Equity and the Sales Ratio Study in Vermont

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Growing Concern and Time For Action

The Problem
Concerns about the current ratio study methodology

➤Issues raised with H.480 and Act 68 (2023)

➤Small sample sizes and representativeness
- The Law of the Vital Few (Pareto Principle)

➤Possible issues with horizontal and vertical equity Statewide and not being tested

➤Insufficient stratification to analyze problems between assessment models and market movement
- Category, Class, and Town limitations

➤Is there a false sense of confidence?

➤Are Vermonters being assessed fairly and equitably?

➤ The answer must be fact-based and quantifiable

Where to find the answers?

Performed an extensive literature review

Attended national and international conferences

◦ 91st Annual Conference for International Association of Assessing Officers (IAAO) in Denver, CO

◦ 117th Annual Conference for National Tax Association (NTA) in Detroit, MI

◦ International Research Symposium for International Property Tax Institute (IPTI) & IAAO in Amsterdam, NL

◦ Ron Rakow & Paul Bidanset Ph.D.(c). *Assessment Tools and Techniques to Measure and Diagnose Issues with Vertical Equity.* 12/5/2024 11:15 – 12:15 pm

Lincoln Institute Vertical Equity App (https://www.lincolninst.edu/data/lincoln-institute-vertical-equity-app/)

The Dataset

Dataset Name: VTSalesStudyDataSetAsOf07112022

Table: PVR_PTR1

Original Dataset: n=51,072 (all categories)

Start Date: 4/2/2018

End Date: 3/31/2021

Fiscal Year: 2022

CLA Calculation Date: June 29 to August 18, 2021

Variables: List Value (LV) & Sales Price Real (PREAL)

*no market adjustment for time for PREAL and one year of the three is a COVID-19 effected market

Trimming Records for 95% Confidence Interval

- No SPAN: 7
- LV/CLA <$10,000: 308
- PREAL <$10,000: 101
- Low A/SR (2.5%): 1,068
- High A/SR (2.5%): 1,068
- After 5% Trimmed: n=48,522

Variables Used: Equalized Listed Value (LV/CLA)

Sales Price Real (PREAL)

Assessment to Sales Ratio (A/SR)

*A/SR calculated for trimming only

Vertical Equity Report
Lincoln Institute of Land Policy

"This report provides guidance on the vertical equity of the assessed values for the file that was provided. Vertical equity for assessments is defined as: "differences in the levels of assessment of properties related to the value ranges of the properties, i.e., properties of higher value have assessment levels different from properties of lower value." Vertical equity exists when assessment levels remain consistent across the entire range of sales prices.

Detailed guidance on sales ratio studies is provided by International Association of Assessing Officers Standard for Sales Ratio Studies (Standard). Measuring the level of vertical equity of assessments is a complex task since the market value of any given property is unknown. As a result, the notion of a single or best measure of vertical equity may be illusive. Instead, the best approach may be to calculate and evaluate all the current measures in the Standard, with the addition of Ginis measures which are new to the assessment profession, to develop a more complete picture of the level of vertical equity for a given distribution. The following analysis is provided based in part on the Standard."

Assessment Ratio Analysis (ASR)

"The first step in this analysis is as analysis of the assessment to sale ratio which is calculated by dividing a property's assessment by its sale price. The overall assessment level is determined by the median assessment to sale ratio (ASR). The median ratio is preferred because it is less affected by extreme values than other measures of central tendency, such as averages. **The overall median ASR is 1.008.**

The median ASR can also be used to evaluate vertical equity when calculated for each sale price decile as provided in this following chart. The chart displays how the ASR changes as the sales price increases. **The range between median ASR for the lowest priced decile (1.628) and highest (0.923) decile is 0.705.** This suggests a trend toward lower ratios as sales prices increase, **a regressive trend.**"

