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European Standards for Statistical Valuation Methods for Residential Properties

3rd Edition

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European Standards for Statistical Valuation Methods for Residential Properties

Adopted by the Standards Committee
of the European AVM Alliance

3rd Edition

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Preface

The European AVM Alliance (EAA) is a pan-European, non-for-profit organisation whose members are leading providers of Automated Valuation Models (AVMs) in Europe. The use of AVMs in financial markets is ever increasing, and so one of the EAA's main aims is to bring a consistent approach to automated Valuations for residential properties enabling the mortgage lending, investor, rating and regulatory communities to operate in a more transparent and effective way.

For this purpose, the EAA has published the European Standards for Statistical Valuation Methods for Residential Properties (ESSVM) and is very proud to hereby present their third edition, to become effective as of 1 March 2022.

While several standards for physical Valuations of residential properties by surveyors have been around for many years, the first ever standards for Statistical Valuation Methods were published by the EAA in September 2017, followed by the second, independently peer-reviewed edition of the ESSVM in August 2019.

Since then, the ESSVM have provided a coherent set of information and descriptions aimed at increasing the understanding of, as well as providing, transparency and clarity to on the wide array of existing Statistical Valuation Methods.

While the second edition of the ESSVM increased the focus on guiding users and regulators when assessing Accuracy, objectivity and reliability of Statistical Valuation Methods, and introduced minimum requirements for performance reports as an objective measure to judge the applicability of any Statistical Valuation Method for any given purpose, this new edition has expanded these aspects further, as well as adding further ones.

In particular the third edition intends to:

- provide clearer guidance as to the 'appropriateness' of a Statistical Valuation Method for specific purposes, by putting renewed emphasis on the qualitative differences between the key methods in terms of their respective degree of complexity, sophistication and the advancement of their mathematical and technical approaches, as these are directly linked to their Granularity and to their ability to provide Property-Specific Valuations

- bring the ESSVM in line with the latest EU legislative and supervisory provisions, such as the EBA guidelines on loan origination and monitoring (EBA/GL/2020/06), or the Covered Bond Directive (EU) 2019/2162, in order to provide clarity on the use of Statistical Valuation Methods in these contexts.

The standards, furthermore, are also intended to be used as a qualitative checklist as to what constitutes an AVM. Since the term 'AVM' is not legally protected, there are currently a plethora of applications and solutions in the marketplace that claim to be AVMs, but which after detailed scrutiny turn out not to be AVMs at all, and instead employ inferior mathematical and technical approaches.

Since many of these inferior applications and solutions provide deficient and unsatisfactory Valuation results, they potentially (and in many cases actually) tarnish the entire concept of an AVM and bring it into disrepute.

The EAA therefore holds the ESSVM and the criteria that characterise an AVM therein to be a benchmark against which any stakeholder using, providing or regulating AVMs – be they credit institutions, mortgage lenders, supervisory authorities, legislators, estate agents, property platforms or consumers – should measure the solution they encounter in the marketplace.

We hope that this third edition of the ESSVM – like its two predecessors – will once more provide guidance, stimulate discussions and be developed further. Feedback from all stakeholders, and regulatory bodies is very welcome and as before any emerging market needs will continue to be considered.

Stefano Magnolfi, EAA Chairman

Part I:
General Considerations and Principles

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1 | Introduction

1.1 | Objectives

These European Standards for Statistical Valuation Methods for Residential Properties are intended to provide a coherent set of information and descriptions aimed at increasing the understanding, transparency and clarity on the wide array of existing Statistical Valuation Methods. The document focusses on principles, definitions and minimum requirements for Statistical Valuation Methods [1] applicable across European jurisdictions.

In addition, these standards include guidance on the selection of the appropriate Statistical Valuation Methods, based on the capabilities of the methods themselves in relation to the actual context in and purposes for which they are intended to be used. The minimum requirements called for in this document should be adhered to by all providers of Statistical Valuation Methods to ensure the highest quality, transparency and objectivity.

The standards are also intended as a guidance for regulators and supervisory authorities to help relate regulatory and legislative provisions to the individual technical characteristics, qualities and capabilities of the various Statistical Valuation Methods. For this purpose, references to the relevant provisions have been included where appropriate.

It should also be noted that the Statistical Valuation Methods described in these standards aim to represent the main types of each of the methods. It is, however, recommended that the standards should also apply to variants of these main types, which may incorporate additional elements.

These standards are monitored, reviewed and will be updated regularly, based on stakeholder feedback and market needs.

1.2 | Scope

These standards provide guidelines for a range of Statistical Valuation Methods used to value residential properties across European jurisdictions. The document comprises an overview of the four central Statistical Valuation Methods, recommendations on quality control and quality assessment as well as best practice guidelines on the understanding and use of these methods.

Generally, Statistical Valuation Methods can be applied to both residential and commercial properties. The standards presented here, however, explicitly address residential properties only, while Statistical Valuation Methods for non-residential and commercial properties will be left for future consideration [2].

All Statistical Valuation Methods considered in these standards adopt a market approach. That is, known property values are used to estimate values of other properties. This is different from other forms of automated Valuations where property values are calculated based on land value, required labour, material and depreciation (i.e., the cost approach), or on the basis of rents, lease or other income that can be generated from the property (i.e., the income approach). The cost and the income approaches require fundamentally different information and Assumptions, and for this reason they are not included here.

These standards do also not consider Statistical Valuation Methods assisted by surveyors, since the intervention of a surveyor during the Valuation process, however small, would result in that Valuation not being purely statistical any longer.

These standards set the minimum requirements for Statistical Valuation Methods in Europe; national legislation and supervisory regimes may apply additional requirements to the standards.

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[1] Capitalised terms are defined within this document, either in the main text or in the Glossary which forms an integral part of the ESSVM.

