

VEROVALUE

AUTOMATED VALUATION MODELS: Federal Agency Quality Control Standards Compliance Guide



Our Contact :

866.458.3767
communications@veros.com
www.veros.com

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Introduction

Veros Real Estate Solutions (Veros®) is pleased to offer VeroVALUE® Automated Valuation Model (AVM) due diligence content to the real estate and mortgage industry. Ensuring compliance with federal guidance is of utmost importance. This guide provides Veros' responses to common questions regarding the June 2024 federal agencies' quality control standards rules.

Lenders and investors must recognize that compliance involves not only the information provided by Veros and other AVMs but also how lenders evaluate and integrate this information. To achieve full compliance, lenders and investors have a duty to consumers and internal risk stakeholders to validate AVM performance data and all related claims. This can be accomplished by comparing due diligence data with internal production experience, using appropriate sample sizes and geographic distributions relevant to the user's lending footprint.

Quality Control Standards Overview

On June 20, 2024, the Office of the Comptroller of the Currency (OCC), Treasury, Board of Governors of the Federal Reserve System (Board), Federal Deposit Insurance Corporation (FDIC), National Credit Union Administration (NCUA), Consumer Financial Protection Bureau (CFPB), and Federal Housing Finance Agency (FHFA) collectively adopted a final rule to implement the quality control standards mandated by the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act). This rule pertains to the use of automated valuation models (AVMs) by mortgage originators and secondary market issuers to determine the collateral worth of a mortgage secured by a consumer's principal dwelling.

These requirements aim to ensure that institutions maintain quality control standards to:

- 1) ensure a high level of confidence in the estimates produced by AVMs;
- 2) protect against the manipulation of data;
- 3) avoid conflicts of interest;
- 4) require random sample testing/review; and
- 5) comply with all applicable nondiscrimination laws.

Read the final rule on the OCC website:

<https://www.occ.treas.gov/news-issuances/news-releases/2024/nr-occ-2024-66.html>

(Consumer Financial Protection Bureau: 12 CFR Part 1026 [Docket No. CFPB- 2023-0025], RIN 3170-AA57 and Federal Housing Finance Agency: 12 CFR Part 1222, RIN 2590-AA62)

How VeroVALUE Complies with Rules

High Level of Confidence in AVM Estimates

Lenders and investors must have measures in place to ensure a high level of confidence in the value estimates generated by Automated Valuation Models (AVMs). This involves validating the accuracy and consistency of the valuation models used.

With more than twenty years of extensive testing, Veros' VeroVALUE AVM approaches and assumptions have proven highly accurate. VeroVALUE has consistently provided quantifiably accurate valuations year after year. Veros has always encouraged open and transparent industry testing. VeroVALUE consistently provides industry-leading performance.

Veros focuses on, but is not limited to, the following VeroVALUE performance metrics:

- **Hit Rate** - % of returned properties as compared to submitted properties.
- **P10 / Accuracy within +/-10%** - The percent of total observations in which an AVM rendered a value within +/-10% of the benchmark value (alternately, an "error" that is within +/-10%).
- **Median Absolute Error** – Taking the median of all errors without regard to sign (i.e., a 5% error is treated the same as a -5% error). This is a more accurate indication of the central tendency of errors as it is less sensitive to a few large outliers.
- **Mean Absolute Error** – Taking the mean of all errors without regard to sign (i.e., a 5% error is treated the same as a -5% error). This is more sensitive to the presence of large outliers.
- **Forecast Standard Deviation (FSD)** – This statistical measurement represents the probability that the value falls within a statistical range of the actual market value.
- **Over/Under Valuations** – Represents the percentage of total observations in which an AVM rendered a value over or under a benchmark value. For example, P25H might be the percentage of valuations that over-valued the property by more than +25%.