Median ASR by Sale Decile

ASR Slope Coefficient: -0.0000002536
p-value: 0.001
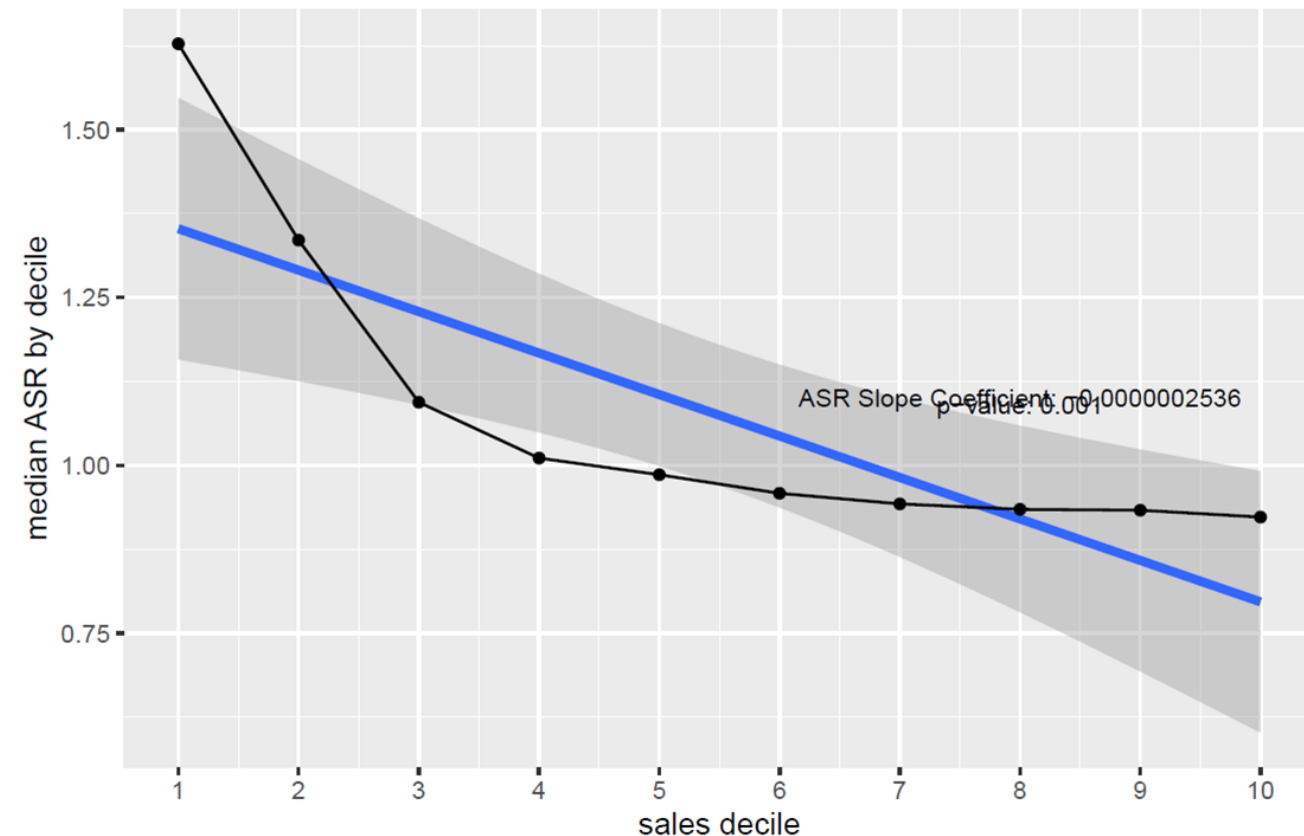
Coefficient of Dispersion (COD)

"The Coefficient of Dispersion, or COD, is not considered to be a measure of vertical equity. It does, however, provide important information on the uniformity or variability of the distribution, and therefore can be informative in this context.

The COD of the properties provided is 36.805. IAAO guidance for the COD are provided below for various residential property uses."

