisal	Standard Deviation	Price Related Differential
Yellowstone	1,236	98.54%	98.91%	98.68%	8.5094	14.2268	0.1221	1.0023
Gallatin	1,229	98.03%	97.94%	97.15%	9.1151	26.2790	0.1326	1.0082
Flathead	1,004	98.68%	100.17%	98.35%	11.4972	37.3925	0.1685	1.0185
Missoula	698	98.89%	99.56%	98.70%	8.9513	16.1411	0.1365	1.0088
Lewis and Clark	572	96.04%	97.62%	96.29%	12.5234	21.6457	0.1773	1.0138
Cascade	483	99.91%	101.17%	100.46%	8.1077	14.7487	0.1367	1.0071
Ravalli	261	99.05%	101.04%	99.86%	13.8423	30.5303	0.2023	1.0118
Lincoln	197	94.09%	93.94%	91.56%	15.5617	44.0102	0.2002	1.0260
Butte-Silver Bow	196	96.54%	100.06%	97.27%	16.5509	22.3032	0.2100	1.0286
Madison	188	88.33%	91.16%	85.56%	18.4669	43.4627	0.2103	1.0655
Lake	131	105.39%	106.55%	100.88%	17.2307	34.1841	0.2408	1.0563
Park	107	99.52%	99.43%	93.77%	15.2080	32.6244	0.2059	1.0603
Stillwater	82	94.55%	98.72%	93.07%	20.9966	28.7546	0.2662	1.0607
Carbon	81	94.19%	97.46%	88.91%	15.9393	28.3384	0.2123	1.0962
Sanders	81	96.77%	96.94%	94.39%	17.6885	32.5684	0.2251	1.0271
Jefferson	75	95.49%	94.79%	95.20%	15.4051	31.9288	0.1913	0.9957
Hill	73	102.26%	106.62%	105.18%	11.9499	22.5036	0.1667	1.0137
Dawson	71	88.17%	92.94%	91.02%	20.1502	36.6555	0.2421	1.0210
Richland	68	100.21%	103.45%	103.64%	18.0639	50.5794	0.2287	0.9982
Fergus	65	95.57%	96.60%	89.39%	17.1643	27.4379	0.2319	1.0806
Beaverhead	62	98.92%	101.28%	99.53%	15.1087	18.7968	0.1998	1.0176
Valley	56	86.77%	93.28%	91.69%	16.4131	39.8861	0.2026	1.0174
Broadwater	53	98.22%	98.64%	92.56%	13.2630	24.7661	0.2057	1.0657
Chouteau	39	89.46%	91.25%	91.98%	13.2630	21.4302	0.1502	0.9921
Custer	38	98.11%	98.03%	94.61%	19.7876	26.3361	0.2517	1.0361

The level of assessment was calculated for each of these counties. In 21 of the 25 individual counties have assessment levels (medians) that fall within the recommended range of 90%-110%. The COD was also calculated for each county and in 15 of the 25 counties, the COD was outside of the recommended standards by IAAO. The COD was then calculated using the 2008 appraisal values, and as can be seen, the CODs decreased from 2008 to 2014 (implying greater uniformity) in all counties, even counties where the 2014 COD exceed IAAO standards.

The far right column 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 18 of the 25 individual counties. 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.

Municipality Analysis

The level of assessment and COD were calculated for the 36 cities and towns in which there were 30 or more sales and are listed below. Most areas have medians in the recommended range (i.e. within 10 percent) with the one exception being Glendive. The IAAO standard for 2014 CODs is met in 20 of the 36 cities and towns (15 or less), and in all but one (Columbus) the COD is greater when the 2008 appraisal values are used.

