VeroVALUE

DATA, MODELING & METHODOLOGY

THE RIGHT PERSPECTIVE CHANGES EVERYTHING

VEROVALUE™ WHITE PAPER
JANUARY 2020

Veros™

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TABLE OF CONTENT

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VEROVALUE™ INTRODUCTION

Originally brought to market in 2001, Veros™ developed a strong reputation for model quality, unsurpassed hit rates in key areas of the U.S. as well as reliable, transparent value estimates and confidence scores that correlate with valuation accuracy. VeroVALUE was considered to be one of the industry's first "second generation AVMs," combining sophisticated predictive modeling techniques and technology with quality data and industry expertise to create valuations with unrivaled reliability and remains at the forefront of the industry to this day.

VeroVALUE and the related models in the VeroVALUE suite were developed and are maintained by Veros' in-house team of modelers, statisticians, economists and industry experts. The VeroVALUE suite provides national coverage with exceptional hit rates and high accuracy, which is regularly tested both through Veros' rigorous internal testing approach as well as through multiple, independent third-parties.

The core methodology responsible for the models' strength has remained at the center of Veros' AVM approach for a number of years. All models are continuously updated with refinements implemented as often as weekly. Veros refers to this as the "Care and Feeding" of our models and is an ongoing approach necessary to maintain and continually improve each model's performance relative to its industry peers. Presently, Veros is focused on testing protocols aimed at improving performance in key U.S. counties.

THE VEROVALUE SUITE OF PRODUCTS

The suite of Veros' automated valuation model (AVM) products includes a number of analytic tools and supporting solutions. Each product is available via a web-based individual order platform, XML integration (both direct to client or via integrations with various industry partners), portfolio or "batch" ordering, or through Veros' proprietary valuation management software systems.

Each AVM report in the VeroVALUE suite returns pertinent data including, but not limited to the following: value estimate, value range, confidence score, available subject property information, market data information and historical price trends for the subject's neighborhood.

VEROVALUE AVM

The VeroVALUE AVM combines multiple predictive technologies with proven real estate fundamentals to provide extremely accurate property values with meaningful confidence scores and high, usable hit rates. VeroVALUE also features supplemental analytics designed to provide deeper insight into collateral such as price trend information and fitness scoring.

Veros' VeroVALUE AVMs will now include property-specific information in regions that have been declared disaster areas as a value-added service and at no additional charge. Using satellite imaging and data analytics, the new data set simply adds the information within the VeroVALUE AVM report on a per property basis. Property-specific monitoring data is available for most disasters and includes hurricanes, earthquakes, wildfires, volcanoes, tornadoes, floods, storm surges and tsunamis.

VEROVALUE REO

VeroVALUE REO is the most accurate default AVM available in the market today. The product was designed to help address challenges brought about by record numbers of distressed assets, rapidly increasing foreclosure rates, and ever-expanding REO portfolios. Applying the most objective analytics and integrating detailed distressed property valuations and reporting functions equips lenders, servicers, and investors with the accurate information needed to successfully manage these troubled loans.

VEROVALUE PORTFOLIO

VeroVALUE Portfolio is ideal for mortgage servicers, investors or others who need frequent access to current estimates of value on a broad spectrum of properties. VeroVALUE Portfolio utilizes Veros' industry leading residential property valuation tool, VeroVALUE, for fast, accurate, and realistic results, even in rapidly changing markets.

For VeroVALUE Portfolio reviews, disaster data is available on a "match and append" basis. Disaster data is appended and can be used to determine whether or not a specific property is located in or near the disaster area. Because this data is geocentric, it is much more granular and specific than county-level disaster information.

VEROVALUE PREFERRED

VeroVALUE Preferred applies strict standards on the AVM's approach to hit rates, market activity, and neighborhood analysis. The VeroVALUE Preferred AVM is a weighted balance between valuation accuracy and hit rate with a focus on accuracy. This is an excellent valuation tool for national use where accuracy is paramount over hit rates. VeroVALUE Preferred is commonly used in the first position in a multiple AVM cascade approach. VeroVALUE Preferred delivers the industry's top-performing AVM results.