IAAO COD Ranges by Property Type

| Type of Property - General	Type of Property - Specific	COD Range
Single-family residential (including residential condominiums)	Newer or more homogeneous areas	5.0 to 10.0
Single-family residential	Older or more heterogeneous areas	5.0 to 15.0
Other residential	Rural, seasonal, recreational, manufactured housing, 2–4 unit family housing	5.0 to 20.0
Income-producing properties	Larger areas represented by large samples	5.0 to 15.0
Income-producing properties	Smaller areas represented by smaller samples	5.0 to 20.0
Vacant land		5.0 to 25.0

Price Related Differential (PRD)

"The Price Related Differential, or PRD is an index statistic used for measuring vertical equity. The PRD is calculated by dividing the mean ASR by the weighted mean ASR. If vertical equity exists, this ratio should be close to 1.00. A PRD above 1.00 suggests a regressive distribution where lower-valued properties are assessed at a higher level than higher-valued properties. A PRD below 1.00 suggests a progressive distribution, where the reverse is true. The PRD as a vertical equity measure is useful but somewhat flawed. The PRD's strengths are its simplicity and ease of calculation. A disadvantage of the PRD is that it can be distorted by a small number of very high-priced properties that can lead to an indication of regressivity when none is present. As a result, the PRD can be a useful indicator that more analysis is necessary, but by itself it is not necessarily conclusive that vertical inequity exists. **The PRD** for the properties provided **is 1.176**, which **is outside the acceptable range** of .98 to 1.03 recommended by the IAAO and **indicates regressivity** is present."

Coefficient of Price Related Bias (PRB)

"The Coefficient of Price Related Bias, or PRB, measures vertical equity with an index calculated by regression that quantifies the relationship between ASRs and value in percentage terms. If vertical equity exists, the PRB value should be close to zero. A PRB below zero suggests a regressive distribution where lower valued properties are assessed at a higher level than higher-valued properties. A PRB above zero suggests a progressive distribution, where the reverse is true. The PRB is a more robust measure that is not as susceptible to the influence of outliers as the PRD. **The PRB for the properties provided is -0.132**, which is **outside the IAAO recommended range** of -0.05 – 0.05 **and indicates regressivity is present.**"