[2] Standards for Statistical Valuation Methods should be consistent for residential and for non-residential and commercial properties. From a technical point of view, the reduced availability of data is the paramount constraint that is likely to limit the range of Statistical Valuation Methods available for non-residential and commercial properties. In general, demonstrations of Accuracy and suitability in the context of any regulatory framework should determine the application of Statistical Valuation Methods for non-residential properties.

2 | Key Definitions

2.1 | Types of Statistical Valuation Methods

All Statistical Valuation Methods for residential properties are mathematical tools used to estimate a property value (a Valuation) through deterministic computations. Different Statistical Valuation Methods vary from each other in the degree of their complexity, both from a mathematical as well as from a technical point of view. A Statistical Valuation Method comprises both the data necessary to initiate a Valuation (or a value update) as well as the mathematical routine.

There are four main types of Statistical Valuation Methods:

- House Price Index
- Single Parameter Valuation
- Hedonic Models (also called 'Hedonic AVMs')
- Comparables Based Automated Valuation Models (also called Comparables Based AVM or simply 'AVMs')

The techniques underlying these four Statistical Valuation Methods comprise a variety of different analytics approaches, such as linear and non-linear regressions, genetic algorithms, neural networks, random forest and fuzzy logic, among others.

With each type of Statistical Valuation Method considered, the underlying techniques used increase in their degree of complexity and sophistication, both from a mathematical as well as from a technical point of view. Single Parameter Valuations are provided as static numbers for a collection of properties in a given area. House Price Indices are series of value changes that are applied to a Previous Value using simple multiplications. The final two Statistical Valuation Methods are characterised by deploying actual Valuation Models. Hedonic Models typically describe property value as a function of the attributes of both the property itself and of its location, a Comparables Based AVM consists of highly sophisticated automated processes and mathematical formulae requiring the deployment of complex bespoke technology and includes elements of a Comparables Based Valuation approach, similar to the approach of Surveyor Valuations. Comparables Based AVMs are thus the only Statistical Valuation Method that fulfils the criteria of Advanced Statistical Models set by the European Banking Authority (EBA) [3].

A schematic overview for the differentiation of Valuation Methods and Valuation Models is displayed in Figure 1. For a broader overview of the valuation spectrum comprising greater detail on non-statistical Valuations too, see Figure 2 in the Appendix.

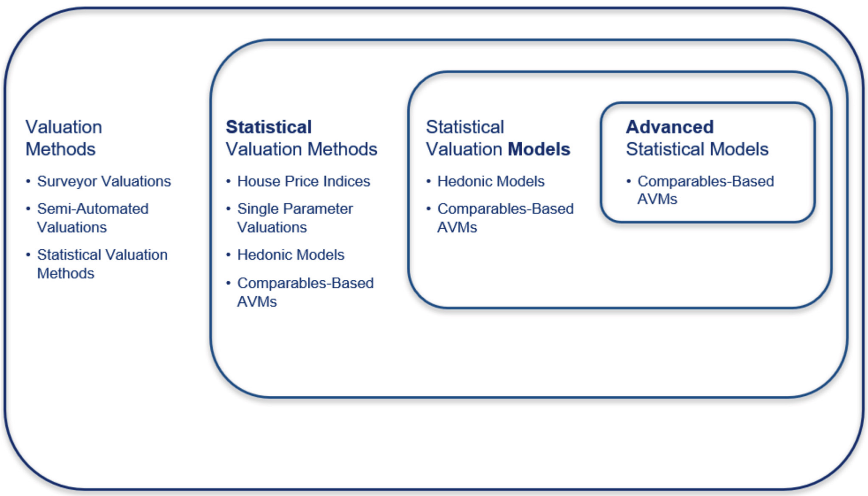

Figure 1: Schematic overview to differentiate Valuation Methods and Valuation Models.

[3] EBA Guidelines on loan origination and monitoring of 29 May 2020 (EBA/GL/2020/06), p. 58f.

Statistical Valuation Methods are designed to calculate values of high Accuracy. Statistical Valuation Methods are entirely objective in the sense that the values are calculated on the basis of measurable characteristics of the property and its location. For this reason, Statistical Valuation Methods are very well suited to be executed in an automated rather than a manual way.

2.2 | Market Value

For the purpose of these standards the Basis of Value of Statistical Valuation Methods is to estimate the Market Value (sometimes also referred to as »Open Market Value«). Depending on the specific purpose of a Valuation, EU legislation provides several definitions of the term Market Value.

In the Valuation of real estate as collateral for a lending institution, Market Value is defined as:

> *'market value' means for the purpose of immovable property, the estimated amount for which the property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion* [4].

For VAT purposes Market Value is defined as:

> *'open market value' shall mean the full amount that, in order to obtain the goods or services in question at that time, a customer at the same marketing stage at which the supply of goods or services takes place, would have to pay, under conditions of fair competition, to a supplier at arm's length within the territory of the Member State in which the supply is subject to tax* [5].

If statistical Valuation Methods are employed to estimate other Bases of Value, for instance market rent or investment value, it must be clearly stated what Basis of Value a Statistical Valuation Method is set up to produce. If the definition of Market Value deviates from that of the EU legislation above, this must be clearly stated also.

2.3 | Intended Use

Statistical Valuation Methods can calculate Market Values of specific residential properties or monitor the price development of residential property markets generally. However, not all Statistical Valuation Methods are ideally suited for both purposes: some methods may be inappropriate when a Property-Specific Valuation is required (e.g., Single Parameter Valuation and Hedonic Models), some may not be able provide a Value for a property without having a Previous Value (e.g., House Price Indices), while others may estimate or update the value of a property without immediate reference to the entire market (e.g., Hedonic Models and Comparables Based AVMs).