VeroVALUE is tested extensively on a continuous basis in three significant ways:

- Veros' Internal Due Diligence Platform
- Customer Testing
- Third-Party Testing

First, Veros' Internal Due Diligence Platform conducts periodic tests at a daily, weekly, monthly, and quarterly cadence. Key performance metrics are tracked and analyzed for any sign of change in the performance of the models. When new property Sales (purchase) transactions are received from Veros' data providers, before uploading it to the Veros' databases, VeroVALUE is run to return a value for that property. This ensures that the AVM models are truly "blind" to the recent sales data. The error measured is then strictly due to the AVM models' accuracy. This allows Veros to assess markets where performance is

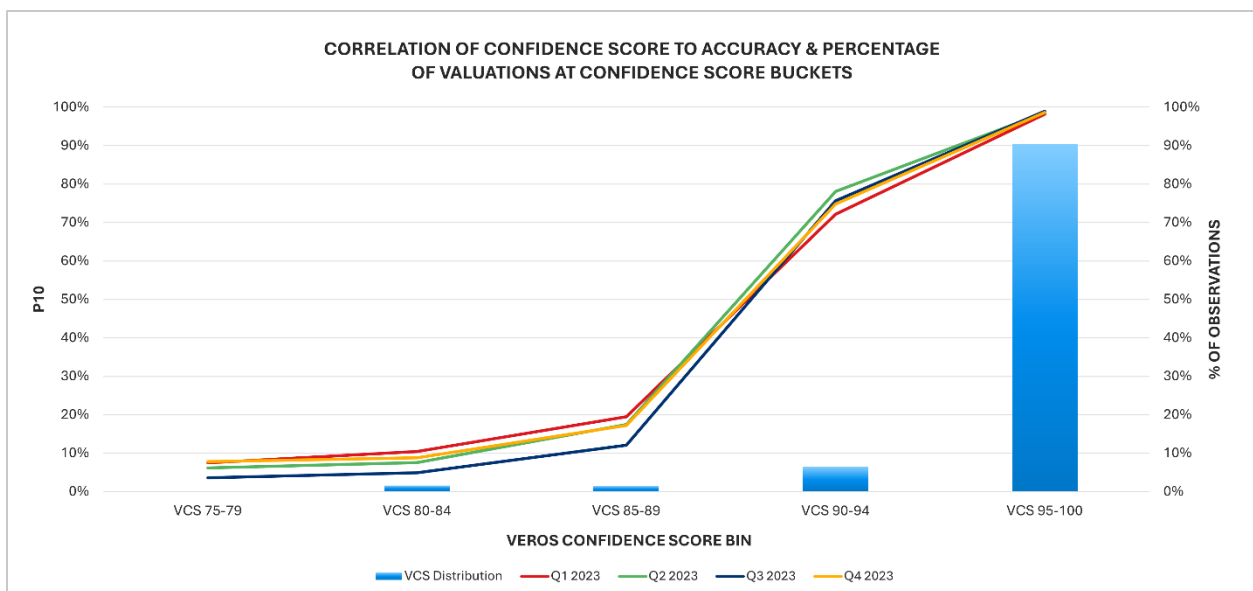
degrading over time, where data is not as current as it should be, where models need to be enhanced, where errors in data could be present, etc.

Second, Verovalue is tested extensively on a weekly, monthly or quarterly basis with customers that are major lenders, banks and other housing finance stakeholders. Testing includes both Sales (purchase) and Refinance (appraisal) transactions. Millions of properties are tested throughout the year at a national and local level to assess how Verovalue performs with respect to the previously mentioned key performance metrics. The Verovalue testing performance is tracked, shared, and discussed with Veros by the testing entity throughout the year depending on testing frequency.

Finally, Verovalue is tested extensively weekly, monthly or quarterly by three separate and independent third-party test organizations. These organizations continually test AVMs for their clients, usually mid-sized and smaller lenders. Testing includes both Sales (purchase) and Refinance (appraisal) transactions. Millions of properties are tested throughout the year at a national level. The Verovalue testing performance is tracked, shared, and discussed with Veros by the testing entity.

In addition to the ongoing and thorough AVM testing, Verovalue users can also examine the Veros Confidence Score (VCS) provided with each Verovalue AVM. The VCS is based on a numeric score of 1 to 100 (the higher, the better). It is proven to be highly correlated to the accuracy of the estimate of value. The VCS is specifically designed to indicate the subject property’s valuation accuracy. It is essentially a statistically based indicator of error or dispersion.

Valuations with higher confidence scores indicate high accuracy. For example, looking at the chart below, the majority of the valuations (about 90% of them) have a VCS of 95-100. The corresponding P10 (percentage with errors less than +/-10%) for these valuations exceeds 95%. Most values returned by Verovalue are at the highest confidence levels (VCS of 95 and above), meaning Verovalue delivers the highest percentage of highly accurate values. As levels of VCS go down, the average value of P10 declines by design.