Coefficient of Price Related Bias Plot

Percent Deviation from Median ASR vs. log(Average of Sale Price and Assessed Value)/log(2))
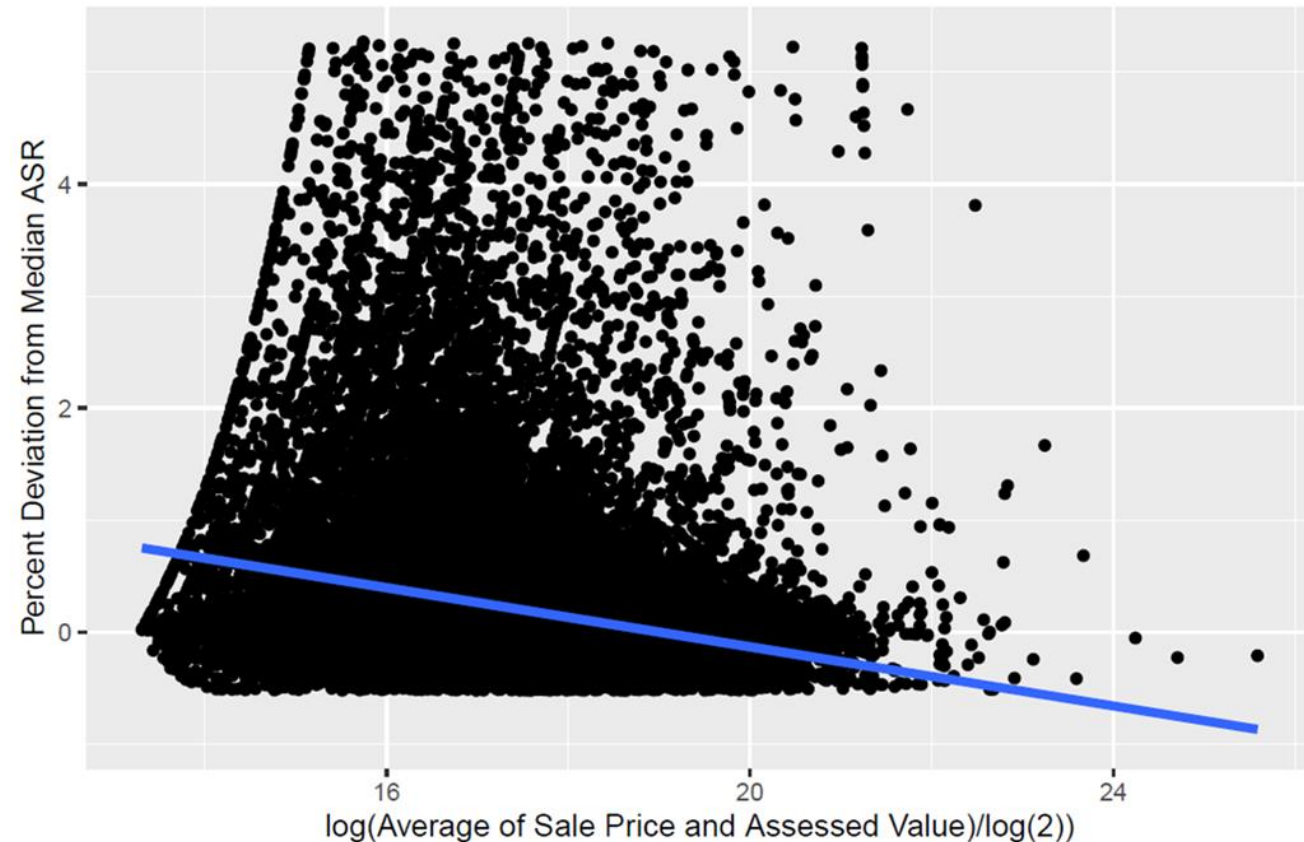
Spearman's Rank-Order Correlation

"While not specifically discussed in the section of the Standard on vertical equity, the Spearman Rank test is mentioned in the Test of Hypotheses section of the Standard. Specifically, Spearman's Rank is recommended for evaluating whether low and high prices properties are appraised at equal percentages of market value i.e., whether vertical equity exists.

The Spearman's Rank measures the strength and direction of association between two ranked variables. Ranks are determined for each property in the analysis, one rank for sale price, the other for assessment to sale ratio (ASR). A correlation analysis of the two ranks is performed, with the resulting statistic referred to as Spearman's rho. A Spearman's rho of close to 0 demonstrates a low correlation between ASR and sales price and suggests vertical equity is present. A statistical test (t-test) is also performed to determine if the correlation is statistically significant. The distribution of a Spearman's rank is also plotted to provide a visual representation of the analysis.

While the Spearman analysis can provide useful information on the relationship between ASR and sales, its limitation is that it is a simple correlation that lacks other important information on the distribution. **A Spearman's Rho of -0.408** suggests a **high correlation of the ASR and sales ranking**, which is confirmed in the plot of these data. The asymptotic T-statistic approximation suggests **this correlation is statistically significant** at a **0.001 confidence level.** As such, the Spearman test indicates **regressivity**."