The Accuracy of the results of a Statistical Valuation Method depends on a number of factors, including the quality and detail of available data and the sophistication of the modelling techniques used. The choice of the appropriate method should carefully consider the required level of Accuracy. The higher the required level of Accuracy the more advanced the Statistical Valuation Method deployed should be.

Comparables Based AVMs are able to produce valuations with high Accuracy and to also provide a predictive measure of the Accuracy to each AVM result. Furthermore, Comparables Based AVMs are also used effectively as a tool by credit institutions both to critically review Valuations they receive at the point of origination, as well as to assess the performance of Surveyors and the Accuracy of Surveyor Valuations as intended by the EBA [6].

[4] Article 4 (76), Regulation (EU) No. 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms (CRR). Since these standards are specifically European in scope and focus on statistical valuation methods for residential property, the definition of market value in the CRR which is a central piece of European legislation and explicitly refers to immovable property is used as the reference point. An equally widely recognised and valid definition is provided by the International Valuation Standards (IVS), which differs to the CRR definition by being wider in in scope, referring more generally to »asset and liability« rather than merely »property«.

[5] Article 72, Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax.

[6] see Art. 214 and 233, EBA/GL/2020/06

2.4 | Assumptions

There are certain Assumptions – about facts and conditions underlying the subject of or the approach to a Valuation – that do not need to be individually verified at each Valuation and which the Valuer is not required to prove to be true. This applies to all Valuers, no matter if they are a surveyor or a provider of a Statistical Valuation Method.

Similarly, providers of Statistical Valuation Methods shall state the Assumptions that apply to each method. Assumptions specific to each Statistical Valuation Method but independent of a specific provider of Statistical Valuation Methods are expanded on further in the specific considerations in Part II of these standards.

In general, Statistical Valuation Methods need access to and are based on data collected previously and independently from the individual Valuation that is carried out. This previously held data may be subject to various degrees of structuring and validation and as a result it may or may not lead to the creation of a Property Database, from which the provider of the Statistical Valuation Method in question may extract information like Previous Values, Comparables, hedonic coefficients etc.

Quite separate from this historic dataset, all Statistical Valuation Methods also require Data Inputs identifying (and possibly describing) any Subject Properties to be valued when using the solution. The historic dataset or Property Database may not necessarily comprise the Subject Properties themselves. Instead, the Property Characteristics of the Subject Property may be taken from external sources such as building plans, Surveyor Valuations, inspections etc.

The quality and detail of the Data Input naturally influences the Accuracy of the result. High quality data, however, does not necessarily warrant results with high Accuracy. Accuracy depends first and foremost on the Statistical Valuation Method and on its sophistication. Only extensive and objective testing can reveal the Accuracy of each Statistical Valuation Method.

Market Values can be estimated using Statistical Valuation Methods both for existing (i.e., 'real') as well as merely hypothetical properties or properties that have ceased to exist. It is assumed that the Property Characteristics submitted as input to the Statistical Valuation Method to value a specific property reflect the condition and circumstances for which the Valuation is needed.

Statistical Valuation Methods assume that values of Residential Properties can be estimated with sufficient Accuracy for a given purpose using deterministic computations. The complexity, sophistication and advancement of a Statistical Valuation Method and the amount and detail of data available set the upper limit of its possible Accuracy. Statistical Valuation Methods that consider Property-Specific Variables are deemed more advanced and are typically able to produce results with higher degrees of Accuracy. If data significant for a given Statistical Valuation Method is missing, or if data has shown to be inconsistent or unreliable, the Statistical Valuation Method should either not be used for that Valuation or, alternatively, information on reduced expected Accuracy should be produced.

2.5 | Mass Appraisals and Portfolio Valuations

The practice of valuing multiple properties as of a given date by a systematic and uniform application of Valuation methods and techniques that allow for statistical review and analysis of results is called 'Mass Valuation'. While this term is typically used in taxation contexts, in the context of financial services such as capital modelling, provisioning, whole loan trading (in particular NPL or ABS) or surveyor management, the Valuation of multiple properties is typically called 'Portfolio Valuation'.

2.6 | Property-Specific Valuations

Property-Specific Valuations comprise Valuations that are performed for specific properties taking into account their individual characteristics, including their precise location, i.e., address or geocoordinates. Specificity of property location and Property Characteristics is achieved if a statistical model takes into consideration the individual characteristics of each Subject Property, instead of an aggregate over a larger set of properties.

Statistical Valuation Methods which are able to provide Property-Specific Valuations are deemed to be Advanced Statistical Models [7]. This advancement of a Statistical Valuation Method is linked to Granularity: A low degree of Granularity of

[7] see Section 7.4, EBA/GL/2020/06

location, e.g., with an entire municipality or postcode area as the smallest geographic unit, allows no differentiation of individual properties. Likewise, when placing properties together into large categories such as ranges of size or years of construction, no finer differentiation is possible.

The information necessary to identify the precise location of a property may depend on the jurisdiction where that property is located. For instance, in some jurisdictions a property can be identified as accurately as the house number using only the postcode, whereas in other jurisdictions postcodes span multiple house-numbers, larger extensions over city quarters and sometimes even municipalities.

Single Parameter Valuations and House Price Indices cannot provide Property-Specific Valuations, due to their low degree of Granularity.

Whether or not a Valuation is Property-Specific not only depends on the Input Data but also on the way these data are used by the Statistical Valuation Method. Hedonic Models may accept individual Property Characteristics but they typically only exploit aggregated data (e.g., parameters for an entire postcode area and not for individual addresses). Such a Valuation is not Property-Specific.

Comparables Based AVMs operate with a degree of Granularity to consider Property-Specific characteristics, including the precise location: Values are calculated from a bespoke set of Comparables individually selected for each given Subject Property. Such a Valuation is Property-Specific. Comparables Based AVM are thus the only Statistical Valuation Method to provide Property-Specific Valuations.