VEROINDEX™ PLUS

Among the methods used in VeroVALUE's blended model methodology is indexing. VeroINDEX Plus applies the already extremely accurate, in-house index that Veros utilizes within VeroVALUE AVM to provide time-based residential property valuations. Derived from advanced analysis of local and regional market trends, hit rates increase to virtually 100%.

VEROPACE™

VeroPACE simplifies the multiple AVM requirement for PACE lenders.

A solution for lenders specializing in PACE (Property Assessed Clean Energy) loans in the state of California, VeroPACE provides PACE lenders with a turnkey solution for valuing properties for PACE loans.

Available through Veros' proprietary VeroSELECT platform, VeroPACE generates a "cascade," through which up to 10 AVMs may be run in order to obtain the requisite three AVMs, significantly increasing the likelihood of getting a hit. VeroPACE then analyzes, ranks and reports the results of the three Automated Valuation Models (AVMs) and calculates the midpoint of the high-low value range for the AVM with the highest confidence score, as required by California State Assembly Bill 1284 and companion State Senate Bill 242. The resulting information is delivered in an easy-to-read, single page format.

In those instances when three AVMs aren't available, PACE lenders also have the ability to request and receive evaluations and full appraisals through the VeroSELECT platform, providing a complete valuation solution for PACE lending.

VEROSELECT™

VeroSELECT offers Accuracy and flexibility beyond AVM Cascade Management Technology.

The VeroSELECT system is a web-based ordering and management platform that provides instant, centralized access to a full suite of innovative property valuation solutions that includes more than 25 offerings from a growing list of more than 15 top valuation providers.

Whatever the scenario, VeroSELECT gives you the perfect product for immediate insight into your local markets with the industry's most accurate AVM models, including Veros' top-performing flagship AVM VeroVALUE, Evaluation and Appraisal services, Broker Price Opinions (BPOs), and Property Condition Reports (PCRs).

With a VeroSELECT integration, all desired products are immediately available. Services are billed on a per-use basis with no ongoing fees or subscription requirements.

VEROPRECISION™

VeroPRECISION is the next-gen alternative to cure the industry of the common cascade. Veros introduces the first property-specific valuation decision logic technology designed to deliver true valuation accuracy. Through suitability decisioning and data-driven automation, VeroPRECISION utilizes sophisticated data analysis to deliver the most accurate automated valuation from the industry's top-performing AVM providers—Veros® and Collateral Analytics®.

DATA SOURCES

Veros' database is sourced and populated from multiple third-party aggregators and other publicly available data sources. Veros receives raw data updates, including property sales, from third-party data providers each week. Recorder data, including recent sales dates and sales prices, and real-estate owned (REO) data, specifically, history of foreclosure data, are also part of the continual data feed supporting Veros' models.

Veros also receives raw data updates from county assessors which contain property characteristic and new construction information as it becomes available. Since each county assessor makes this available at different times of the calendar year, this is an ongoing process, but is typically no less than once per calendar year. This data includes tax assessment information, property characteristic update information and new construction characteristic information.

In addition to the above sources, VeroVALUE is fueled by MLS data (including listing prices and property characteristics); the proprietary home price indexes Veros builds and maintains; and multiple third-party indices, including products from the National Association of Realtors® (NAR) and OFHEO/FHFA.

QUALITY CONTROL

Data from all sources undergoes a proprietary and rigorous raw data import and verification process (RDIV) that, among other tasks, analyzes, address verifies, cleans, matches, and resolves conflicts in the various data sources prior to loading in the Veros proprietary development and production database systems that are used to fuel the AVM engine. The RDIV system itself undergoes continuous development and enhancement. As a result, for optimal performance and in addition to customary handling procedures, Veros also undertakes full database reloads at least twice per annum.

