



***Montana Department of Revenue***

# **Measuring the Quality of Reappraisal**

**Residential Property – 2021 Reappraisal**

Montana Department of Revenue

**September 2021**



## **Executive Summary**

This report demonstrates that the 2021 appraisal meets or exceeds the International Association of Assessing Officers (IAAO) standards of appraisal quality in a majority of cases (International Association of Assessing Officers, 2013). 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 was 99.0 percent for residential properties and 97.5 percent for commercial properties. The reappraisal also meets uniformity standards on a statewide level for the both types of property being examined. Because, the reappraisal values are believed as evidence by this report, the increases and decreases in appraised values are due to genuine changes of property value.

The rest of this report discusses the sales ratio study performed by the Department of Revenue to evaluate the 2021 appraisal. The first section discusses commonly used sales ratio statistics, followed by a section examining the residential sales ratios for the 2021 reappraisal. The final section is a similar analysis examining commercial properties. Statistics for individual regions, select counties, select municipalities, and valuation methods are also reported.

# Measuring the Quality of the 2021 Reappraisal

## Introduction

The main goal of the Department of Revenue when appraising Class 4 property is to appraise the property at 100% of true market value (15-8-111, MCA). An appraised value represents an estimate of the true market value of property on a specified point in time. It is important that these estimates be as accurate as possible. This analysis will provide confidence in the results of the 2021 appraisal.

The reappraisal cycle ending December 31, 2020 is now complete. The Department of Revenue assigned a new appraised value to each Class 4 residential and commercial property that replaced the previous two-year cycle's value. The new appraised value represents an estimate of what the true market value of the property would have been on January 1, 2020 (42.18.121 ARM).

A vast majority of properties saw an appreciation in value since the last reappraisal, however, significant variation in appreciation levels exists in more narrowly defined areas. For these reasons, the Department of Revenue must provide assurance that the reason for changes in appraised values and the magnitude of the changes are due to the genuine changes of property value and not due to faulty or poor reappraisal performance. Further, because some over appraised properties will have the effect of 'canceling-out' under appraised properties, it is important to also examine the uniformity of the current appraisal cycle.

## Measuring the Quality of Reappraisal

The most common method of measuring the performance of property appraisal 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 are generally assumed to represent true market values in ratio studies (International Association of Assessing Officers, 2013). Therefore, a ratio study analyzes the relationship between the assessed value and sale price of property. The key data element in any sales ratio study is the ratio of assessed value to sale price. To calculate this ratio, divide the assessed value of the property by the sale price of the property.

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

This assumes the sale of the property was an arm's-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 is under appraised. A ratio of greater than 1.00 indicates that the property is over appraised. For example, a property with an assessed value of \$80,000 that sold for \$100,000 has a ratio expressed as .80 or 80 percent.

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

← Assessed Value  
 ← Sales Price  
 ← Numeric expression of the relationship

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

**Appraisal level:** An appraisal level refers to the overall level at which properties are assessed. In Montana, the desired assessment level is 100 percent of true market value. The assessed 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 (Gloude-mans, 1999).

**Appraisal uniformity:** The term appraisal uniformity refers to the variation of appraisals and examines over appraisals and under appraisals. The degree to which the appraisals of the sample 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 (Gloude-mans, 1999).

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 (Gloude-mans, 1999).

## Measures of Appraisal Level

The three most common measures of appraisal level are the

1. median sales ratio,
2. mean sales ratio, and
3. weighted mean sales ratio.

Each measure has advantages and disadvantages, and it is common practice to compute all three measures (International Association of Assessing Officers, 2013). 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. In addition, it is also desirable to calculate the confidence intervals for each of these statistics so that the range of possible values can be determined with a specified degree of confidence (Eckert, Gloude-mans, Almy, & International Association of Assessing Officers, 1990).

**Median:** The median sales ratio 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 relative to other measures is that it is easy to compute and easily understood. By nature, the median is not affected by extreme ratios (International Association of Assessing Officers, 2013) (DeGrouot & Schervish, 2002).

Mean: The mean sales ratio 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 (International Association of Assessing Officers, 2013) (DeGrouot & Schervish, 2002).

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 property or each sale) (International Association of Assessing Officers, 2013) (DeGrouot & Schervish, 2002).

Confidence Intervals: When sampling a larger population, it is necessary to be aware of the difference between the attributes of a particular sample and the characteristics of the overall population being sampled. Confidence intervals are a measurement of how likely the sample statistics represent the overall population based on the size and variation of the sample. A confidence interval of a sample statistic is a range of values the true population statistics is likely to be between based on a predetermined level of confidence, usually 95 percent confidence level (Eckert, Gloudemans, Almy, & International Association of Assessing Officers, 1990) (DeGrouot & Schervish, 2002).

## **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 frequency distribution is 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 (Gloudemans, 1999).

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 (DeGrouot & Schervish, 2002). 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 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:

$$\sigma = \sqrt{\left(\frac{\sum_{i=1}^n (Ratio_i - \overline{Ratio})^2}{n - 1}\right)} \times 100$$

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 one of the most used measure of uniformity in ratio studies (International Association of Assessing Officers, 2013). 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 sales ratio. The average deviation is calculated by subtracting the median sales ratio for the entire population from each individual 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% (Gloude-mans, 1999). 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, usually 15 or less for older, heterogeneous areas. A COD of 10 would be considered good for newer, homogeneous areas (Gloude-mans, 1999).

**Price-Related Differential:** The price-related differential (PRD) is a statistic for measuring assessment regressivity or progressivity (Gloude-mans, 1999). 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 (Gloude-mans, 1999). 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 (Gloude-mans, 1999).

The following table displays some the IAAO standards for an appraisal being evaluated with a sales ratio analysis (International Association of Assessing Officers, 2013):

<b>Select IAAO Appraisal Standards</b>	
<b><u>Level of Appraisal</u></b>	
Min=90%	Max=110%
<b><u>Coefficient of Dispersion</u></b>	
<b>Area</b>	<b>Standard</b>
Single Family Residence	5.0 to 15.0
<i>Larger Urban Areas</i>	5.0 to 10.0
Income Producing Property	5.0 to 20.0
<i>Larger Urban Areas</i>	5.0 to 15.0
Vacant Land	5.0 to 20.0
<i>Seasonal and Rural Land</i>	5.0 to 25.0
<b><u>Price Related Differential</u></b>	
Min=0.98	Max=1.03

## 2021 Appraisal-Residential

The Department of Revenue's Tax Policy and Research unit in cooperation with the Property Assessment Division conducted a study to assess the quality of the recently completed appraisal. The analysis included computing the measures of assessment level and uniformity as discussed previously. These measures were calculated on a statewide basis, regional basis, county basis (where a sufficient number of sales existed), a municipality basis (where a sufficient number of sales existed), and for the valuation method used to appraise the property.

The sales values and corresponding appraisal values were extracted from the Department of Revenue's property valuation information system and provided the data for the analysis. The data set contained 3,168 residential properties that sold from January 1, 2020 to March 31, 2020 and were considered to be valid sales using standard screening practices. In quality of reappraisal analysis from prior cycles, sales from the full six months of the calendar year would have been used in the sales ratio analysis. However, in CY 2020, the COVID-19 pandemic is believed to have caused a significant disruption to the residential market in Montana. For this reason, only sales from the first quarter of CY 2020 are used in an attempt to reduce the COVID-19 impacts on the sales data.

Observations that had a sales ratio outside 1.5 times the inter-quartile ranges from the 25th and 75th percentile were dropped when calculating any of the sales ratio statistics. This trimming of sales is standard in these types of studies (International Association of Assessing Officers, 2013). This trimming was done at each stratification of the overall sample, as an observation may be an outlier in one circumstance (on a statewide basis for example), but may not be an outlier in another circumstance (on a county or municipal basis for example).

Trimming the sales in this fashion eliminates ratios that are unreasonable. They can be unreasonable for a variety of reasons (International Association of Assessing Officers, 2013):

- the sales price is not accurate measure of the property's value
- the assessed value is not accurate at the time of the sale
- there is a mistake in the data entry, or
- the nature of the parcel changed between the sale date and assessment date.