2.7 | Granularity

Granularity refers to the size of categories that are considered by a Statistical Valuation Method. Granularity applies to location attributes as well as to categories of Property Characteristics.

In the case of location attributes, Granularity can be as precise as to be Property-Specific (i.e., a specific single-family house or a specific flat in an apartment block). The degree of Granularity with regard to location decreases as more and more of these specific properties are aggregated. For instance a postcode area aggregates over multiple addresses (and thus a potentially much larger class of properties) and therefore has a lower degree of Granularity with regard to location than the individual address level; it is Location-Specific as opposed to Property-Specific.

Granularity with regard to Property Characteristics is likewise a measure of the degree of detail at which Property Characteristics are captured. This can be Property-Specific, or it can apply to a grouping according to certain attributes: For instance, the attribute 'year of construction' is sometimes grouped into categories reflecting different architectural or historic periods, or into categories such as 'newly built' vs. 'existing property'. This poses the additional challenge that attributes do not remain fixed over time. Aggregations are possible both for numeric attributes (e.g., year of built, living space, plot size etc.) as well as for categorical attributes (e.g., the grouping together of terraced, semi-detached and detached houses as 'houses').

Granularity is linked to the Accuracy of a Statistical Valuation Method in the following way: With all things being equal, a lower degree of Granularity results into lower Accuracy than a greater degree of Granularity.

Among Statistical Valuation Methods Comparables Based AVMs possess the highest degree of Granularity and Accuracy, which are among the key criteria set by the EBA for Advanced Statistical Models.

2.8 | Glossary of Terms and Definitions

A detailed Glossary of Terms and Definitions frequently used in these standards and the context of Statistical Valuation Methods more generally can be found in the Appendix to this document; the Glossary is continuously updated and also available online on the website of the European AVM Alliance (www.europeanavmalliance.org).

3 | Operational Aspects

3.1 | Access

Statistical Valuation Methods must be developed and calibrated before they can be applied to yield reliable results. User access can be granted through computer software via web interfaces, system-to-system connections, local installation etc. Less complex Statistical Valuation Methods (e.g., House Price Indices) are sometimes provided as static tables. Providers may also choose not to grant direct access to Statistical Valuation Methods, but to offer instead online or offline services where Valuations or value updates are executed on-demand.

3.2 | Development

The development and calibration of a Statistical Valuation Method requires mathematical skill and expertise, as well as the availability of relevant and sufficient market data. The necessary amount of market data, plus the quality and detail that is required depend on the method, which may call for a high degree of technical knowledge and computation hardware, as well as for sufficiently detailed data.

3.3 | Data Quality and Quantity

Statistical Valuation Methods must be devised, their Accuracy must be tested and the models may need calibration to increase Accuracy and reduce statistical noise.

Quantitative data used as a basis for Surveyor Valuations to calculate property values (in particular Transaction Prices) are also available to be used for Statistical Valuation Methods.

The Quantity of data available to a Statistical Valuation Method strongly determines the potential Accuracy and the Coverage that can be achieved. Data should be sufficient to calculate reliable results and where possible details on the Comparable Evidence should be provided.

Data preparation should entail thorough validation of the data. The extent and level of complexity of the validation procedure depends on the kind, origin and detail of the data. Statistical validation and cleansing routines should be used alongside screenings of samples to cross-check and improve the data quality.

3.4 | Updates

Statistical Valuation Methods require regular updates; these must be carried out at least quarterly so that the Valuation methods can respond promptly to any market developments.

3.5 | Quality Assurance

The development of Statistical Valuation Methods, of data preparation, of quality assurance, of update routines and of technical security should be documented and the established processes should be adhered to. Measures must be in place to ensure correct functionality.

3.6 | Providers

A provider of Statistical Valuation Methods is a legal entity offering Statistical Valuation Methods to customers. Statistical Valuation Methods can be provided offline through software or data packages, or online through web interfaces. Providers are expected to adhere to the standards included in this document and should endeavour to always maintain the highest levels of quality, data security and integrity. Providers must aim to maximise Accuracy at all times and maintain reliability and objectivity of their Statistical Valuation Methods to the benefit of the consumer, the customer and a stable economy overall. In particular, if providers of Statistical Valuation Methods are Valuers, they must remain fully objective and maintain their independence of the Valuation Process to guarantee an unbiased Valuation. Furthermore, any fees charged must not be based on or directly linked to the estimated Value of the property produced by the Statistical Valuation Model.

3.7 | Objectivity

Providers of Statistical Valuation Methods should always endeavour to develop objective tools that are unbiased and whose Accuracy can be tested. There must under no circumstances be any fitting or manipulation of algorithms or of numerical values to deviate from the result which the Statistical Valuation Method produces. This comprises all influences that would cause values to be inflated, deflated, or fit for purpose other than calculating objective Market Values. Only objective scientific measurements must influence the development. All products that do not aim to calculate Market Values (see section 2.2) but values for special requirements or other purposes must unambiguously state the Basis of Value.

3.8 | Compliance

Providers should comply with European and national law both within their own jurisdiction and within the jurisdictions of which they hold data and/or for which they provide services. In addition, a member of permanent staff should be officially commissioned with data protection and compliance and should be available for contact.

3.9 | Open Doors Policy

Providers of Statistical Valuation Methods should adhere to an Open Doors Policy. Financial regulators, customers and rating agencies should have the possibility to audit services and to ask questions regarding the reliability and Accuracy of the services of Statistical Valuation Methods offered by a provider, as well as the provider's compliance with national and European law.

Providers should answer honestly and to the best of their knowledge. Information that is subject to the protection of personal data, to intellectual property rights, or that are crucial business information may not be shared with all parties or shared with reduced detail, or under a Non-Disclosure Agreement.