Spearman's Rank-Order Correlation

Spearman's Rho Ranges

Spearman's Rho Coefficient	Interpretation	Acceptable Range
-1.0 to -0.9	Very Strong Regressive Correlation	No
-0.89 to -.70	Strong Regressive Correlation	No
-0.69 to -0.40	Moderate Regressive Correlation	No
-0.39 to -0.20	Weak Regressive Correlation	Yes
-0.19 to 0.01	Very Weak Regressive Correlation	Yes
0	No Correlation	Yes
0.01 to 0.19	Very Weak Progressive Correlation	Yes
0.20 to 0.39	Weak Progressive Correlation	Yes
0.40 to 0.69	Moderate Progressive Correlation	No
0.70 to 0.89	Strong Progressive Correlation	No
0.90 to 1.0	Very Strong Progressive Correlation	No

Spearman's Rank-Order Correlation Plot
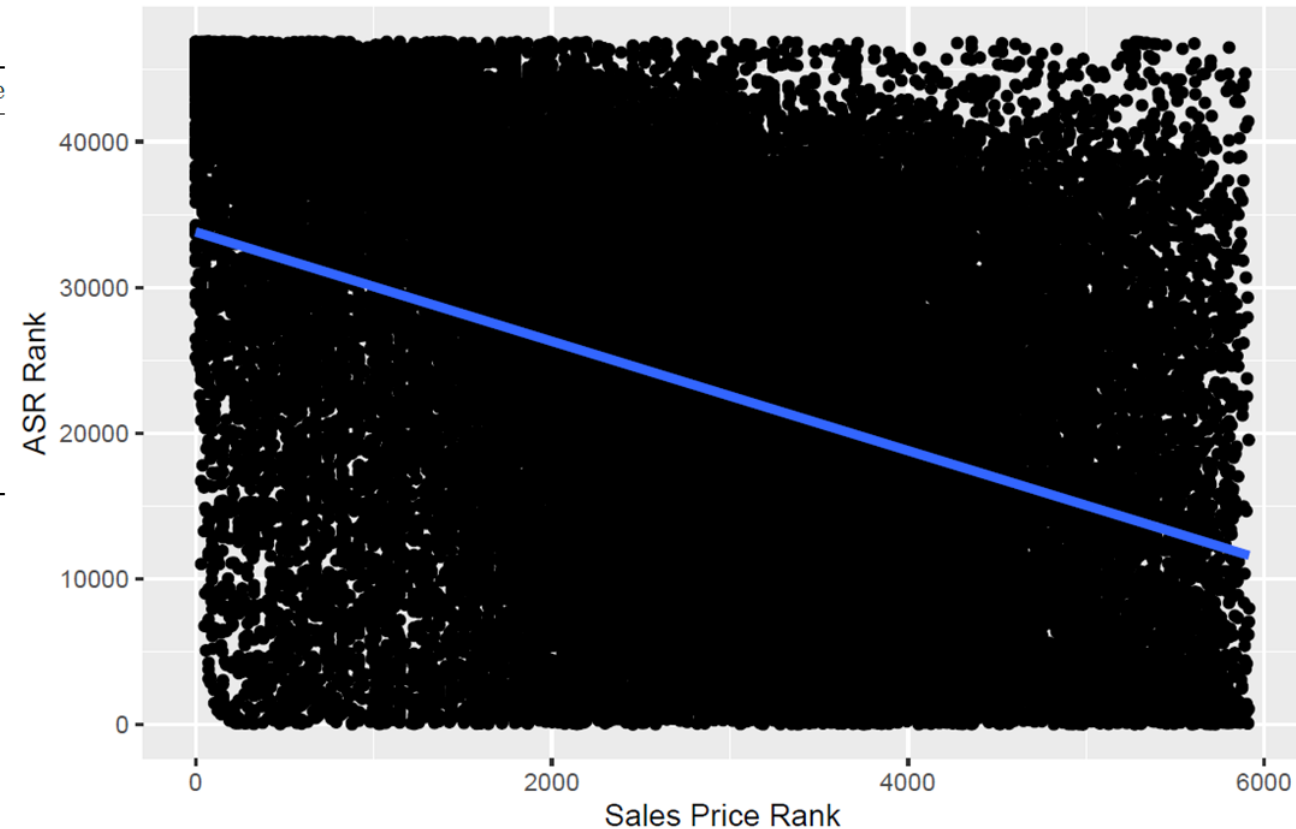
Gini Measures (Gini)

"While the use of Gini measures as a method for measuring inequity has been common in economic analysis for decades, it has only recently been considered as a measure of vertical equity for assessments. More information on the use of Gini measures to measure vertical equity in assessments can be found in recent papers by Quintos (2020), and McMillen and Singh (2021).