Veros data managers continuously review the data provided by all data sources to ensure it complies with license agreements (e.g. receiving what is expected). The data Veros licenses in each county are also periodically validated with checks for completeness, currency, and accuracy. In the event of any discrepancy, the data engineers work with the data provider to immediately resolve any potential issues.

Further, Veros ensures data quality, accuracy, and integrity continually as part of its own data integration process. Veros performs substantial data analysis, cleaning, scrubbing, and matching prior to the data being incorporated into the proprietary database that fuels the valuation engines. There is no blind or unchecked insertion of data into the valuation engine at any time. The data import and verification process are included as part of every AVM update (twice each month), in addition to smaller test databases that are run each morning.

Veros approaches each property valuation with over twenty different proprietary valuation methods.

VEROVALUE'S METHODOLOGY

Each product within the VeroVALUE suite is truly a "blended model" drawing upon a combination of hedonic, index, and various hybrid valuation methodologies. Each valuation method is backed by any number of predictive technologies including Neural Network, Linear and Non-Linear Regression, Econometric and Statistical Non- Regression-Based Time Trend, Data Mining, Statistical Discrete and Statistical Fuzzy Clustering, Probabilistic, Bayesian, and Optimization approaches. Utilizing multiple, and intentionally different proprietary valuation methods on any given subject property, Veros consistently produces one of the most accurate and reliable valuations on the market.

The blending approach recognizes that no one or two methods alone will ever be able to consistently produce accurate valuations. For example, a vendor who relies primarily on linear regression methods would be heavily dependent on complete and accurate information on all variables in their models such as square footage, number of bedrooms, year built, etc. In the event data was lacking for a particular property or geographic region, the linear regression method would either perform poorly or be rendered unusable. Further, if the linear regression method was only one of two approaches, the entire valuation would be dependent solely on a single remaining valuation method. This is a very risky approach. By recognizing that this situation is likely to occur in any imperfect database(s), Veros approaches each property valuation with numerous, distinctly different methods. In more optimal (data-rich) situations, the system would obtain numerous valuations in tight agreement with one another indicating an extremely accurate prediction. However, even in a relatively data-poor scenario, the AVM would obtain valuations from enough of the methodologies to still produce a highly accurate valuation.

It is important to note that Veros' multiple valuation methods are all very different classes of methodologies. To simply have multiple neural network methodologies, for example, and then claim to have different valuation methods would be misleading. In such an example, there is really only one methodology, and the different neural networks would produce valuations that are highly correlated. For example, if one tended to drastically overvalue a property, they would all be likely to overvalue it. Veros' strategy is to use extensive expertise in these multiple predictive technologies to solve the valuation problem by attacking it from completely different approaches.

Before a property is processed through Veros' highly blended modeling approach, every address is processed through Veros' proprietary address standardization system, which will result in a one-to-one match for valid U.S. addresses. The goal is to ensure invalid addresses are not valued while maximizing the overall accuracy and total number of valuations produced. This address standardization system is the same system used by Fannie Mae and Freddie Mac within the Uniform Collateral Data Portal® (UCDP®) as well as by the Federal Housing Administration (FHA) within the Electronic Appraisal Delivery (EAD) portal.

Veros' testing policy is designed to ensure open communication and transfer of transparent and accurate information between all parties involved in the testing process.

TESTING PROTOCOLS

Veros performs two types of internal testing on semi-monthly and monthly schedules. On a semi-monthly basis, Veros performs data updates of sales and assessment records. Veros continually ensures data quality, accuracy, and integrity as part of the data integration process. This data is received, scrubbed, matched, validated, and tested to ensure it is accurate and that all models are functioning properly. On a monthly basis, Veros tests against extremely large data sets with known benchmark values to validate the models and to gauge the accuracy of the output.

Additionally, outside of internal testing and due diligence processes, Veros encourages frequent, "transparent" customer testing with ongoing dialog between the end-user and the individual AVM companies. Veros sincerely wants current and potential direct customers, as well as those who may access Veros' services through third-party providers, to become familiar with the accuracy of Veros' products in a real-world testing environment. Veros believes that understanding critical factors such as gross hit rate, effective hit rate, confidence score correlation, valuation accuracy, model consistency, and other analytics are essential to making critical decisions related to the use and allocation of various automated collateral valuation and risk tools.