3.10 | Regulations

The use of Statistical Valuation Methods should comply with national legislation and, where applicable, with the legislative and regulatory framework of the European Union. Statistical Valuation Methods should therefore be regularly updated to comply with legislative provisions. When used for credit institutions and in IT-Systems, they should also comply with banking supervisory rules on IT security and outsourcing of services.

4 | Testing, Quality Assurance and Transparency

4.1 | Limitations and Scrutiny Procedures

The results of any Statistical Valuation Method are statistical in nature and are therefore produced subject to a certain degree of uncertainty or error. The frequency and extent of such errors must be thoroughly tested and regular and detailed reports must be produced, presenting the performance achieved in any such tests and expected from the real-life usage of the Statistical Valuation Method in question.

These tests may be conducted either by the provider or by the user of a Statistical Valuation Method, and in order to be meaningful they should fulfil a number of key requirements. First of all, they should be performed on sufficiently large data samples so as to properly address the statistical nature of the results being produced. Small data samples can be affected by stochastic fluctuations and thus misrepresent the true underlying performance of the solution.

4.2 | Test Samples

The samples of properties utilised for testing should be representative of the intended circumstances of usage of the tool. The Benchmark Values utilised in testing should be true representations of Market Values. Therefore, only Surveyor Valuations and Sales Prices in arm's length transactions should be used. For example, if the intended usage is for the periodic revaluation of a given property portfolio, a randomly selected sample from that very portfolio would be appropriate, not one selected manually, and perhaps focussing on properties with a different mix of geographic locations or property characteristics. The results must not be tested in circumstances more favourable than those to be expected in real-life usage.

4.3 | Scrutiny Procedures

Scrutiny procedures must deploy strictly out-of-sample and Blind Tests. These are closely controlled tests where the Statistical Valuation Method being tested has no access to the Benchmark Value against which it will be compared, neither as part of the inputs being provided, nor within the database that may be used to produce the result. This may require the careful removal of certain pieces of information by the valuation supplier before running the test or the removal of certain test cases altogether by the user after the test itself.

There are at least two main types of Blind Tests that can be deployed to thoroughly assess the performance of a Statistical Valuation Method: Lender Test and Bulk Test.

4.4 | Lender Test

Lender Tests are tests where the Subject Properties being tested are controlled by the user, typically a bank or mortgage lender, and their Benchmark Values are disclosed to the supplier of the Statistical Valuation Method only after the results have been delivered to the user. This aims to verify in a procedural manner that the exercise be truly a Blind Test, hence the typical requirement for the user to utilise only recent cases, whose Benchmark Values or any other indications of value (e.g., Asking Prices, Customer Estimates etc.) should not yet be available to the provider being tested. The main disadvantage of the Lender Tests is the resulting relatively small sample, as well as sometimes the reliability of the Benchmark Values.

4.5 | Bulk Tests

Bulk Tests are tests where the Subject Properties being tested and their Benchmark Values are extracted from the Property Database held by the provider. The latter still must ensure that these be strictly Blind Tests by not using the Benchmark Value for the purpose of computing the result, but the user has to take this on trust and is not in a position to verify the integrity of the procedure. This is the main disadvantage of Bulk Tests, their main advantage being the ability to source very large samples and conduct very specific analyses on cases with only the desired or relevant mix of attributes.

4.6 | Benchmark Values

Statistical Valuation Methods aim to calculate or update Market Values. In order to assess how well they are capable of doing so, it is therefore necessary to compare the Market Values produced by the Statistical Valuation Method to the corresponding 'true' Market Values of the properties being tested. These are referred to as Benchmark Values. A Benchmark Value consists of either a confirmed Sale Price or Surveyor Valuation, produced by a professionally qualified individual conducting a full internal inspection of the property. Surveyor Valuations are sometimes also referred to as Appraisals in American English.

The established market practice in different jurisdictions tends to determine whether Sale Prices or Surveyor Valuations are typically preferred as Benchmark Values in the testing of any Statistical Valuation Methods. Asking Prices or estimated values that do not qualify as Surveyor Valuations are not considered as valid Benchmark Values.

Benchmark Values themselves may not be entirely free from error or a margin of uncertainty; hence they may need to be treated accordingly when used for testing a Statistical Valuation Method. For example, errors in individual Benchmark Values can arise from transcription problems when extracting the test sample or from the inclusion of Sale Prices that were not established in a truly open market context, but were altered by special circumstances like a distressed sale or a non arm's length relationship between buyer and seller. On the other hand, a certain level of uncertainty, even for Benchmark Values free from errors, is due to the fact that Market Value itself is not an entirely precise concept. Even in ideal open market circumstances the actual price set by different buyers and/or different sellers for the exact same property at the exact same point in time may vary slightly and therefore slightly different valuation results are entirely legitimate.

5 | Measures of Performance

Performance is a generic term used to refer collectively to several aspects of the quality of a model's results. It comprises Coverage, Accuracy and the reliability of any Confidence Measures that may be produced as part of the output. The Performance of a Statistical Valuation Method can only be measured on large samples of cases and its assessment must bring these various aspects coherently together. The single aspect of Accuracy, for instance, cannot be viewed independently from Coverage, due to the fact that by changing sample or considering only parts of it, Accuracy itself may appear higher or lower.

5.1 | Coverage

Coverage refers to the ability of a Statistical Valuation Method to produce a result, regardless and before one enters into any consideration of the correctness of that result i.e., of its Accuracy.

Coverage can be high at the expense of Accuracy (see 5.2) and vice versa. An accurate valuation method is easy to attain, if it were only able to produce a result in very few cases, e.g., only for properties of a given kind in a given location; conversely, a method with high Coverage is equally easy to attain if Accuracy were of no concern, e.g., by assigning the same value to all properties. Because of that, the two aspects of Coverage and Accuracy cannot be considered in isolation from each other.

Coverage depends on all of the following:

1 | The quality of the data provided as input, which can vary greatly from one property sample to another and is therefore completely independent from the Performance of the Statistical Valuation Method itself.