In the cases where the assessment value does not represent market value, the values may be adjusted by informal reviews. However, the data in the sample was extracted before most informal reviews were submitted. Therefore, these reviews should not affect the overall quality of reappraisal this report is trying to determine.

## **Residential Analysis Results**

### **Statewide Residential Analysis**

The overall statewide level of assessment, as measured by the median ratio, is 98.99 percent. It is recommended that the overall level of assessment should be within 10% of market value (so between 90 percent and 110 percent) (Gloude-mans, 1999). The upper and lower bounds of this measurement are also within this range, so we can say with 95 percent accuracy that the appraisal level satisfies this standard.

The statewide coefficient of dispersion is 6.216 for this sample. This value is below 15, and above five, the recommended level IAAO, and indicates good appraisal uniformity (Gloude-mans, 1999).

The following table displays a summary of the ratio statistics using the 2021 appraisal values.

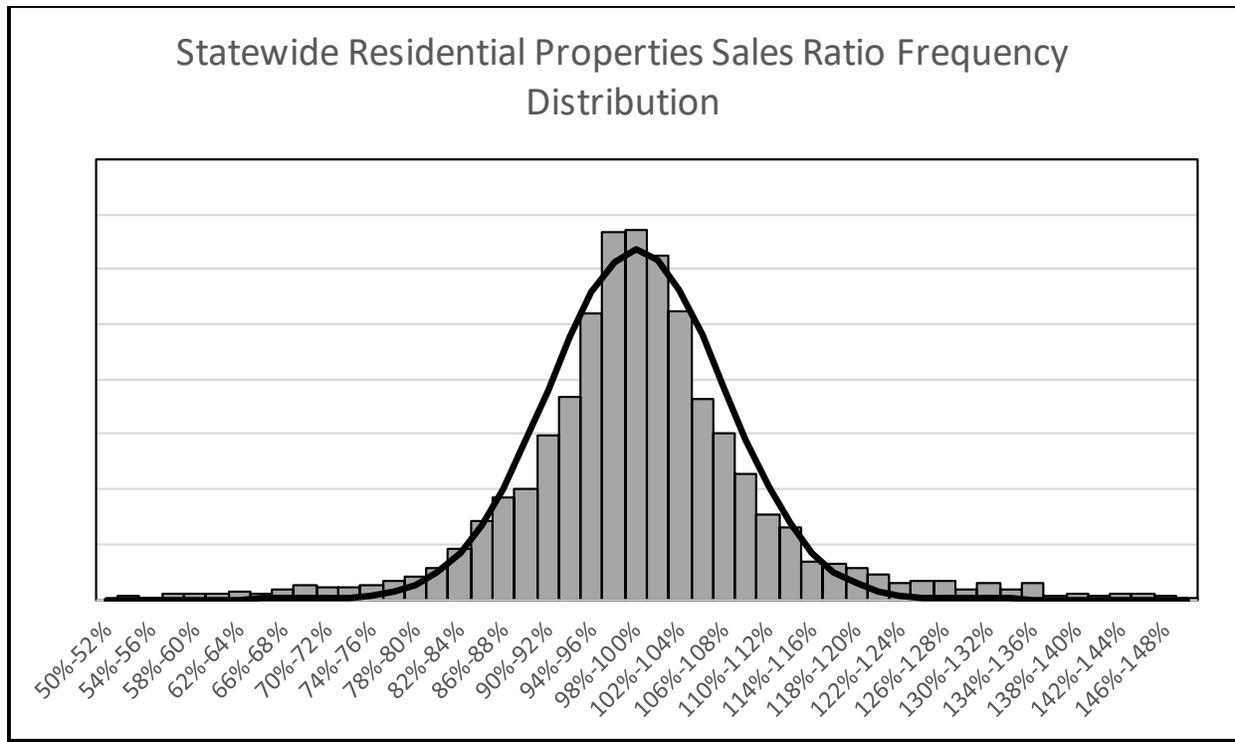
<b>Residential Ratio Statistics</b>	
<b>CY 2020<sup>1</sup> Sales Relative to TY 2021 Values</b>	
<b><u>Number of Sales</u></b>	<b><u>Values</u></b>
<b>Total Observations</b>	<b>3,168</b>
<b>Used Observations</b>	<b>2,897</b>
<b><u>Measurement of Appraisal Levels</u></b>	
<i>Upper Bound Confidence Interval</i>	99.28%
<b>Median Ratio</b>	<b>98.99%</b>
<i>Lower Bound Confidence Interval</i>	98.67%
<i>Upper Bound Confidence Interval</i>	99.33%
<b>Mean Ratio</b>	<b>99.04%</b>
<i>Lower Bound Confidence Interval</i>	98.75%
<i>Upper Bound Confidence Interval</i>	98.81%
<b>Weighted Mean</b>	<b>98.15%</b>
<i>Lower Bound Confidence Interval</i>	97.50%
<b><u>Measurement of Appraisal Uniformity</u></b>	
<b>Coefficient of Dispersion</b>	<b>6.216</b>
<b>Coefficient of Variation</b>	<b>8.015</b>
<b>Standard Deviation</b>	<b>0.079</b>
<b>Price Related Differentials</b>	<b>1.009</b>
<b><u>Range (1.5x Inter Quartile Range)</u></b>	
<b>Maximum Ratio in the Sample</b>	<b>121.0%</b>
<b>Minimum Ratio in the Sample</b>	<b>77.7%</b>

<sup>1</sup>Sales from 1/1/2020 to 3/31/2020

In examining the statistics measuring appraisal levels, the median, mean, and weighted mean are well within the standards set by IAAO. The statewide price-related differential for the current cycle is 1.009, which is within the 0.98 to 1.03 range suggested by the IAAO (Gloudemans, 1999).

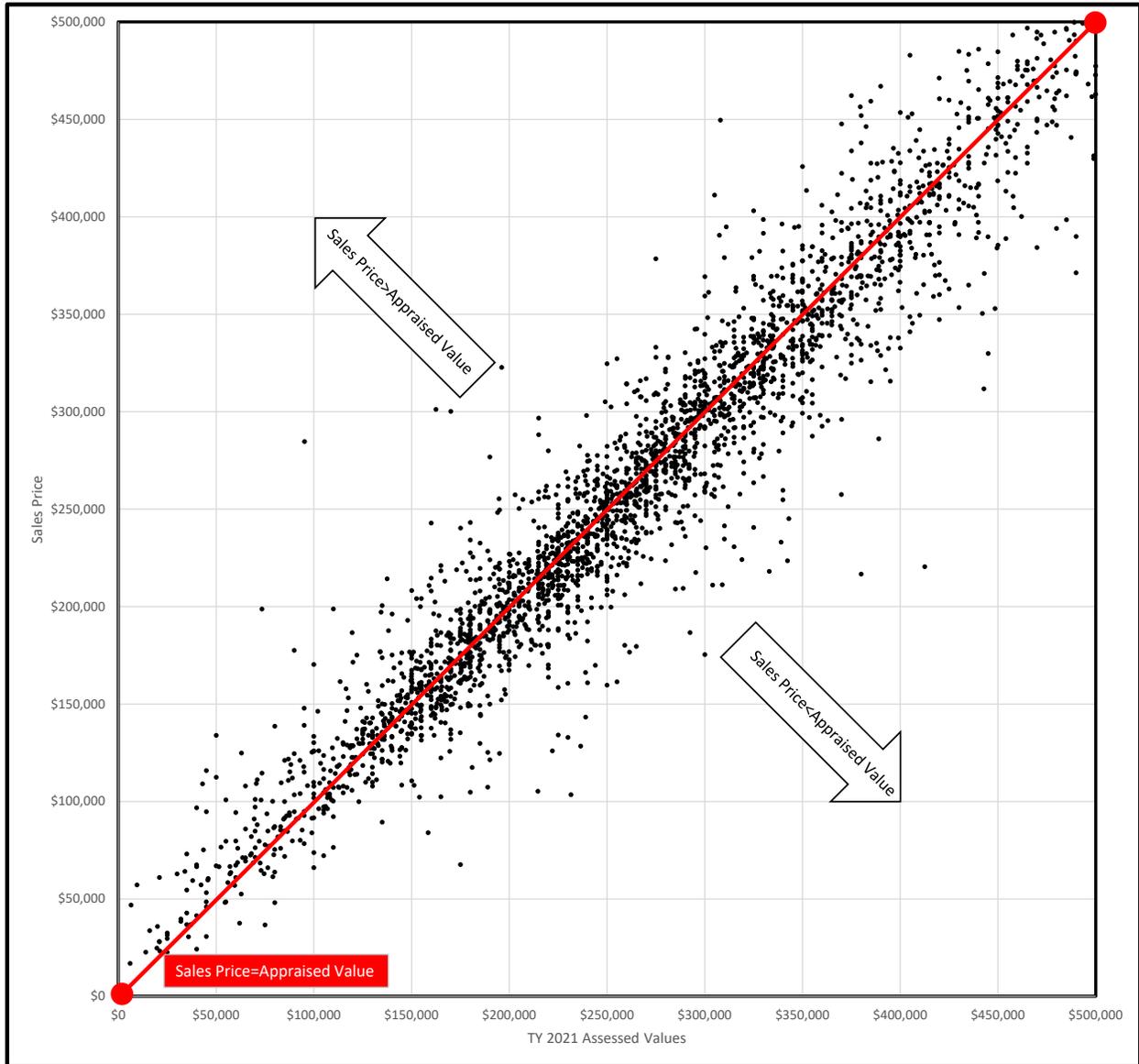
The frequency distribution of the sales ratios is displayed in Figure 1. The distribution is a tight, symmetrically curved, and centered about the assessment level of 98.99 percent. These characteristics are evidence of good appraisal uniformity and is further supported by a low standard deviation of 0.079.