Veros' testing policy is designed to ensure open communication and transfer of transparent and accurate information between all parties involved in the testing process. Performance testing not only provides an obvious benefit to end-users, but also benefits vendors/developers with valuable insights to customer needs and model performance. By understanding how the products are perceived to be strong or weak, Veros is able to further enhance the value of its products for its users.

Since its creation, the VCS has correlated to error and now has a proven correlation to FSD

CONFIDENCE SCORING & FORECASTED STANDARD DEVIATION

The Veros Confidence Score℠ (VCS℠) is specifically designed to be an indicator of the subject's valuation accuracy and is based on a numeric score of 1 to 100 (the higher the better). It's important to recognize that the vast majority of the VeroVALUEs are generated with VCS of greater than 90. Meaning, we are not only returning values but very accurate values! The VCS has proven to be highly correlated to the accuracy of the estimate of value. Each major confidence range in the system (i.e. group of 10) generally corresponds to a 5% variance. Thus, values with confidence scores of 90-100 generally correspond with +/- 5% of variance and values with confidence scores of 80-89 generally correspond with +/- 10% variance, and so on.

Veros has an internal confidence score cut-off of 78. Anything below that score will not be returned. In addition to the Veros threshold, the client has the ability to create their own thresholds at any level they choose. Veros takes seriously the importance of not returning values that would be misleading or harmful to the end users.

VeroVALUE's Forecasted Standard Deviation (FSD) is derived from an analysis of the standard deviation of AVM errors in the internal and external evaluations of millions of properties. Veros interprets its FSD to be an indicator of the expected standard deviation for the property in question.

The Veros FSD is tested against the VCS. Since its creation, the VCS has correlated to error and now has a proven correlation to FSD. For example, in a group of properties with a 97-99 VCS, Veros finds that the standard deviation is on average 0.06. This correlation continues to very low confidence scores (and large FSDs).

Veros has developed an in-house due diligence platform that performs daily tests on the FSD values generated. Larger scale weekly and monthly tests are also conducted on this platform and results are considered for future updates to the VeroVALUE AVM.

PRODUCT MODIFICATION APPROACH

Major model structural changes are rare as Veros makes gradual and controlled changes to optimize its models on a routine basis.

In 2011, as part of a renewed focus on property valuation analytics excellence, considerable resources were devoted to a controlled series of model enhancements. Although there have been significant changes to the overall AVM process, many of the underlying methods have not changed, but will continue to be evaluated over time.

The most significant change that took place at this time was Veros' approach to data and model classification. Classification has been extensively used in areas such as bankruptcy prediction, credit scoring, and quality control. Veros' approach to classification is in-line with quality control principles where the goal of the classification engine is to identify properties and valuation patterns associated with a high probability of excessive valuation error. This post-processing classification engine relies on property specific attributes and valuations generated by Veros' different mathematical approaches. County-specific patterns are identified, and all future valuations are processed through the classification quality control module.

The underlying philosophy behind adding the quality control classification engine is to improve overall error distribution by removing properties from the extreme ends of the spectrum or "tails". Net result: superior valuation accuracy with fewer outliers.

Outside of the VeroVALUE production environment, Veros continually tests new modeling techniques and methods to optimize existing valuation approaches as well as approaches around the handling of the data which feeds the various models. Additionally, Veros is heavily engaged in various testing protocols aimed at enhancing the models' accuracy in key counties. Numerous internal staff members are involved in the semi-monthly and monthly testing procedures.

EXCLUDED PROPERTY / ADDRESS TYPES

The following property types and addresses are not valued through VeroVALUE at this time:

- Mobile Homes
- Manufactured Homes
- Cooperatives
- Commercial Properties
- Vacant Land
- Multi-Family Properties (Duplex, Triplex, Apartments, etc.)
- Post Office Boxes

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