2 | The Input Requirements of the Statistical Valuation Method and its ability to interpret and backfill incomplete and/or invalid data. This can in fact set one method apart from another and it is key to the meaningful assessment of Coverage. In practice, some methods may require an extensive – perhaps even unrealistic – amount of information to be provided as input, while others may function even based on a few key inputs that are nearly always available.

3 | The Hit Rate, defined as the ratio of cases producing a valuation divided by the number of cases that meet the Input Requirements of the Statistical Valuation Method, i.e., where a Valuation has been attempted. Even for certain cases that meet Input Requirements, it is possible that a given Statistical Valuation Method is unable to return a result, for example because of the lack of sufficient Comparable Evidence for those specific cases. Because Hit Rate only considers cases meeting Input Requirements, it can be quoted in general terms, regardless of a given property sample and its data quality.

5.2 | Accuracy

After a Statistical Valuation Method has produced a result, Accuracy refers to the closeness of that valuation to the respective Benchmark Value.

The Accuracy of Statistical Valuation Methods incorporates at least two distinct dimensions: Bias and Dispersion.

Bias, intended as any overall tendency to systematically overvalue or undervalue properties when compared to the Benchmark Value. This can be quantified by the average Error, although the median Error is typically preferred in order to minimise the effect of any spurious Benchmark Values and thus provide a better representation of the true Accuracy of the Statistical Valuation Method.

Dispersion, intended as the relative frequency of all different sizes of Errors. This typically displays the shape of a Bell curve with a tall narrow peak and thin tails if Dispersion is low or a low broad peak and thicker tails if Dispersion is high. It can be quantified by the Standard Deviation or the Average Absolute Error or the Percentages within 10%, 15%, 20% etc. of the Benchmark Value as described below.

The Error referred to here is the relative difference between the result of the Statistical Valuation Method and the corresponding Benchmark Value (BV), calculated for each individual Valuation as shown in Formula 1.

Formula 1: $$Error_{valuation} = \frac{result\text{-}BV}{BV}$$

Due to the mutual compensation between overvaluations and undervaluations when calculating the above, the Bias of a Statistical Valuation Method may be small even if few or no cases were actually valued accurately at all, i.e., with an acceptably small Error. For this reason, Dispersion must also be assessed. Dispersion captures the typical distance between the results of a Statistical Valuation Method and the corresponding Benchmark Values, regardless of the direction of the Error.

The most commonly quoted measures of Dispersion for a Statistical Valuation Method are the percentages of Valuations where the Error is within a given margin, e.g., 10%, 15%, 20%, from the Benchmark Value, as shown in Formula 2.

Formula 2: $$DispersionPct_{method} = \frac{\{|\,Error_{valuation}\,| \leq margin\}}{n_{valuations}}$$

The margins used should be set to a meaningful values, e.g., to no less than 10%, to accommodate the inherent uncertainty typically associated to the very concept of Market Value. This is also the reason why the most often quoted measure of Dispersion is the percentage of results with an Error within 20% of the Benchmark Value, because granting a 10% margin to both the result of the Statistical Valuation Method and to the Benchmark Value, the two may differ by up to 20% without necessarily leading to the conclusion that either of them must be inaccurate. Fair and objective like-for-like comparisons require the exact same measure of Dispersion when comparing the Accuracy of different Statistical Valuation Methods.

5.3 | Confidence Measures and their Reliability

Some Statistical Valuation Methods can provide an estimate of Accuracy for each individual value estimate they produce. This is provided as an additional output alongside the value estimate itself and it is usually given on a provider's proprietary scale. Unique or non-standard properties are harder to value than standard properties and this should therefore result in a valuation with low confidence.

A Confidence Measure must be predictive. For that to be the case it must be reliably translatable into a Forecast Standard Deviation. A reliable Confidence Measure can then be used to accept or reject individual results based on the usability requirements and risk management controls set by the user as Output Rules.

For any Confidence Measure provided with a Statistical Valuation Method, suitably detailed documentation must be available to define their meaning and interpretation. This should provide for example a clear mapping between the Confidence Measure in question and Forecast Standard Deviation.

5.4 | Overall Performance Considerations and Usability of the Results

User-defined Output Rules decide whether to accept or reject individual results. These are typically dependent on the Accuracy of a Statistical Valuation Method and on the reliability of its Confidence Measure. The overall acceptance of a result will therefore depend not just on the mere fact that it has been produced, as related to the quality of the Input Data, the Input Requirements, and the Hit Rate (see 5.1), but also on the extent to which its Accuracy and the reliability of its Confidence Measure may fulfil all Output Rules.

Performance indicators that take into account the fulfilment of Output Rules are Pass Rate and Success Rate.

Pass Rate is defined as the ratio of cases fulfilling all Output Rules divided by the number of cases producing a Valuation. Because Output Rules are considered, Pass Rate is typically related to Accuracy and to Confidence Measures.

Success Rate is defined as the ratio of cases producing a valid result divided by the total number of cases in the initial sample, including those whose data quality does not fulfil the Input Requirements. As data quality of the test sample also has an impact, Success Rate can only be meaningfully measured in the context of a given test sample. Similarly, as Output Rules also have an impact, it can only be measured with reference to a given user.

5.5 | Performance Reports

As explained in chapter 4, Bulk Test provide perhaps the most effective context to assess the Performance of a Statistical Valuation Method.

All aspects of performance measured from a Bulk Tests must be presented in Bulk Test Reports and available on request to any parties with a legitimate interest in reviewing them, such as users and regulators.

Bulk Test Reports should contain tables and figures, such as a histogram of the distribution of Error. Such a histogram should be sufficiently granular to be able to reveal sufficient detail on the Dispersion of Errors and potential Bias, which typically requires that histogram bins span no more than 5% ranges.