Gini measures are like Spearman's rank in that they do not use sales ratios to determine equity and that both measures use a ranking of variables in their calculation. However, Ginis go beyond a simple measure of co-movement as is done in Spearman's Rank, quantifying how the distribution of assessments behave relative to the distribution of sales at given price levels. By capturing the cumulative distribution behavior of assessments and prices across ordered price levels, Gini measures provide more information on the vertical equity of the entire distribution. The Gini analysis provides two numerical measures that summarize the relationship of the sales and assessment distributions, the Kakwani index (KI) and the Modified Kakwani index (MKI). Assessments are considered regressive when KI is less than zero, or MKI is less than one. A progressive distribution occurs when KI is above zero, or MKI is above one."

Gini Measures (Gini)

"In addition to these indexes, the level of equity in assessments can also be visualized in a Gini analysis via a plot of the relationship between of the sales and assessments. If the lines move together, vertical equity is present. Where the line representing the assessments lies above the sales line, a regressive distribution is indicated. Where the assessment line is below the sales line, a progressive distribution is implied. Unlike the other vertical equity measures which provide a global measure of vertical equity for the entire distribution, the Gini plot provides an indicator of the measure of equity across the entire price distribution. This information can be used to better understand the performance of a valuation model across different segments of the price distribution, allowing for better diagnosis of potential vertical equity issues. The Gini analysis for this distribution provides **a KI of -0.058** and a **MKI of 0.869** indicating **regressivity** in the distribution. This finding is confirmed through the inspection of the lines representing assessments and sales produced by the Gini analysis.