**Figure 1: Sales Ratio Histogram**



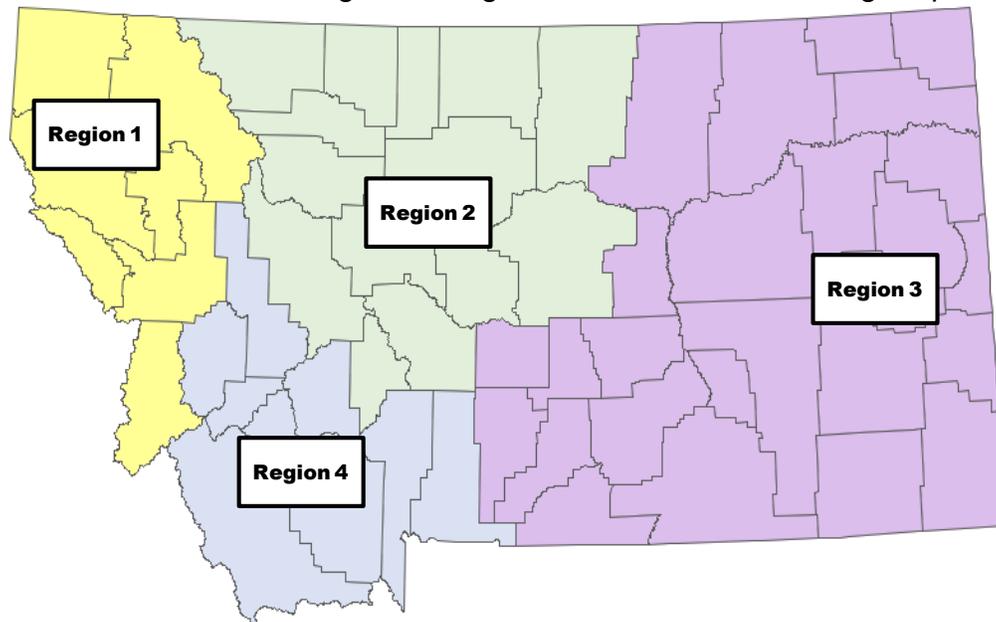
The following graph shows a scatter plot of the relationship between sales prices and assessed values. The plot has a line where 100 percent of market value is attained, or where sales price equals the assessed value. Values above the line indicate a sales price greater than the assessed value. Similarly, values below the line indicate an assessed value greater than the sales price. As the graph show, there does not appear to be any groupings above or below the line, nor does there appear to be a strong relationship between the value of the property and the sales ratio. Again, these trends would be expected given previous statewide table as the scatter plot is essentially a different representation of the same idea.

**Figure 2: Plot of Sales Price and Assessed Values**



## Region Analysis-Residential

For this report, reappraisal statistics for the state as a whole, as well as for each of the Department of Revenue's management regions shown in the following map.



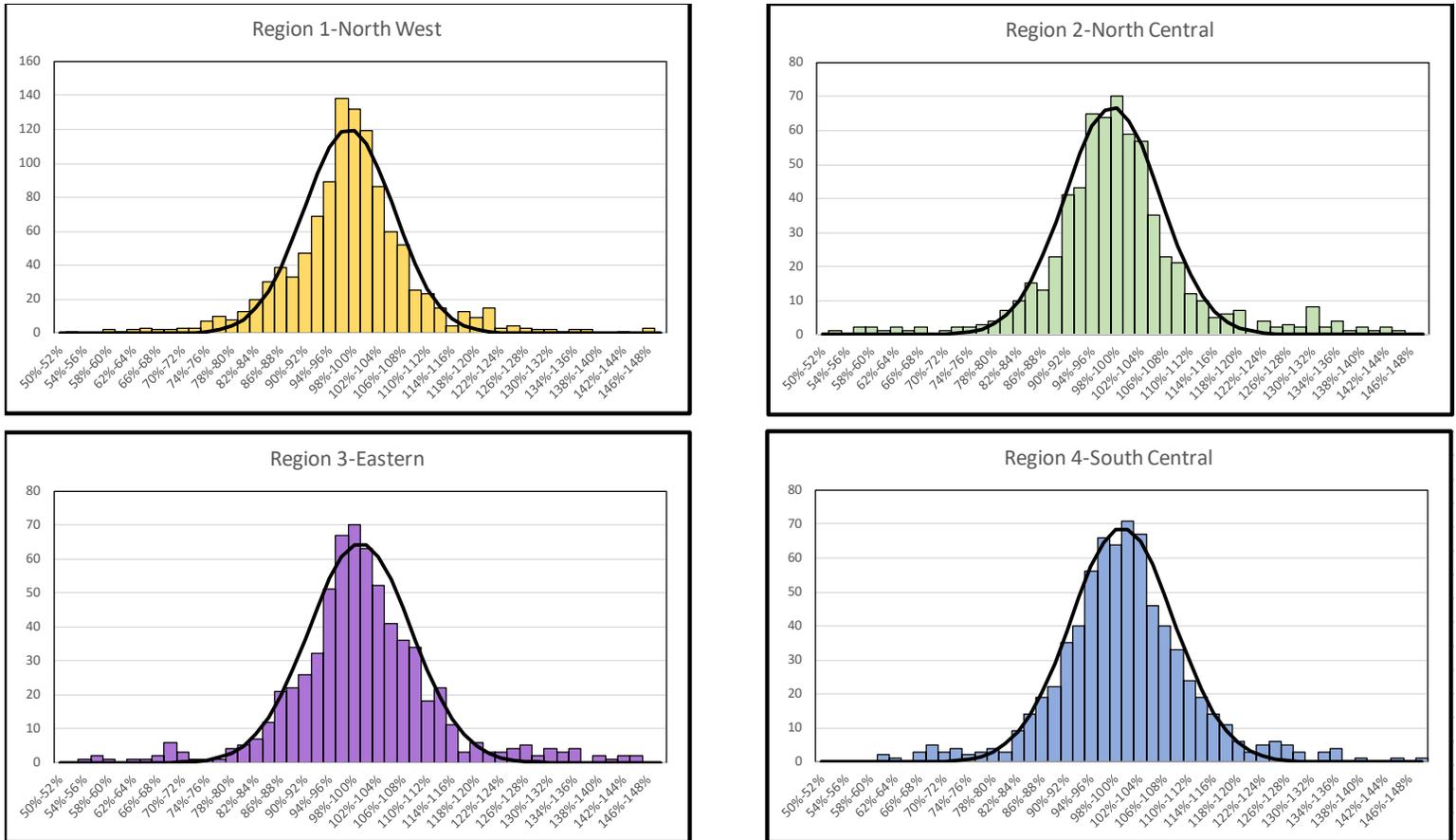
The following tables show the number of verified sales, statistics of central tendencies, and statistics concerning the distribution of the sales assessment ratios for each region. All four regions have median assessment ratios, COD, and PRD values that are within the IAAO recommendation for a quality appraisal (International Association of Assessing Officers, 2013).