The key performance indicators should also be presented in tables broken down by any relevant categories, e.g., by property type, geographic area and price range. For each segment, such tables should display at a minimum the number of cases and the key indicators of Accuracy, i.e., the percentage of results within 10%, 15% and 20% of the Benchmark Value.

Part II:
Specific Considerations Applying to Each Statistical Valuation Method

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Statistical Valuation Methods differ in the amount and detail of data necessary for their development and the sophistication of the algorithms they deploy, which in turn determine their performance, especially in terms of Accuracy. They also differ with regard to their Input Requirements and therefore the operational effort required for using them.

This section provides information on the main types of Statistical Valuation Methods: House Price Indices, Single Parameter Valuations, Hedonic Models and Comparables Based AVMs. For an overview of the key features of Statistical Valuation Methods please see Figure 3 in the Appendix.

It should always be clear to the user what Statistical Valuation Method has been used. Any supporting evidence should help users of a Statistical Valuation Method to understand the result rather than misleading them.

6 | House Price Indices (HPIs)

■ In a nutshell

A House Price Index (HPI) is a Statistical Valuation Method that consists of a time series capturing the development of values of residential properties in a given geographic area (e.g., postcode, municipality, region etc.). HPIs may or may not consider other property characteristics as well. They can be used to update the value of a property based on a Previous Value. The result of a Valuation produced by applying an HPI is also referred to as an Indexed Valuation and it constitutes a mere update of the Previous Value provided as input, not the attainment of a new and independent Valuation.

■ Description

To obtain a time series, values are needed repeatedly for categories of properties in given areas at regular time intervals. The change of value over time is transformed into a percentage which constitutes the HPI. Based on the data they use and on the methodology deployed, HPIs can be grouped into several different types including Expert Opinions, Simple Aggregations, Basket of Goods Approach and Repeat Sales Indices.

Expert Opinions: Many HPIs are based on opinions on the development of the property market that are collected through surveys among experts.

Unfortunately, Expert Opinions are highly subjective and tend to focus on discrete figures rather than recognising small variations; they therefore suffer from a lack of reliability.

Simple Aggregation: In producing this kind of HPIs, the values of individual properties available for a given category, period of time and geographic area are aggregated. The aggregation can be attained through means, medians or other statistical measures and the relative changes over time of these aggregated values constitute the HPI.

Simple Aggregations are easy to carry out and require little effort. The disadvantage is that the results are strongly influenced by the volume and typology of cases available for each period of time. Because of that a change over time may or may not be observed simply because the quantity, quality and distribution of the properties have changed.

Basket of Goods Approach: In a Basket of Goods Approach the HPI is calculated from individual values of the same properties over time. That basket of goods is filled with properties that are valued for each period of time. The Valuation of properties can be carried out manually or using Statistical Valuation Methods. The relative change of value of these baskets of goods represents the HPI. The advantage of the Baskets of Goods Approach is that for each period of time the same properties are valued which reduces the problem of changing components known from Simple Aggregations. However, the quality of each Valuation still depends on the quality of Valuation of the properties in the basket of goods.

Properties in the basket of goods can be synthetic or real. Synthetic properties are realistic combinations of property characteristics but do not necessarily exist. Real properties are properties that do exist and are chosen to represent a geographic area and asset class for the purpose of calculating the House Price Index. Real properties in the basket of goods have the advantage that regional peculiarities can easily be taken into account. The advantage of synthetic properties is that they can be created any number of times for all areas differentiated by the HPI.

Repeat Sales Indices: A type of HPI that uses recorded Sale Prices of the same properties at two or more points in time. These indices have the benefit of removing any effects from spatial factors and different Property Characteristics. They also have the advantage to not include additional error from the Valuation of properties in a basket of goods. A disadvantage is that Repeat Sales Indices assume that the characteristics of the property remain unchanged, whereas renovations, extensions or wear and tear can alter the property and affect the Sale Price at subsequent points in time. As Repeat Sales Indices require very large volumes of Sale Price data for their production, they also entail a significant disadvantage in terms of data requirements and are not available in all jurisdictions.

Assumptions

Regardless of the type, every HPI assumes that all properties that fall within the category covered by it (e.g., single-family homes in a certain geographic area) would experience the same price developments. HPIs also assume that the recorded Previous Values and their dates are correct. In this regard HPIs are highly similar to Single Parameter Valuations, as they place great reliance on a single piece of information.

While HPIs are calculated for whole categories of properties, there may not always be sufficient data available for all geographic areas or all time periods, respectively. In these cases, it is common to revert to including neighbouring categories. While this may be the best option to compensate for insufficient data, the theoretically achievable Accuracy using an HPI will suffer from merged categories.

Intended uses

With HPIs an independent value cannot be calculated. HPIs allow to update a value from a given date or to value at a previous time if a current value is known. Because of that HPIs are mainly used to monitor portfolios and market trends, e.g., for capital requirement purposes.

While a Previous Value is needed to obtain an update of a property value, HPIs are also used by themselves. For instance, when monitoring market trends, the mere rate of change, i.e., percentage of market fluctuation, is looked at.

How to use

Applying HPIs to update values is easy and requires no or little technical support. An HPI for a given Property Type in a given location only requires a Previous Value and the corresponding date to calculate the value for a different date.

Documentation

When providing an HPI the type of HPI (e.g., Basket of Goods Approach, Repeat Sales Index), the source (e.g., listing sites, land registries) and the type of value (e.g., Surveyor Valuations, Sales Prices, Asking Prices), that have been used for the calculation should be stated. The documentation should also include a description on how the data were treated and what value is reported (e.g., average, median).

Reporting

Reports of HPI results should contain information on the origin of data (i.e., Expert Opinions, Transaction Data etc.), type of HPI (i.e., Simple Aggregation, Basket of Goods Approach, Repeat Sales) and the Granularity for which that value is returned.