Veros proudly reports that the VeroVALUE VCSs are consistent across property types, price ranges, and geographic footprints. Consistent delivery of an accurate VCS allows users to appropriately route and base decisions on valuations. In other words, a VCS of 95 should have the same meaning, whether it was delivered for a \$250,000 property in Washington or a \$650,000 property in Virginia.

Protection Against Data Manipulation

Lenders and investors are required to establish safeguards to prevent data manipulation that could compromise the integrity of valuation outcomes. This includes implementing controls to detect and mitigate any attempts at data tampering.

At Veros, physical access to the company's production data center is controlled and administered by independent production systems support, release management, and data center security staff. Only specific Veros employees are authorized to modify access privileges, and only via the established process. Logical access to the Veros production data center is controlled by network segmentation strategies at the router/switch level, and ID/password access control protocols are regularly maintained.

Data received from business partners and vendors must pass a series of quality control and verification measures before it is loaded into the production environment. The ingestion process involves staging the consumed data and repeating the quality control and verification measures originally performed to ensure no loss of content or integrity. Validation of the results occurs under dual control. Veros also has a robust Business Continuity Plan and Disaster Response Plan with multiple Tier III data centers for maximum protection of the database(s) that fuel VeroVALUE and Veros' other analytic tools and services.

Internally, Veros conducts cross-functional training to ensure multiple members of the Veros analytics team can perform essential VeroVALUE model-related functions and ensure continuity. Process guides are highly confidential and are not disclosed to entities outside the organization.

In addition, a VeroVALUE conclusion or contributory data cannot be altered or abridged by any third party. VeroVALUE does not facilitate operator interaction by lenders or investors.

Avoidance of Conflicts of Interest

Federal regulations require lenders and investors to establish mechanisms that identify and mitigate potential conflicts of interest in the valuation process. This is essential for maintaining objectivity and impartiality in property valuations.

There is a distinction between professional-grade AVMs and consumer-grade AVMs. Consumer-grade AVMs are not used for risk decisions and thus may allow for more user interaction. In contrast, professional-grade AVMs, like VeroVALUE, undergo rigorous testing over time and across millions of properties. The only input these AVMs accept is the property address—no user, borrower, or lender information is included. They rely solely on data, models, and AVM output.

At Veros, the output of VeroVALUE cannot be influenced by the third-party user. Veros advocates for ongoing, transparent testing with AVM users to ensure that the models perform as expected and to help optimize them using user benchmarks.

When data errors from the data provider are identified, Veros works directly with the data providers to research and correct the inaccuracies. Only after the data is fully corrected can the data be integrated into the Veros database.

Random Sample Testing/Review

To ensure the effectiveness and accuracy of AVMs, lenders and investors are obligated to conduct periodic random sample testing and reviews. This practice helps validate the performance of AVMs across a diverse range of properties and scenarios.

Related to VeroVALUE, Veros performs three types of testing as mentioned previously in this guide: (1) Veros Internal Due Diligence (2) customer testing and (3) third-party testing. VeroVALUE's performance is continually validated through ongoing external tests conducted weekly, monthly, and quarterly from all three types of testing. These test results detail the AVM's performance, and in all cases, the external due diligence shows the VeroVALUE model to be one of the most accurate AVM models.

Veros also performs weekly data updates of sales, validates data, and executes testing to ensure that the data and the models work together correctly. This is done before adding the sales to the Veros databases so that the models are blind to these data. Numerous internal staff members participate in the testing procedures.

Veros has an Internal Due Diligence Platform that it uses to determine if there is a significant change to multiple accuracy measurements over time. Veros' platform is set up so that prior to uploading new data to Veros' database, Veros treats the properties in the file as a test sample that the models have not yet seen. Thus, the errors are true "blind errors," meaning the models have not yet seen the recent property sales price. Variables that Veros tracks include (but are not limited to):

- Median Absolute Error
- Mean Absolute Error
- Forecast Standard Deviation
- Percentage of Errors within +/-5%
- Percentage of Errors within +/-10%
- Percentage of Errors within +/-15%
- Percentage of Errors greater than +15%
- Percentage of Errors less than -15%
- Percent of Errors greater than +25%
- Percent of Errors less than -25%
- Hit Rate

For each of these metrics, Veros can drill down to the State, County, or Zip code level. Veros routinely monitors these metrics at the County level. In addition, Veros tracks these values over time (weekly) to quickly determine if there is a shift from historical norms (or alternatively, a gradual drift up or down). This tells Veros which counties require specific focus.