Residential Sales Ratio Statistics by Region

Region	Sample Data		Appraisal Levels						Appraisal Uniformity			
	Count (All Sales)	Count (Non-Outlier)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
<b>1-North West</b>	1,110	1,014	98.54%	-0.7%;+0.5%	98.16%	±0.5%	97.96%	±0.6%	5.743	7.484	0.073	1.002
<b>2-North Central</b>	653	593	98.17%	-0.4%;+0.7%	98.27%	±0.6%	97.76%	±0.7%	6.116	7.902	0.078	1.005
<b>3-Eastern</b>	678	613	99.71%	-0.9%;+0.6%	99.98%	±0.7%	99.37%	±0.7%	6.517	8.369	0.084	1.006
<b>4-South Central</b>	727	674	100.12%	-0.9%;+0.6%	100.10%	±0.6%	98.06%	±1.6%	6.579	8.384	0.084	1.021
<b>State Wide Total</b>	<b>3,168</b>	<b>2,897</b>	<b>98.99%</b>	<b>-0.3%;+0.3%</b>	<b>99.04%</b>	<b>±0.3%</b>	<b>98.15%</b>	<b>±0.7%</b>	<b>6.216</b>	<b>8.015</b>	<b>0.079</b>	<b>1.009</b>

The following graphs show the distribution analysis of sales ratios for the four regions using the new appraisal values as well as the normal distribution for comparison.

**Figure 3: Regional Sales Ratio Histogram**



In all for regions, the distribution appears to be tight and symmetrically centered near 100 percent, indicating a good and uniform reappraisal in all four regions.

### County Analysis-Residential

There were 14 counties with at least 30 valid sales between January 1 and March 31, 2020. The following table shows the number of verified sales, statistics of central tendencies, and statistics concerning the distribution of the sales assessment ratios.

Residential County Sales Ratio Statistics												
County	Sample Data		Appraisal Levels						Appraisal Uniformity			
	Count (All Sales)	Count (Non-Outlier)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
Carbon	37	36	98.53%	-10.7%;+5.1%	96.69%	±5.0%	95.23%	±4.6%	11.142	15.164	0.147	1.015
Cascade	290	268	98.89%	-0.9%;+1.1%	99.10%	±0.9%	98.83%	±0.9%	5.632	7.253	0.072	1.003
Fergus	34	33	97.33%	-3.6%;+4.0%	97.28%	±2.9%	96.90%	±2.8%	6.522	8.304	0.081	1.004
Flathead	432	403	99.07%	-1.2%;+0.7%	98.61%	±0.7%	98.41%	±0.9%	5.482	7.063	0.070	1.002
Gallatin	427	403	100.52%	-0.8%;+0.6%	100.74%	±0.7%	99.92%	±1.2%	5.349	6.857	0.069	1.008
Lake	69	62	96.49%	-3.2%;+3.1%	96.69%	±2.5%	95.71%	±2.3%	7.648	10.058	0.097	1.010
Lewis And Clark	237	217	97.81%	-1.9%;+0.4%	97.24%	±1.0%	97.02%	±1.0%	5.780	7.400	0.072	1.002
Lincoln	51	49	96.18%	-5.6%;+5.3%	96.68%	±4.2%	95.46%	±4.1%	11.953	15.022	0.145	1.013
Madison	63	58	95.32%	-3.2%;+1.7%	94.49%	±2.4%	93.03%	±4.2%	7.252	9.729	0.092	1.016
Missoula	372	336	98.68%	-0.8%;+0.7%	98.40%	±0.7%	98.24%	±0.8%	5.033	6.561	0.065	1.002
Park	55	53	97.74%	-3.5%;+5.3%	98.94%	±2.5%	98.67%	±2.5%	7.744	9.331	0.092	1.003
Ravalli	145	128	98.45%	-1.7%;+1.0%	97.87%	±1.2%	97.36%	±1.5%	5.429	7.075	0.069	1.005
Silver Bow	98	88	102.40%	-3.2%;+3.5%	102.65%	±2.4%	101.21%	±2.4%	8.646	10.817	0.111	1.014
Yellowstone	499	470	99.85%	-0.7%;+0.7%	100.09%	±0.6%	99.55%	±0.7%	5.458	6.936	0.069	1.005
State Wide Total	3,168	2,897	98.99%	-0.3%;+0.3%	99.04%	±0.3%	98.15%	±0.7%	6.216	8.015	0.079	1.009

The level of assessment was calculated for each of these counties. All of the counties have assessment levels (medians) that fall within the IAAO recommended range of 90%-110% (Gludemans, 1999). Similarly, the PRD and the COD were also calculated for each county, and in all counties listed, the PRD and COD were inside of the recommended standards by IAAO (Gludemans, 1999). Carbon and Lincoln counties had a COD level of above 10, which would be the standard for large urban areas, but it is below 15, which is the upper standard for areas outside of large urban areas.

## Municipality Analysis-Residential

The level of assessment and COD were calculated for the 32 cities and towns (as identified by the properties address) in which there were 30 or more sales. These statistics are listed in the table below.

Residential City* Sales Ratio Statistics <i>*(based on Zip Code)</i>												
City	Sample Data		Appraisal Levels						Appraisal Uniformity			
	Count (All Sales)	Count (Non-Outlier)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
Belgrade	102	94	100.00%	-1.2%;+1.5%	100.38%	±1.0%	100.16%	±1.0%	3.630	4.627	0.046	1.002
Bigfork	45	45	103.61%	-7.1%;+2.9%	102.38%	±3.4%	100.62%	±4.4%	8.841	11.171	0.114	1.017
Billings	455	435	99.84%	-0.8%;+0.7%	100.00%	±0.6%	99.49%	±0.7%	5.315	6.737	0.067	1.005
Bozeman	246	232	100.76%	-0.6%;+1.1%	101.18%	±0.9%	100.91%	±1.1%	5.457	6.956	0.070	1.003
Butte	93	84	102.13%	-3.7%;+3.0%	102.29%	±2.4%	100.40%	±2.3%	8.716	10.902	0.112	1.019
Columbia Falls	47	43	99.06%	-1.2%;+2.0%	99.13%	±1.4%	99.03%	±1.4%	3.473	4.511	0.045	1.001
East Helena	36	32	97.47%	-1.5%;+3.2%	97.62%	±1.6%	97.78%	±1.6%	3.731	4.636	0.045	0.998
Great Falls	270	249	98.88%	-1.0%;+0.9%	99.03%	±0.9%	98.78%	±0.9%	5.373	6.899	0.068	1.002
Hamilton	52	47	98.48%	-4.8%;+1.3%	97.65%	±2.0%	96.82%	±2.7%	5.586	7.056	0.069	1.009
Helena	197	181	97.81%	-2.2%;+0.4%	97.05%	±1.1%	96.81%	±1.2%	6.093	7.770	0.075	1.002
Kalispell	217	205	99.53%	-1.6%;+0.6%	99.13%	±0.9%	98.85%	±1.0%	5.317	6.811	0.068	1.003
Lewistown	33	32	96.97%	-3.2%;+4.4%	96.99%	±2.9%	96.71%	±2.9%	6.449	8.275	0.080	1.003
Livingston	48	46	96.12%	-2.4%;+7.0%	97.95%	±2.6%	98.08%	±2.7%	7.585	8.952	0.088	0.999
Missoula	306	276	98.89%	-0.9%;+0.7%	98.68%	±0.7%	98.39%	±0.8%	4.840	6.320	0.062	1.003
Stevensville	44	39	99.02%	-3.1%;+1.3%	98.33%	±2.0%	98.24%	±2.0%	4.915	6.417	0.063	1.001
Whitefish	105	100	96.90%	-1.3%;+2.2%	95.84%	±1.4%	95.76%	±2.4%	5.878	7.606	0.073	1.001
<b>State Wide Total</b>	<b>3,168</b>	<b>2,897</b>	<b>98.99%</b>	<b>-0.3%;+0.3%</b>	<b>99.04%</b>	<b>±0.3%</b>	<b>98.15%</b>	<b>±0.7%</b>	<b>6.216</b>	<b>8.015</b>	<b>0.079</b>	<b>1.009</b>

