



Department of Local Government Finance

2021 Level II Ratio Study / Trending



Ratio Studies

- Primary tool used to measure mass appraisal performance.
- Compares assessed values to “objectively verifiable data.”
- In our case, compares the assessor’s estimate of TTV to indicators of market value in use. (i.e. sales prices and/or independent appraisals)



Ratio Studies

- Ratio studies measure certain aspects of assessments:
 - Accuracy – the level of assessment; the overall percentage that TTV represents of market value-in-use.
 - Uniformity – relates to fair and equitable treatment of individual properties; uniformity requires that properties be valued equitably within each major property class, township and that each these groups be valued at the same level of assessment.
 - Regressivity / Progressivity – relates to whether lower valued properties are under or over-assessed in relation to higher valued properties.



Ratio Studies

- An assessment ratio is calculated using the following formula:
TTV divided by market value = ratio
- Example:
TTV = \$46,500 Sale Price = \$50,000
 $46,500 / 50,000 = .93$ or 93%



Ratio Studies

- Let's calculate the assessment ratio on these two sales.
- Sale 1 – sale price is \$218,500; TTV is \$232,400.
- Sale 2 – sale price is \$98,300; TTV is \$96,200.



Ratio Studies

- Let's review the answer to the assessment ratios you worked.
- Sale #1 - $\$232,400 / \$218,500 = 1.064$ or 106.4%.
- Sale #2 - $\$96,200 / \$98,300 = .979$ or 97.9%.



Ratio Studies

- The measures of central tendency we will be working with in this class are:
 - Median
 - Mean
 - Weighted Mean



Ratio Studies – Median

- The Median is the middle ratio in a rank order of ratios. A rank order lists the ratios in ascending or descending order.



Ratio Studies – Median

- If the sample contains an odd number of sales ratios, the median will be the one which divides the ranked observations into two equal parts.
- If the sample contains an even number of sales ratios, the median will be the arithmetic average of the two ratios in the middle.
- There is a formula for finding the location of the median within the sample once you have ranked the ratios.



Ratio Studies – Median

- The formula is: $n + 1$ divided by 2 = location of the median.
- The letter n represents the number of ratios in the sample.



Ratio Studies – Median

Example with "odd" # of sales

Sales Ratio

0.920
0.920
1.055
0.983
1.075

Median

Ranked Sales Ratios

0.920
0.920
0.983
1.055
1.075

.983 or 98.3%



Ratio Studies – Median

Example with "even" # of sales

Sales Ratio

0.920
0.920
1.055
0.935
0.983
1.075

Median

Ranked Sales Ratios

0.920
0.920
0.935
0.983
1.055
1.075

.959 or 95.9%



Ratio Studies – Median

- The median is affected very little by extreme values because it is based on the ranks of the data – it represents only the middle value.



Problem #1

- Please go to the Ratio Study Problem / Answer packet with Audio and work Problem #1.



Problem #2

- Please go to the Ratio Study Problem / Answer packet with Audio and work Problem #2.



Ratio Studies – Mean & Weighted Mean

- The next things we want to look at are the mean and the weighted mean.
- The mean is the result of adding up all of the ratios and dividing by the number of ratios in the sample.



Ratio Studies – Mean

- The mean is the most common measure of central tendency.
- However, it can be heavily influenced by extreme values.



Ratio Studies – Mean

- Mean (arithmetic average) – The result of adding all the individual ratios and dividing by the number of ratios.
- Mean = sum of ratios ÷ number of ratios

Sale #	True Tax Value	Sale Price	Sales Ratio
1	\$ 45,800	\$ 49,800	0.920
2	\$ 48,200	\$ 52,400	0.920
3	\$ 42,200	\$ 40,000	1.055
4	\$ 57,150	\$ 58,125	0.983
5	\$ 55,300	\$ 51,450	1.075
Total of Sales Ratios			4.953
Total Number of Ratios			5
Mean			99.05%

$4.953 / 5 = .9905$ or 99.05



Ratio Studies – Weighted Mean

- The weighted mean is a measure of central tendency in which each item is adjusted/weighted by a factor reflecting its relative importance to the whole before the items are summed and divided by their number.



Ratio Studies – Weighted Mean

- Weighted Mean – the total of the TTV’s for all sales divided by the total of the sales prices for all sales
- Weighted Mean = Sum of the TTV’s ÷ Sum of the Sales

Sale #	True Tax Value		Sale Price
1	\$ 45,800		\$ 49,800
2	\$ 48,200		\$ 52,400
3	\$ 42,200		\$ 40,000
4	\$ 57,150		\$ 58,125
5	\$ 55,300		\$ 51,450
	\$ 248,650	Divided by	\$ 251,775

Weighted Mean

.9876 or 98.76%



Problem #3

- Please go to the Ratio Study Problem / Answer packet with Audio and work Problem #3.



Problem #4

- Please go to the Ratio Study Problem / Answer packet with Audio and work Problem #4.



Ratio Studies – Absolute Deviation and Absolute Average Deviation

- The absolute deviation measures the difference between each ratio and the median. Also the absolute deviation ignores the (+) or (-) differences. (See example on next slide.)
- The absolute average deviation measures the average difference between each ratios and the measure of central tendency.
- Both can be calculated around any measure of central tendency, but is usually calculated around the median.