Assessment Levels and Coefficients of Dispersion for Select Cities								
City	Number of Sales	Measures of Appraisal Level			Measure of Appraisal Uniformity			
		Median Assessment Ratio	Mean Assessment Ratio	Weighted Mean Assessment Ratio	COD 2014 Appraisal	COD 2008 Appraisal	Standard Deviation	Price Related Differential
BILLINGS	1,092	98.36%	98.68%	98.39%	7.9701	13.5352	0.1131	1.0029
BOZEMAN	858	97.77%	97.76%	97.38%	8.1370	21.6541	0.1126	1.0038
MISSOULA	554	98.86%	99.31%	99.18%	8.1759	14.6697	0.1234	1.0014
KALISPELL	529	98.52%	99.87%	98.99%	10.9160	35.7132	0.1581	1.0089
HELENA	507	95.88%	97.13%	95.97%	11.8312	20.7723	0.1666	1.0121
GREAT FALLS	438	99.75%	100.80%	100.20%	7.4022	13.4706	0.1235	1.0060
WHITEFISH	192	98.73%	99.31%	96.36%	9.8097	36.6079	0.1452	1.0306
BELGRADE	189	98.77%	97.99%	97.45%	7.9623	32.3225	0.1168	1.0055
BUTTE	179	96.72%	100.72%	97.94%	16.1189	20.3778	0.2075	1.0283
COLUMBIA FALLS	129	97.76%	100.42%	98.33%	12.8523	44.0643	0.1802	1.0213
BIGFORK	94	99.66%	100.48%	101.03%	14.0872	32.2711	0.2007	0.9946
HAMILTON	89	100.52%	103.13%	102.86%	12.6582	27.0020	0.1951	1.0027
LIVINGSTON	87	98.80%	99.17%	96.95%	15.5255	35.0295	0.2123	1.0230
LAUREL	86	99.47%	99.78%	100.91%	9.0250	16.6646	0.1263	0.9888
BIG SKY	78	93.93%	95.21%	88.62%	15.8732	43.0712	0.2195	1.0743
STEVENSVILLE	71	96.75%	97.39%	96.19%	11.5988	32.7973	0.1776	1.0125
HAVRE	68	101.79%	106.04%	105.11%	11.2727	22.6080	0.1589	1.0089
GLENDIVE	67	88.44%	94.35%	93.33%	19.6213	36.0445	0.2380	1.0110
POLSON	64	104.82%	106.55%	100.69%	15.0331	32.1530	0.2276	1.0582
LEWISTOWN	58	96.21%	98.35%	92.08%	15.7386	26.4097	0.2202	1.0681
DILLON	54	97.89%	101.38%	100.02%	15.5057	17.6207	0.2042	1.0136
LOLO	52	96.18%	97.52%	96.58%	7.9797	10.1251	0.1017	1.0098
LIBBY	52	99.34%	102.18%	100.60%	13.6382	38.0224	0.2070	1.0157
EAST HELENA	46	97.46%	100.26%	98.42%	13.9310	19.6743	0.1975	1.0187
CLANCY	43	97.44%	98.72%	96.80%	12.7742	25.0597	0.1708	1.0199
MILES CITY	38	98.11%	98.03%	94.61%	19.7876	26.3361	0.2517	1.0361
SIDNEY	37	103.65%	106.80%	105.61%	14.9870	52.4117	0.1976	1.0112
THREE FORKS	36	99.30%	98.88%	98.33%	15.9544	27.8543	0.2100	1.0057
ENNIS	35	95.97%	93.73%	88.91%	17.9853	39.6100	0.2155	1.0543
COLUMBUS	35	91.88%	96.60%	90.69%	22.3496	20.4595	0.2816	1.0652
RED LODGE	34	93.82%	99.72%	85.94%	17.7807	32.5523	0.2490	1.1603
CORVALLIS	33	100.03%	102.62%	101.42%	15.3439	25.0776	0.2093	1.0118
FLORENCE	32	98.47%	104.21%	98.36%	15.2883	32.3020	0.2121	1.0595
GLASGOW	31	90.73%	95.66%	92.39%	17.1077	42.0371	0.2085	1.0354
SHEPHERD	31	97.91%	103.18%	102.23%	16.2117	20.7001	0.2240	1.0093
MANHATTAN	30	97.90%	102.62%	102.40%	13.8509	29.0490	0.2083	1.0022

Conclusion

Based on widely recognized norms and standards, the 2014 reappraisal is generally of high quality, as evidenced by this study. The goal of having a sample appraisal level within 10 percent of market value is met. The sample assessment level of 98.2 percent is actually within 2.0 percent 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 12.07 is below the recommended 15. The PRD of 1.0338 may indicate a slight hint of regressivity in the reappraisal, although less regressive relative to the old appraisal values, as indicated by the prior PRD of 1.07.

Statewide, the ratio distribution of the old and new values seems to indicate neither strong appreciation nor depreciation, as evidence of the old and new frequency distributions general overlap. However, when we look at individual regions we can see areas of depreciation and appreciation more clearly.