All areas have medians in the recommended range (i.e. between 90 percent and 110 percent) (Gloude-mans, 1999). The COD values are also all less than the IAAO Standards. However, there are five cities (Belgrade, Columbia Falls, East Helena, Missoula and Stevensville) where the COD is less than five, the lower bound for the IAAO standard (International Association of Assessing Officers, 2013). This may indicate the sample is not representative of the overall population, in which case the appraisal is not necessarily bad, but rather may not be as uniform as the COD indicates. Another reason for low COD levels could be that the markets are extremely homogenous and stable. In all four of the cities, the COD is only slightly below the 5.0. A COD lower than 5.0 could indicate some sales chasing may have occurred because it represents 'too accurate' of a value. It is possible some sales chasing did occur, but it is probably more likely to be too few and non-representative samples. As long as the representative features of the sales are applied to the subject properties it means accuracy is attained.

## Valuation Method-Residential

As an additional check on the quality of the 2021 appraisal, it is helpful to examine sales ratio characteristics based on the method in which properties were appraised. The two primary approaches to valuing residential property are a market-based approach and a cost-based approach.

Residential Sales Ratio Statistics by Valuation Method												
Region	Sample Data		Appraisal Levels					Appraisal Uniformity				
	Count (All Sales)	Count (Non-Outlier)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
Market	2,802	2,603	99.02%	-0.3%;+0.3%	99.08%	±0.3%	98.24%	±0.7%	6.046	7.743	0.077	1.009
Cost	354	311	97.79%	-1.4%;+1.6%	96.61%	±1.5%	97.22%	±3.4%	10.089	13.746	0.133	0.994
State Wide Total	3,168	2,897	98.99%	-0.3%;+0.3%	99.04%	±0.3%	98.15%	±0.7%	6.216	8.015	0.079	1.009

As the table shows, the both valuation methods are within the appraisal level standards established IAAO (International Association of Assessing Officers, 2013). IAAO states that if the different stratification groups have appraisal levels within five percentage points of the overall appraisal levels, the appraisal is still considered valid (International Association of Assessing Officers, 2013). Additionally, the two groups have COD levels below the standards set by IAAO indicating good uniformity (International Association of Assessing Officers, 2013). However, properties that were appraised using the cost approach have a COD value above 10.0, but this is likely a byproduct of the cost approach being used on less homogenous and rural properties. Therefore, these properties still meet the appropriate IAAO standard of 15.0. Both valuation methods also have acceptable PRDs, indicating that there is not an abnormal level of regressivity as a result of the valuation method.

### Conclusion-Residential

Based on widely recognized norms and standards, the 2021 appraisal 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 (International Association of Assessing Officers, 2013). The sample assessment level of 98.99 percent is within 1.01 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 6.216 is within the accepted range of 5.0 to 15.0, with the lower number reflecting greater accuracy. The PRD of 1.009 is also between the IAAO recommended 0.980 and 1.030 standard (International Association of Assessing Officers, 2013).

This study only used sales from the first quarter of CY 2020 to exclude any effect of COVID-19 related market disruptions. However, in the coming 2023 reappraisal cycle, these sales (as well as sales up to December 31, 2021) may be included when developing assessment values using market valuation.

### 2021 Appraisal-Commercial

Similar to residential properties, the Department of Revenue must provide assurance that the reason for increases or decrease in appraised values for commercial properties is due to the genuine changes in property value and not due to faulty or poor reappraisal performance.

Commercial sales that occurred were verified by PAD to determine if the sales were usable for valuation purposes. This includes making sure that the sale price is representative of only the market value of real property and ensuring that the sales are arms-length transactions.

Oftentimes, sales prices for commercial property include the real property and also the business interest or personal property located inside that property. For example, a gas station may sell for \$250,000, but the land could be purchased for \$75,000 and the building could be built for \$50,000. The cost approach to valuation would value the property at \$125,000. In this example, the other \$125,000 in the sale price is for the established business and personal property (like the gas pumps and the signs). When this is the case, the sale price may not be a valid indicator of the market value of real property, but instead represents the market value of the entire business, including the personal property.

Single-family residential property is rarely purchased for anything other than to provide housing. This generally means that there is significantly less distortion in the residential sales price as a result of business interests or personal property, as may be the case in commercial sales.

Another criterion for a sales ratio analysis is for the properties that sell to be representative of all properties being evaluated. In the case of Class 4 commercial properties, the Department of Revenue wants to determine if the reappraisal of all commercial properties is accurate. So, the commercial sales must be representative of the commercial properties in the state. This means that the distribution in terms of geography, use, and value of the properties that sell is representative of all commercial properties in the state. Some types of properties only have a very specific use, and there may only be one or two properties of its kind in the state. It is unlikely that these properties sell in any given year, so it can be more difficult to use sales to verify the assessed values on these properties. The more sales that occur, the more likely that the sample of sales is representative of the universe of properties.

Even if the sales are not representative of the universe of commercial properties, confidence intervals and other statistical tests can be calculated and used to evaluate appraisal quality. A confidence interval determines the range that the true assessment ratio is between. This acknowledges that there may be some variation between the all commercial properties in the state and the sample of properties that sold. The use of confidence intervals can also make up for having fewer sales.

Because of limited sales and the complexity of commercial real estate markets, assessing the quality of the appraisal for commercial property is more difficult than assessing the quality of reappraisal for residential property. The quality of commercial reappraisal includes confidence intervals and hypothesis testing because of fewer commercial sales and a more complex commercial market. Statistical tools and tests can then be used to overcome some of the challenges in validating the quality of commercial mass appraisal.

Lastly, it is important to bear in mind that the results for commercial property are not necessarily directly comparable to the results presented for residential property, however the two are related. In acknowledging the complexity of mass appraisal for commercial property, the IAAO generally has different standards for assessment level and uniformity for commercial and residential property (International Association of Assessing Officers, 2013).

## **Data-Commercial**

The sale prices and corresponding assessment values were extracted from the Department of Revenue's property information valuation system and provided the data for this analysis. The data set contained 525 commercial properties sold from October 1, 2019 to June 30th, 2020 and that were considered to be valid sales. Standard screening processes were used to determine the validity of sales. This screening is meant to ensure the sales price represents the market value of the real property. The screening eliminated sales where the sales price represents more than the market value of the real property (for example when the sales price includes personal property or the value of an established business).

Ideally, there would be enough sales in the first quarter of 2020 (as is the case with residential properties), and additional sales from outside this time frame would not be needed. Sales before January 1, 2020 were used in the models to determine assessment value, and therefore the assessed values are not strictly independent of the sales prices. The sales after January 1, 2020 are independent and would be the preferred measure of market value, given enough data. Additionally, some of the commercial sales from the second quarter of 2020 may have been impacted by the COVID-19 pandemic. In these cases, the sales price may not be representative of the true market value of the property on the assessment date (January 1, 2020).