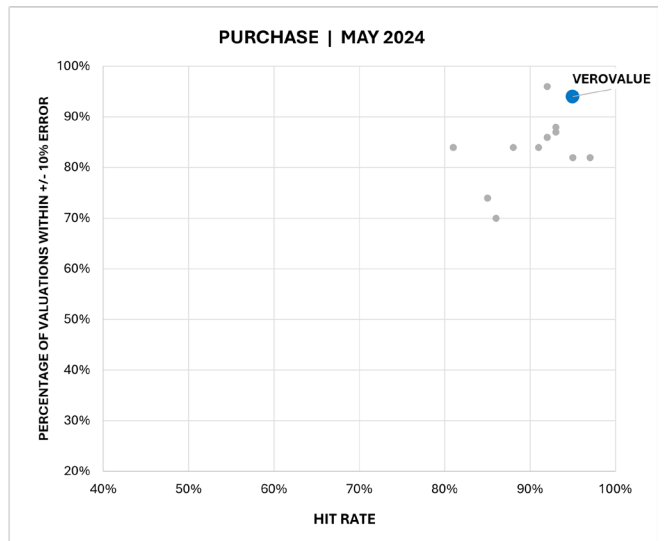
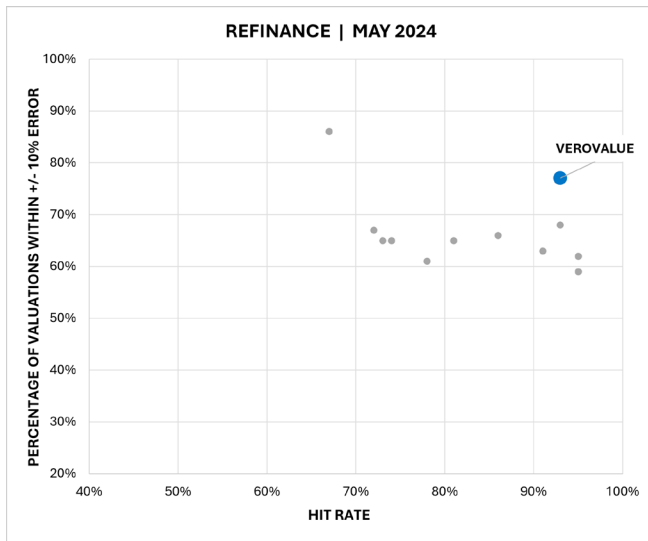
VeroVALUE is also tested by third party testers and large lenders using purchase (sales) and non-purchase transactions such as refinance transactions. A sample test from a large lender shows how Veros' AVMs,

VeroVALUE performs for both Purchase and Refinance transactions. As can be seen, Veros AVM models are clear market leaders for both Purchase and Refinance transactions. In the following Large Lender blind AVM test, the difference in AVM performance is seen.

Below are recent blind testing results from a large lender showing how the VeroVALUE performs for both purchase and refinance transactions on a national basis.