Ratio Study – Absolute Deviation

When calculating the absolute deviation you need to ignore the (+) or (-) differences of the ratios.

<u>Sales Ratio</u>	<u>Median</u>	<u>Deviation</u>	<u>Abs Dev</u>
0.928	0.995	+0.067	0.067
1.013	0.995	-0.018	0.018



Ratio Studies – Absolute / Average Absolute Deviation

- Example: Absolute Deviation / Average Absolute Deviation Example

Sale #	True Tax Value	Sale Price	Sales Ratio	Median	Absolute Deviation
1	\$ 45,800	\$ 49,800	0.920	0.983	0.063
2	\$ 48,200	\$ 52,400	0.920	0.983	0.063
3	\$ 42,200	\$ 40,000	1.055	0.983	0.072
4	\$ 57,150	\$ 58,125	0.983	0.983	0.000
5	\$ 55,300	\$ 51,450	1.075	0.983	0.092
	\$ 248,650	\$ 251,775	Total Absolute Deviation		0.290
			Average Absolute Deviation		0.058



Ratio Studies – COD

- Coefficient of dispersion – based on the average absolute deviation, but is expressed as a percentage of the measure of central tendency.
 - Most often used with the median.
 - **Calculated by dividing the absolute average deviation by the median and multiplying that answer by 100.**



Ratio Studies – Statistics

Coefficient of Dispersion (COD) =
 Ave. Abs. Deviation ÷ Median x 100

Sale #	True Tax Value	Sale Price	Sales Ratio	Median	Absolute Deviation
1	\$45,800	\$49,800	0.920	0.983	0.063
2	\$48,200	\$52,400	0.920	0.983	0.063
3	\$42,200	\$40,000	1.055	0.983	0.072
4	\$57,150	\$58,125	0.983	0.983	.000
5	\$55,300	\$51,450	1.075	0.983	0.092
	\$248,650	\$251,775	Total Absolute Deviation		0.290
			Average Absolute Deviation		0.058
			Median		0.983
			COD		5.90%



Ratio Studies – PRD

- There is one other factor that will need to be taken into account when you work with ratio studies – the price-related differential (PRD).
- The PRD is a statistic that measures assessment regressivity or progressivity.



Ratio Studies – PRD

- Assessments are considered regressive if high value properties are under assessed relative to low value properties.
- Assessments are considered progressive if high value properties are over assessed relative to low value properties.



Ratio Studies – PRD

- PRD is calculated by dividing the mean assessment to sales ratio by the weighted mean ratio.



Ratio Studies – PRD

- Mean = Average of the sales ratios.
- Weighted Mean = Total True Tax Value / Total Sales Price.

Sale #	True Tax Value	Sale Price	Sales Ratio	
1	\$ 45,800	\$ 49,800	0.920	
2	\$ 48,200	\$ 52,400	0.920	
3	\$ 42,200	\$ 40,000	1.055	
4	\$ 57,150	\$ 58,125	0.983	
5	\$ 55,300	\$ 51,450	1.075	
	\$ 248,650	\$ 251,775		
			Mean	.991
			Weighted Mean	.988
			PRD	1.003

PRD = 1.003 or 100.3%



Ratio Studies – Statistics

- **Measures of Regressivity/Progressivity**
- PRD's above 103% tend to indicate assessment regressivity; higher valued properties are under-assessed in relation to lower valued properties.
- PRD's below 98% tend to indicate assessment progressivity; higher valued properties are over-assessed in relation to lower valued properties.



Ratio Study

- Now that we have discussed all the terms, let's review a completed Ratio Study.



Ratio Study – Example

Sale	TTV	Sales Price	Sales Ratio	Median	Abs Dev
1	81,900	86,000	0.952	0.958	0.006
2	68,900	72,000	0.957	0.958	0.001
3	66,200	69,000	0.959	0.958	0.001
4	135,200	120,000	1.127	0.958	0.169
			Total Abs. Dev.		0.177
		352,200	347,000	Avg. Abs. Dev	0.0443
				# of sales	4
				Mean	0.999 (Average of the 4 sales ratios)
				Median	0.958 (Middle sales ratio - Average of .957 & .959)
				Wghtd. Mean	1.015 (\$352,200 / \$347,000)
				COD	4.624 (Avg. Abs Dev / Median x 100)
				PRD	0.984 (Mean / Wghtd. Mean)



Ratio Study

- Now that we have reviewed the ratio study example, you will now work a ratio study.
- You will calculate the Sales Ratio, Mean, Median, Absolute Deviation, Average Absolute Deviation, COD, Weighted Mean & PRD.



Problem #5

- Please go to the Ratio Study Problem / Answer packet with Audio and work Problem #5.



Evaluating Ratio Study Results

The Annual Adjustments and Equalization Standards Rule sets the following standards:

1. **Accuracy** – Median assessment ratio for any class within a township must be between 90% and 110% of TTV.
2. **Uniformity** – The coefficient of dispersion for residential improved must be 15% or less and 20% or less for all other classes within a township.
3. **Regressivity/Progressivity** – The PRD for any class within a township must be between 98% and 103%.



Level II – Ratio Studies

This concludes the Ratio Study tutorial and is a reminder that should you have questions you can email these questions to the DLGF.

Please send emails to Level2@dlgf.in.gov.