In a valid sales ratio, the properties that sold are representative of all the commercial property in the state. To test this hypothesis, a t-statistic was calculated. The null hypothesis is that the two groups of commercial properties have the same mean assessed value in TY 2021. The t-statistic indicated that we cannot reject the null hypothesis at the 95<sup>th</sup> percent confidence level. In other words, the commercial properties sold have similar assessed value as commercial properties that did not sell, indicating that they are similar.

The assessment ratios for properties sold in the fourth quarter of 2019 were compared to properties that sold in the first half of 2020. The mean and median assessment ratio were similar, and a t-test indicated there was no statistical difference between the assessment levels, between the sales prices, or between the sales ratios. Therefore, the full time period's worth of sales can be used to estimate the assessment level for all commercial and industrial properties.

Lastly, a similar analysis was performed on the properties sold in the second quarter of 2020 to determine if there was a statistical difference in properties as the result of COVID-

19 market distortions. As with the prior analysis, t-statistics indicated the sales ratios, sales prices, and assessment values of these properties did not appear to be statistically different than all the other properties in the sample. Therefore, the inclusion of these properties in the sample is not anticipated to dramatically bias the overall results of the analysis.

Observations that had a sales ratio outside 1.5 times the inter-quartile ranges from the 25th and 75th percentile were dropped in any sales ratio calculation. This trimming of sales is standard in these types of studies (International Association of Assessing Officers, 2013). As with the residential sales, the trimming was done at each stratification of the overall sample, as an observation may be an outlier in one circumstance (on a statewide basis for example), but may not be an outlier in another circumstance (on a county or municipal basis for example).

Trimming the sales in this fashion eliminates ratios that are unreasonable. They can be unreasonable for a variety of reasons (Gloudemans, 1999):

- the sales price is not accurate measure of the property's value
- the assessed value is not accurate at the time of the sale
- there is a mistake in the data entry, or
- the nature of the parcel changed between the sale date and assessment date.

In the cases where the assessment value does not represent market value, the values may be adjusted by informal reviews. However, the data in the sample was extracted before most informal reviews were submitted. Therefore, these reviews should not affect the overall quality of reappraisal this report is trying to determine.

**Commercial Results**  
**Statewide Commercial Analysis**

The following table displays a summary of the ratio statistics using the 2021 appraisal values.

<b>Commercial Ratio Statistics</b>	
<b>Sales<sup>1</sup> Relative to TY 2021 Values</b>	
<b><u>Number of Sales</u></b>	<b><u>Values</u></b>
<b>Total Observations</b>	<b>525</b>
<b>Used Observations</b>	<b>464</b>
<b><u>Measurement of Appraisal Levels</u></b>	
<i>Upper Bound Confidence Interval</i>	98.28%
<b>Median Ratio</b>	<b>97.45%</b>
<i>Lower Bound Confidence Interval</i>	96.54%
<i>Upper Bound Confidence Interval</i>	97.52%
<b>Mean Ratio</b>	<b>96.41%</b>
<i>Lower Bound Confidence Interval</i>	95.29%
<i>Upper Bound Confidence Interval</i>	95.51%
<b>Weighted Mean</b>	<b>93.32%</b>
<i>Lower Bound Confidence Interval</i>	91.13%
<b><u>Measurement of Appraisal Uniformity</u></b>	
<b>Coefficient of Dispersion</b>	<b>9.432</b>
<b>Coefficient of Variation</b>	<b>12.685</b>
<b>Standard Deviation</b>	<b>0.122</b>
<b>Price Related Differentials</b>	<b>1.033</b>
<b><u>Range (1.5x Inter Quartile Range)</u></b>	
<b>Maximum Ratio in the Sample</b>	<b>129.0%</b>
<b>Minimum Ratio in the Sample</b>	<b>63.5%</b>
<sup>1</sup> Sales from 10/1/2019 to 6/30/2020	

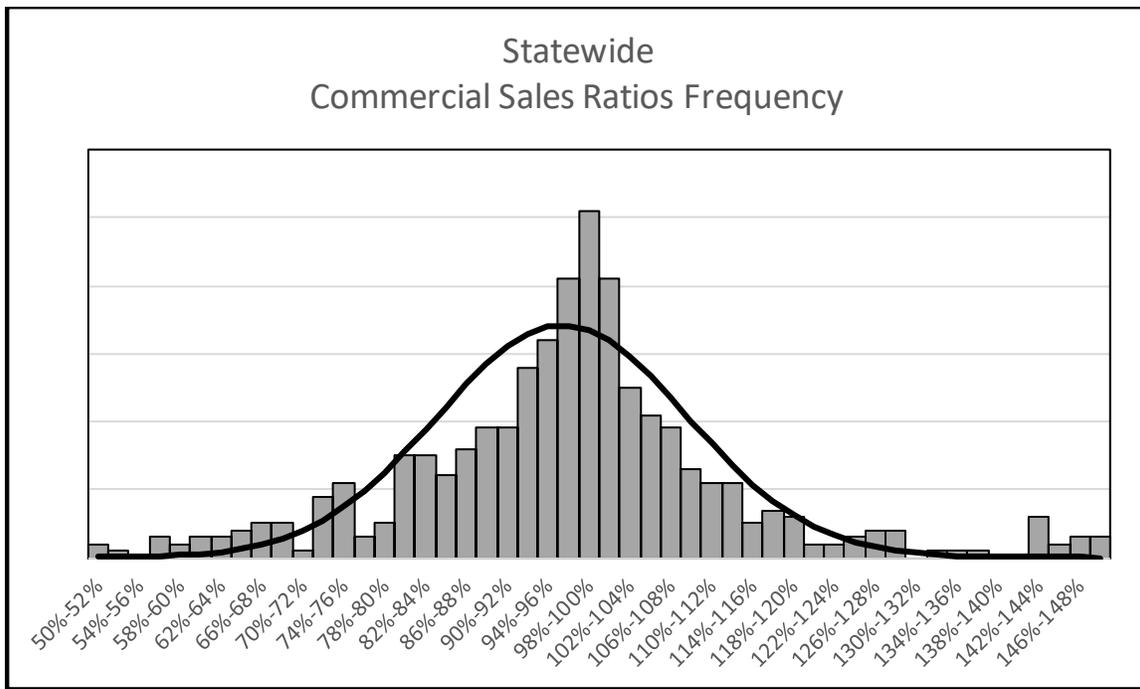
The statewide overall level of assessment, as measured by the median sales ratio, is 97.45 percent. The mean sales ratio for commercial properties in 2021 was 96.41 percent while the weighted mean sales ratio was 93.2 percent. Although all three measures are less than 100 percent by a statistically significant margin, all three statistics are within the IAAO standard of being within 10 percent of the target of 100 percent (International Association of Assessing Officers, 2013).

The measures of uniformity show that the coefficient of dispersion is also within the acceptable IAAO range of five to 20, indicating the 2021 appraisal had good uniformity

for commercial properties (International Association of Assessing Officers, 2013). The price related differential is 1.033 which is slightly above the IAAO standard of 1.03. The PRD statistic is much more sensitive to extreme values and higher priced properties, and because of the nature and complexity of commercial properties, a PRD value outside of the IAAO standard for commercial properties may not be as important as in the case of residential properties (International Association of Assessing Officers, 2013). An additional measure of vertical equity is the coefficient of price-related bias (PRB). For the commercial sales in the sample, the PRB did not show evidence of vertical inequality, and therefore the single PRD slightly higher than 1.03 for commercial sales is likely not concerning (International Association of Assessing Officers, 2013).

The following graph shows the distribution of assessment ratios in the sample. Ideally, the distribution would show a tight, symmetrical distribution centered around 1.0. Because the commercial properties have more variation, and there are fewer overall sales, the distribution of commercial ratios is not as smooth relative to the distribution of the residential ratios. However, as the graph shows, the distribution of sales ratios may not be perfectly normal, but it also does not appear to be dramatically different from a normal distribution.