CHART 1: EXTERNAL DUE DILIGENCE: LARGE LENDER BLIND AVM PERFORMANCE

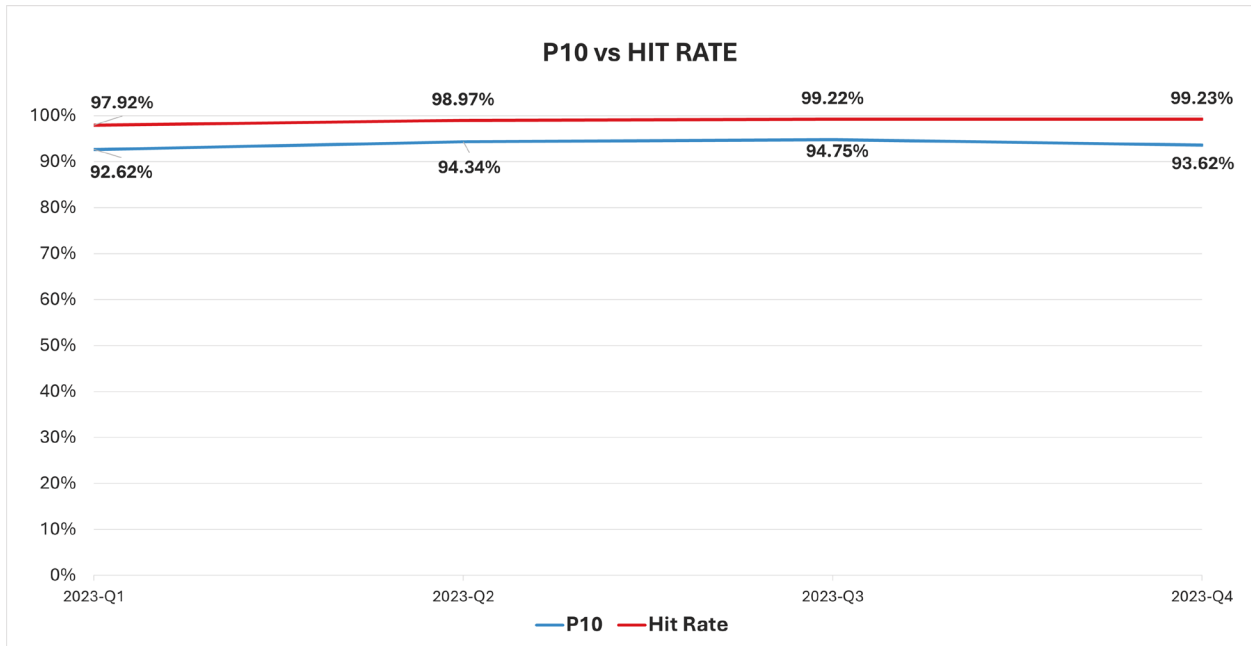
Hit Rate vs. Accuracy within 10% (P10) / Time Period: May 2024 / National



The graph below shows the P10 and Hit Rate from Q1 2023 - Q4 2023 at the national level. Results for hit rate and P10 are consistent across all time periods.

CHART 2: INTERNAL DUE DILIGENCE – VEROVALUE PERFORMANCE: SALES TRANSACTIONS

Time Period: Q1 2023 – Q4 2023 – State: ALL – County: ALL
 Hit Rate, Percentage of Valuations within +/- 10% Error (P10)

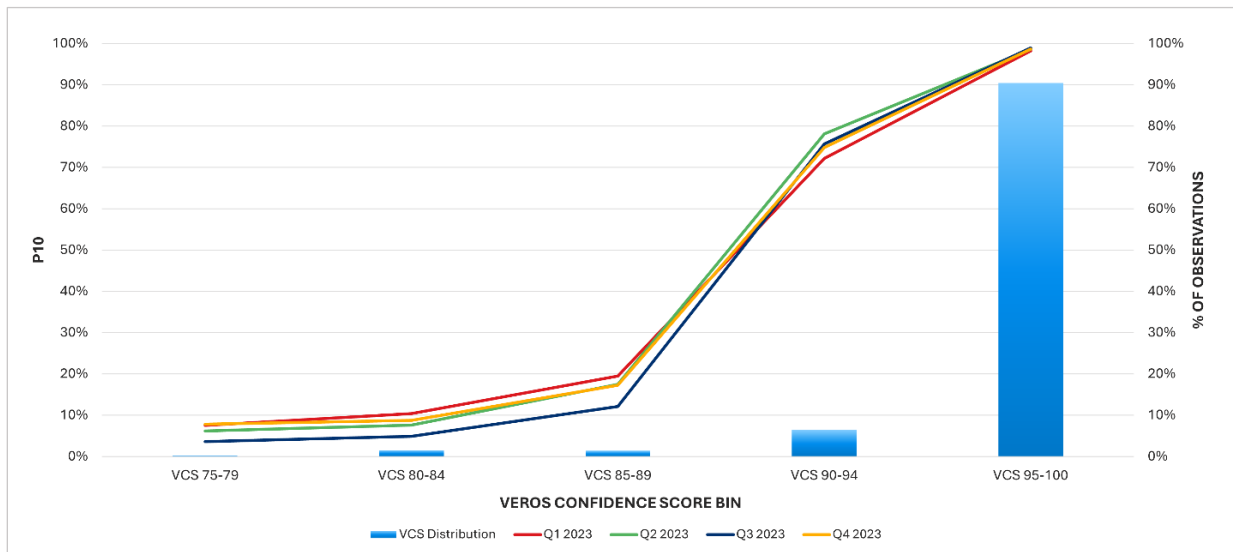


Below is a representation of the correlation between VCS and the percentage of valuations with a percent error of +/- 10% (P10) for Q1 2023- Q4 2023. This indicates that as VCS increases, the accuracy of the AVM increases as well. Notice the high volume of Verovalue valuations in the highest confidence levels (VCS of 95 and above), meaning Verovalue delivers the highest percentage of highly accurate values.