Gini Measures (Gini)
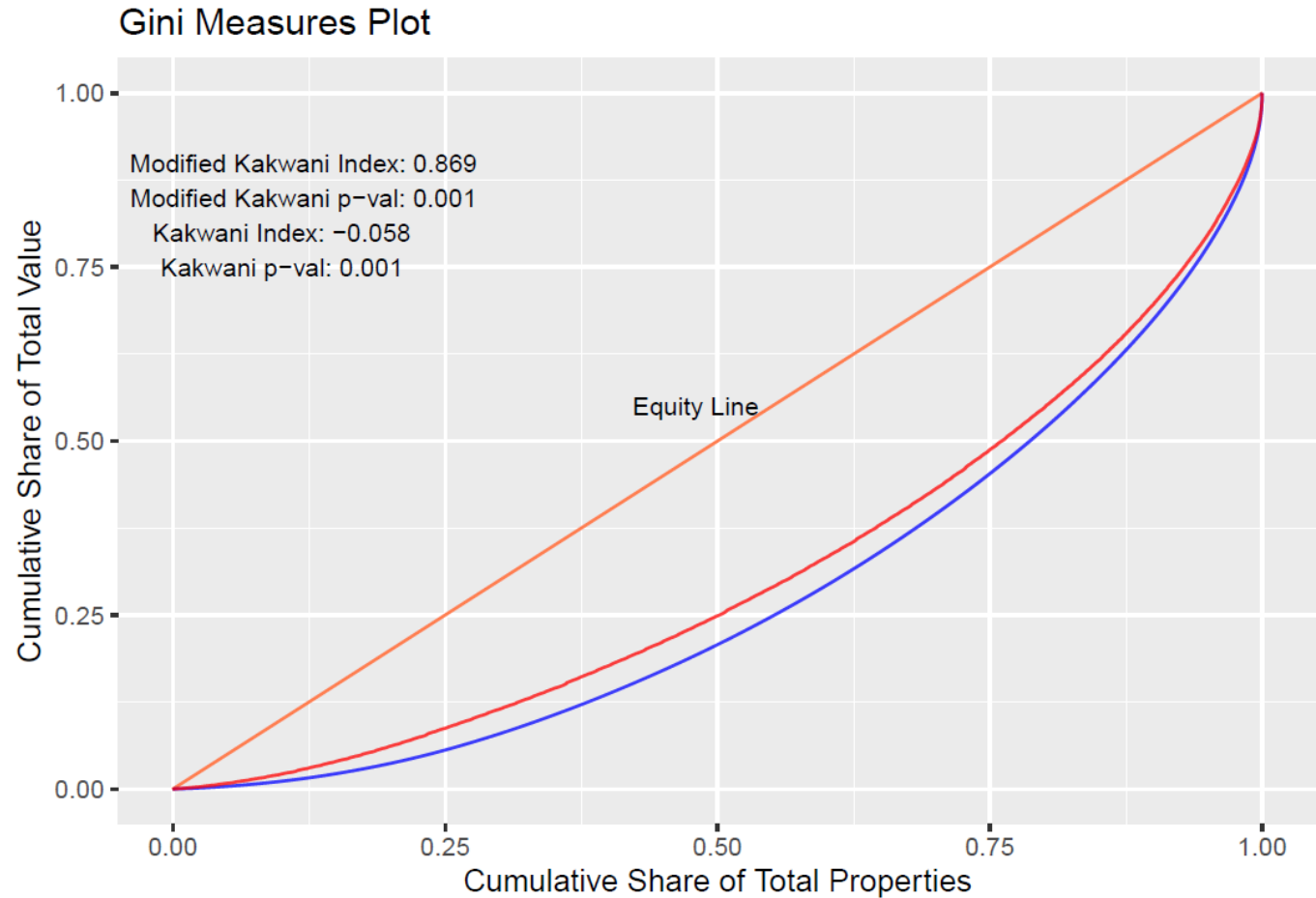
Summary

ASR – "The range between median ASR for the lowest priced decile (1.628) and highest (0.923) decile is 0.705... a **regressive trend**."

COD – "The COD of the properties provided is 36.805." (5.0 to 20.0) **Out of standard on horizontal equity**

PRD – "for the properties provided is 1.176, which is outside the acceptable range of .98 to 1.03 recommended by the IAAO and **indicates regressivity** is present.

PRB – "for the properties provided is -0.132, which is outside the IAAO recommended range of -0.05 – 0.05 and **indicates regressivity** is present."

Spearman's rho – "of -0.408 suggests a high correlation of the ASR and sales ranking, which is confirmed in the plot of these data. The asymptotic T-statistic approximation suggests this correlation is statistically significant at a 0.001 confidence level. As such, the Spearman test **indicates regressivity**."

Gini measures – "for this distribution provides a KI of -0.058 and a MKI of 0.869 **indicating regressivity** in the distribution."

Fiscal Year 2022 appears to have issues with both Horizontal and Vertical Equity.

Possible Solutions

- The Ratio Study should be front and center in decision making on how we perform assessments in Vermont,

- Five or six assessment districts (~65,500 to 54,600 parcels),
  - The Law of Large Numbers,

- The ratio studies are created by the district using CAMA variables and audited by PVR,

- Market Adjustment (Time) on Sales Prices,
  - Captures movement within the market,

- Assessed values to be determined annually,
  - Relying on the Sales Comparison Approach over the Cost Approach,
  - Using experienced personnel over the use of AI tools,

- Test for vertical and horizontal equity Statewide with independent audits,

- Implement a continuous improvement program, and

- Implement the solutions made by the IAAO Consulting Service in Pub. RP-1348.

Any Questions?

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