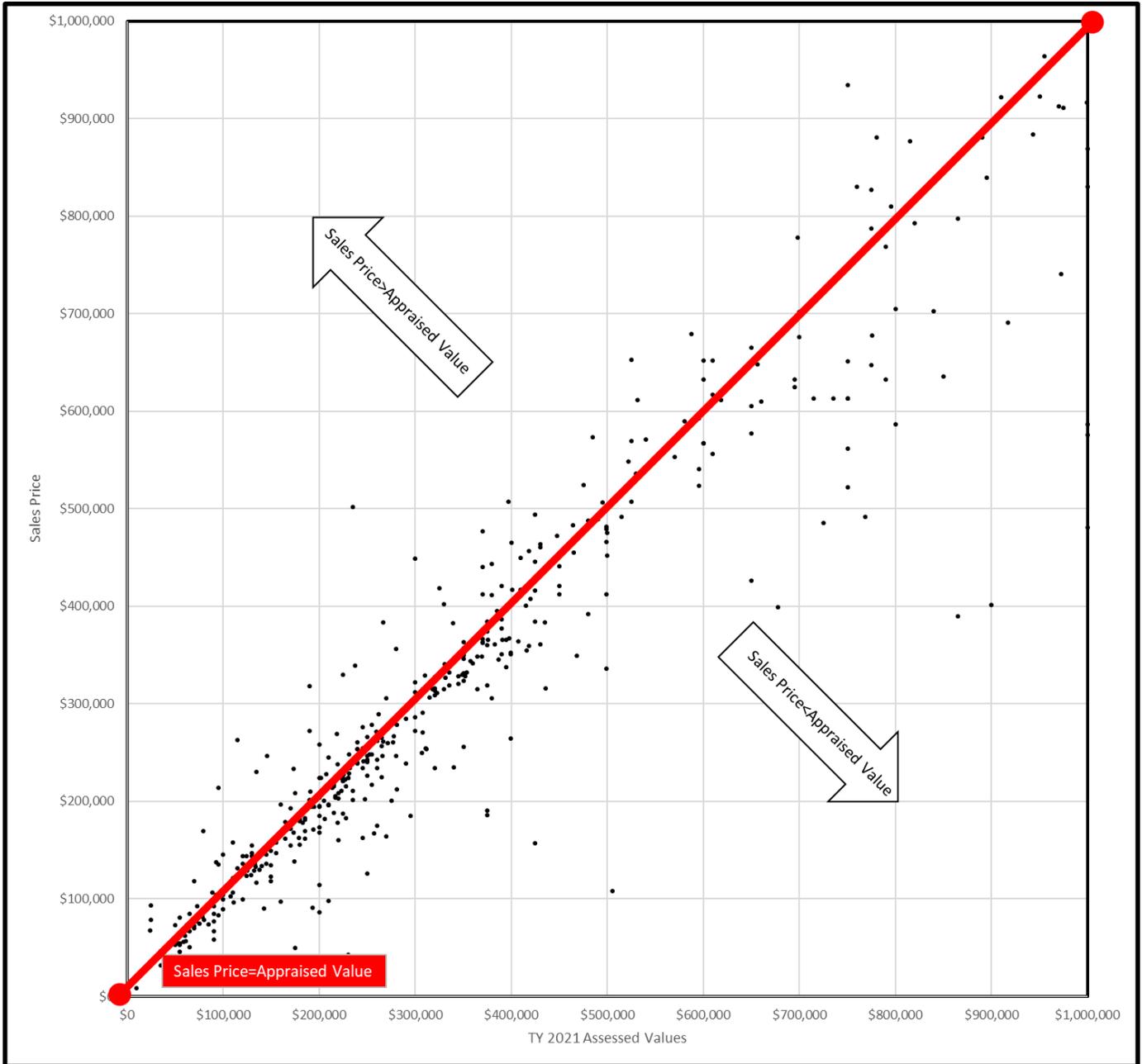
**Figure 4: Commercial Sales Ratio Histogram**



The following graph shows a scatter plot of the relationship between sales prices and assessed values. The plot has a line where 100 percent of market value is attained, or where sales price equals the assessed value. Values above the line indicate a sales price greater than the assessed value and values below the line indicate an assessed value greater than the sales price. As the graph shows, there does not appear to be any groupings above or below the line, nor does there appear to be a strong relationship between the value of the property and the sales ratio. Again, these trends would be

expected given previous statewide table as the scatter plot is a different representation of the same idea.

**Figure 5: Plot of Commercial Sales Price and Assessed Values**



### Region Analysis-Commercial

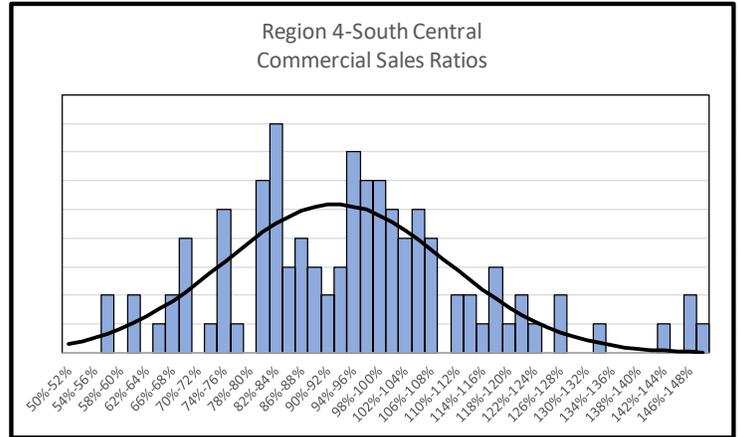
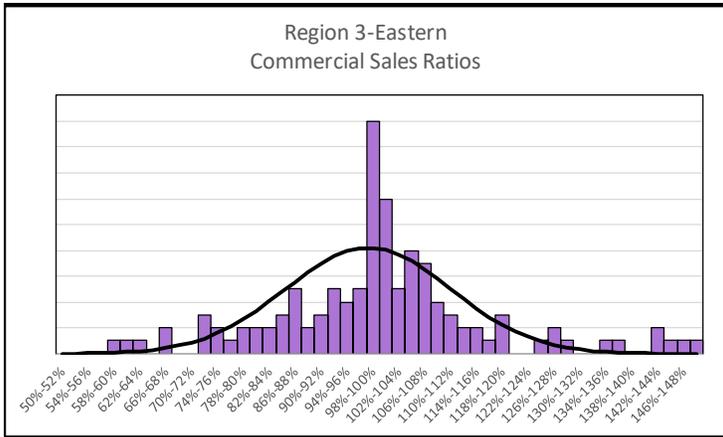
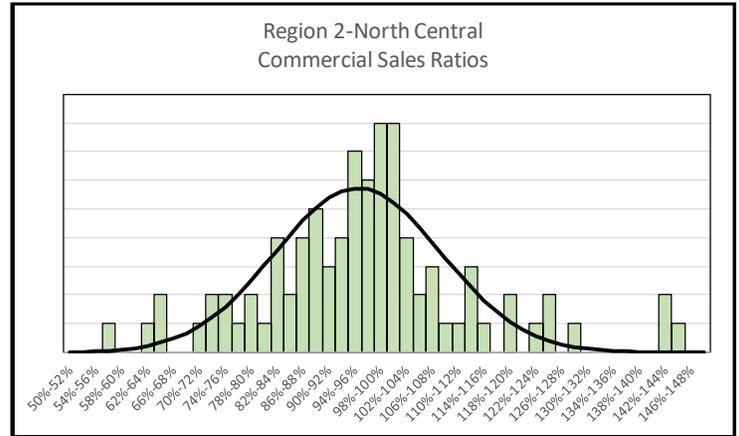
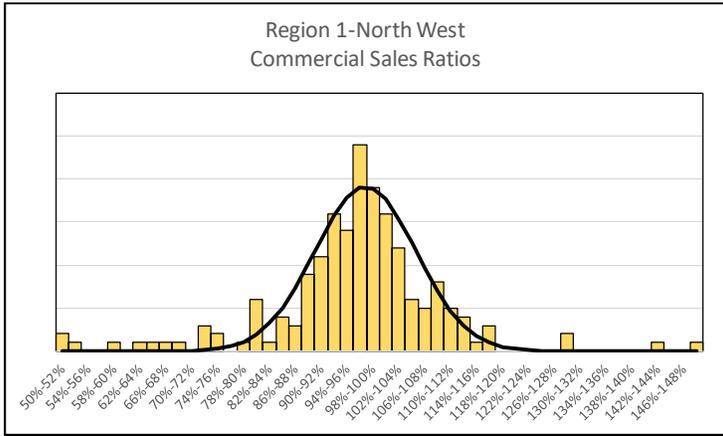
As with residential properties, the Department of Revenue calculated the sales ratio statistics for the different administrative regions in the state. The following tables show the number of verified sales, statistics of central tendencies, and statistics concerning the distribution of the sales assessment ratios. All four regions have median assessment ratios, COD, and PRD values that are within the IAAO recommendation for a quality appraisal.