CHART 3: INTERNAL DUE DILIGENCE – VEROVALUE PERFORMANCE: SALES TRANSACTIONS

Time Period: Q1 2023 – Q4 2023 – State: ALL – County: ALL

Correlation of Confidence Score to Accuracy & Percentage of Valuations at Confidence Score Buckets



Comply with Applicable Nondiscrimination Laws

The inputs to Veros’ AVM, Verovalue, do not contain any reference to demographics such as race, gender, ethnicity, or socioeconomic status of any party involved in the real estate transaction or any protected class data as identified by the Equal Employment Opportunity Commission and the Fair Housing Act. Verovalue uses only factual data about the subject property, its physical characteristics, and its sales history. This is also true for all the comparable sales used to arrive at the valuation conclusion. If the input data has no identification with protected classes of citizens, then it is impossible for the model to create discriminatory valuation conclusions based on data that it has zero access to.

Verovalue has been tested for fairness/disparate impact. The test was conducted by Veros’ in-house economists, as detailed in the “AVM Performance Report – Is There Evidence of Racial Bias?” The testing was conducted in 2022, based on AVM estimates from December 2021. The economics team investigated the correlations of P15L (proportion of properties undervalued by 15% or more by the AVM in comparison to the sale price) and P15H (proportion of properties overvalued by 15% or more by the AVM in comparison to the

sale price) with the racial composition of ZIP codes in 5 cities across the US (Chicago, Atlanta, Houston, Los Angeles, and Philadelphia). Additionally, the Median Absolute Error (MAE) was also analyzed to determine if VeroVALUE is less accurate on average in minority ZIP codes.

The testing results show that P15L does not have a significant positive correlation (at a 95% confidence level) with the proportion of Black and Hispanic populations in a ZIP code. Hence, P15L does not increase as the proportion of Black or Hispanic populations increases. Similarly, P15H, the proportion of properties that are overvalued by 15% or more, is not positively correlated (at a 95% confidence level) with the percentage of the White population. Therefore, P15H does not increase as the proportion of the White population increases. Hence, the VeroVALUE does not exhibit any systemic undervaluation as minority populations (Black or Hispanic) increase and, similarly, does not exhibit overvaluation as the White population increases. Also, the variation in MAE is not significantly explained by the racial compositions of communities; that is, the VeroVALUE is no less accurate in minority communities. In summary, Veros found no evidence of racial bias in the VeroVALUE.

VeroVALUE was also tested by Veros' economists to determine if it was inadvertently influenced by the inclusion of data steeped in historical biases stemming from historical redlining practices in the report "2024 Study Update: Does Historical Redlining Influence Today's AVM Estimates?" This study was conducted across six metropolitan areas – Austin, TX; Birmingham, AL; Boston, MA; Chicago, IL; Los Angeles, CA; and was based on Q3 2023 data.

The study utilized a hedonic modeling approach that considered only the physical attributes of homes. Additionally, a location factor was included to distinguish between properties in historically redlined and non-redlined neighborhoods. After controlling for physical attributes of homes such as lot size, living area, the number of bedrooms and bathrooms, the presence of a fireplace, the number of stories, and the age of the property, the VeroVALUE returned comparable estimates for properties on either side of the redline. The location variable did not emerge as a statistically significant variable in any of the models. The results concluded that historical redlining did not impact current home valuations provided by VeroVALUE.

To access Veros' latest AVM research reports on Bias and Historical Redlining, visit the following:

"2022 Updated Report: AVM Performance Report - Is There Evidence of Racial Bias?"

<https://www.veros.com/solutions/automated-valuation-solutions/is-there-evidence-of-racial-bias-in-home-valuation-data-of-avms>

"2024 Study Update: Does Historical Redlining Influence Today's AVM Estimates?"

<https://www.veros.com/solutions/automated-valuation-solutions/does-historical-redlining-influence-todays-avm-estimates>

Contact Information

For Additional Information, Contact:



SALES MANAGEMENT

communications@veros.com

(866) 458-3767, option 2



CUSTOMER SUPPORT

support@veros.com

(866) 458-3767, option 3

CORPORATE HQ

2333 N Broadway #350, Santa Ana, CA 92706 | www.veros.com

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