Commercial Sales Ratio Statistics by Management Region												
Region	Sample Data		Appraisal Levels						Appraisal Uniformity			
	Count (All Sales)	Count (Non-Outliers)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
<b>1-North West</b>	188	168	97.38%	-0.9%;+1.6%	97.88%	±1.2%	97.17%	±1.7%	6.247	8.016	0.078	1.007
<b>2-North Central</b>	92	82	96.62%	-3.1%;+3.1%	95.53%	±2.8%	91.12%	±4.0%	10.098	13.400	0.128	1.048
<b>3-Eastern</b>	132	111	99.53%	-1.4%;+1.6%	98.28%	±2.4%	96.87%	±3.4%	9.374	13.067	0.128	1.015
<b>4-South Central</b>	113	101	94.71%	-7.6%;+2.9%	92.23%	±3.4%	86.41%	±5.4%	14.442	18.881	0.174	1.067
<b>State Wide Total</b>	525	464	97.45%	-0.9%;+0.8%	96.41%	±1.1%	93.32%	±2.2%	9.432	12.685	0.122	1.033

As the table shows, almost all the ratios measuring the appraisal levels are all within the IAAO standards of 90% to 110% (Gloude-mans, 1999). The one possible exception to this would be the weighted mean for Region 4 in South Central Montana. However, the confidence intervals for this statistic show that we cannot say there is a statistical difference between this value and a value that would be within the standards set by IAAO (DeGrouot & Schervish, 2002). Similarly, the COD values are in the acceptable ranges in all four regions.

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

**Figure 6: Regional Commercial Sales Ratio Histogram**



As the graphs show, in all four regions the distributions appear to be primarily centered around 1.0, and relatively normal. The one area that may be somewhat less normal relative to the others would be Region 4 in South Central Montana. This is likely a byproduct of the larger variation in the commercial property markets in that area, specifically Gallatin County.

**County Analysis-Commercial**

There were six counties with at least 30 valid sales between October 1, 2019 and June 30, 2018. The following table shows the number of verified sales, statistics of central tendencies, and statistics concerning the distribution of the sales assessment ratios.

Commercial County Sales Ratio Statistics												
County	Sample Data		Appraisal Levels					Appraisal Uniformity				
	Count (All Sales)	Count (Non-Outliers)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
Flathead	42	36	97.89%	-1.4%;+3.8%	98.11%	±1.8%	97.64%	±1.6%	4.126	5.508	0.054	1.005
Gallatin	37	36	84.75%	-3.0%;+12.0%	86.53%	±5.0%	85.73%	±7.3%	14.100	17.096	0.148	1.009
Missoula	80	71	96.09%	-2.5%;+3.0%	96.58%	±2.2%	93.20%	±6.0%	7.625	9.832	0.095	1.036
Silver Bow	36	31	97.79%	-7.2%;+6.4%	98.49%	±6.0%	91.59%	±7.1%	12.491	16.482	0.162	1.075
Yellowstone	73	62	99.62%	-1.4%;+1.6%	99.54%	±2.0%	98.88%	±3.0%	5.773	7.988	0.080	1.007
State Wide Total	525	464	97.45%	-0.9%;+0.8%	96.41%	±1.1%	93.32%	±2.2%	9.432	12.685	0.122	1.033

The level of assessment was calculated for each of these counties. Five of the six displayed counties have assessment levels (medians) within the recommended range of 90%-110% (Gloude-mans, 1999). The one county outside of this range is Gallatin County, although the confidence intervals indicate, we cannot say an acceptable measure would be statistically different from the values observed in this analysis. Similarly, the PRD and the COD was also calculated for each county, and in all counties, the COD was inside of the recommended standards by IAAO (Gloude-mans, 1999).

### Valuation Method-Commercial

As a final check on the quality of the 2021 appraisal for commercial properties, it is helpful to examine sales ratio characteristics based on the method in which properties were appraised. The two approaches to valuing commercial property are an income-based approach and a cost-based approach.

Commercial Sales Ratio Statistics by Valuation Method												
Region	Sample Data		Appraisal Levels					Appraisal Uniformity				
	Count (All Sales)	Count (Non-Outliers)	Median	Conf. Interval	Mean	Conf. Interval	Weighted Mean	Conf. Interval	COD	COV	Std. Dev.	PRD
Income	388	338	98.09%	-1.1%;+0.9%	97.30%	±1.1%	95.35%	±1.8%	7.734	10.389	0.101	1.020
Cost	137	126	93.78%	-3.9%;+3.5%	91.64%	±3.2%	79.48%	±5.8%	15.003	19.707	0.181	1.153
State Wide Total	525	464	97.45%	-0.9%;+0.8%	96.41%	±1.1%	93.32%	±2.2%	9.432	12.685	0.122	1.033

For both the groups of property, the levels of appraisal uniformity and appraisal levels are all within the standards set by IAAO (International Association of Assessing Officers, 2013). However, the cost method for the valuation commercial properties produces a slightly lower sales ratio relative to the income valuation method. This difference is also statistically significant at the 95% confidence interval, and a t-test analysis indicates there is a statistically significant difference between the two groups. This difference would imply that properties being appraised using the cost approach may be under appraised relative to properties values using the income approach. However, this difference is within the standards of plus or minus five percentage points for different strata (International Association of Assessing Officers, 2013).

### Conclusion-Commercial

Based on widely recognized norms and standards, the 2021 commercial appraisal 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 (International Association of Assessing Officers, 2013). The median sample assessment level of 97.45 percent is within three percent of market value.

The reappraisal also meets uniformity standards, as evidenced by the coefficients of dispersion. The statewide COD of 9.4 is within the recommended range of 5.0 to 20.0 (International Association of Assessing Officers, 2013). The statewide PRD of 1.033 is slightly outside the IAAO recommended limit of 1.03, indicating the possibility of some appraisal regressivity, but most likely the result of a small sample size and less important in commercial sales ratio analysis relative to residential studies (International Association of Assessing Officers, 2013).

Finally, the method used to appraise commercial properties does seem to yield statistically different appraisals levels as measured by the sales ratio. However, the difference is with IAAO standards, and both methods are believed to be valid means of appraising commercial properties (International Association of Assessing Officers, 2013).

## **Bibliography**

- DeGrouot, M. H., & Schervish, M. J. (2002). *Probability and Statistics*. Boston: Addison Wesley.
- Eckert, J. K., Gloudemans, R. J., Almy, R. R., & International Association of Assessing Officers. (1990). *Property Appraisal and Assessment Administration*. Chicago, Illinois: International Association of Assessing Officers.
- Gloudemans, R. J. (1999). *Mass Appraisal of Real Property*. Chicago, Illinois: International Association of Assessing Officers.
- International Association of Assessing Officers. (2010). *Property Assessment Valuation*. Kansas City, Missouri: International Association of Assessing Officers.
- International Association of Assessing Officers. (2013). *Standard on Ratio Studies*. Kansas City, Missouri: International Association of Assessing Officers.
- Peter, K. (2003). *A Guide to Econometrics, Fifth Edition*. Cambridge, Massachusetts: The MIT Press.