Indexed Values should be reported alongside the date and amount of the Previous Value, the Effective Date of the Indexed Value and the parameters taken into consideration (e.g., property type, geographic area etc.). If categories were extended due to an insufficient quantity of data for a given segment, this should also be reported.

When used as is without updating a value, the report to an HPI should include the dates of the belonging period of time, the parameters taken into consideration (e.g., property type, region, period of time) and the type of HPI, unless made available through documentation. If categories were extended due to insufficient numbers of data for a given geographical region this should also be reported.

Accuracy Testing

Because HPIs do require a Previous Value to produce a result, testing HPIs is less straightforward than for those Statistical Valuation Methods that are able to produce a value regardless. HPIs can only be tested using properties for which more than one transaction and transaction dates have been recorded within the period of time covered by the HPI. In a so-called 'Match-Pair Analysis' the Benchmark Value is a later value that is compared to an Indexed Value created by applying the HPI to a Previous Value referring to the same property. Accuracy is then measured in the same way as described in section 5.2, e.g., with particular attention to Dispersion and Bias, even in Match-Pair Analyses.

Advantages [8]

When deployed for the purpose of Portfolio Valuations (and naturally subject to the restriction that a Previous Value be available for each property to be valued), HPIs typically offer some key advantages, including:

- First and foremost, they are often relatively cheap or even free. Given the large number of properties involved in many portfolio Valuations, coupled with the frequency of the exercise which might be as often as quarterly or even monthly, this is by far the key attraction of using HPIs. Even in those jurisdictions or for those providers where HPIs are not completely free, they are typically charged at a small cost and on a flat fee basis, not on a volume basis, making it still very economically attractive for users.

- Even regardless of cost, in some jurisdictions HPIs are – or have been for a long time – the only available tool that could realistically be deployed for valuing quickly and consistently the large number of properties typically involved in Portfolio Valuations, hence their popularity due to lack of alternatives. In this context, the use of HPI for regularly updating portfolio values is of course much preferable to not applying any updates at all.

- HPIs seemingly provide greater transparency than other Statistical Valuation Methods, e.g., in the eventuality that the resulting property values were subjected to scrutiny by a third party, because their usage entails a trivial multiplication between a previous property value and a factor (or percentage change) that can be disclosed in full. However, this apparent simplicity in the application of HPIs is accompanied by an often overlooked 'black box' approach in their production, i.e., on how the HPI factors themselves are actually produced (see Limitations).

Limitations

HPIs are not Property-Specific. The Assumption behind HPIs is that all properties of the same type (e.g., purpose-built flats, second hand single family houses etc.) in the same geographic area (e.g., a given postcode district, municipality, region etc.) change value over time at the same rate. The Accuracy of HPIs is therefore strongly limited.

HPIs come with no confidence information. That is, when applying an HPI to update a property value there is no information on the expected Accuracy of that update.

The Accuracy of an updated value highly depends on the Accuracy of the Previous Value and Previous Valuation Date. Potential errors in either of those would result in Valuation errors, with no scope for redress by taking any other elements or checks into account.

The Accuracy of HPIs decreases with the amount of time passed since the Previous Value has been observed.

At last and in contradiction with their perceived simplicity and transparency, some HPIs, e.g., Expert Opinion HPIs, can be affected by highly subjective elements and even those that are produced solely through quantitative computations may actually deploy methodologies within them that are just as proprietary (and therefore unknown to the user) as those deployed within other Statistical Valuation Methods. The data used to construct an HPI may also not be in the public domain. This makes any checks on the integrity of the calculation process impossible to conduct and, in this light, it becomes understandable why it is not unprecedented for HPI providers to occasionally re-state retrospectively entire sections of their HPI history, whenever significant changes to the methodology are introduced and/or any errors are uncovered [9].

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[8] see also EMF/EAA Joint Paper on the use of Automated Valuation Models in Europe, May 2016; https://www.europeanavmalliance.org/publications.html

[9] ibid.

7 | Single Parameter Valuations

In a nutshell

Single Parameter Valuations estimate the value of a property on the basis of one Property Characteristic. Typically, this is the property type such as purpose-built flat or detached house, which might be specified further, e.g., three-bedroom flat in central Vienna. The concept can be extended to comprise a combination of two or more Property Characteristics, e.g., floor area and property type.

Description

Single Parameter Valuations are typically aggregated values, such as the mean or median value of a number of properties in a given geographic area (e.g., postcode, municipality, region etc.) and for a given time period (e.g., a specific year). Single Parameter Valuations can be provided as a value per square metre or as the value of an assumed standard property. The standard property might vary for different geographic areas. No Previous Value is needed.

Assumptions

Single Parameter Valuations assume that very few Property Characteristics that are not Property-Specific sufficiently describe the property to obtain a value with adequate Accuracy for the intended use.

Intended uses

Single Parameter Valuations are typically used as a starting point for further analyses or for high level illustration of price levels in given markets. Price developments of residential property markets can be captured using Single Parameter Valuations by comparing values at different points in time.

How to use

Single Parameter Valuations only require a lookup from a table without further calculation. Only one Property Characteristic and, typically, the geographic area and a Valuation Date are all that is needed.

Documentation

When providing Single Parameter Valuations the key data source (e.g., listing sites, land registries) and the kind of data (e.g., Asking Prices, Sale Prices, Expert Opinions), should be stated. The documentation should also include a description on how the data were treated and which statistical measure is used to compute the values (e.g., average, median).

Reporting

Reports of Single Parameter Valuations should contain information on the origin of data (i.e., Transaction Data, Asking Prices etc.) and the Granularity for which that value is returned.

Results of Single Parameter Valuations should comprise the value, a statement of the parameters taken into consideration (e.g., property type, geographic area) and the technique used (e.g., mean, median).

Accuracy testing

Accuracy of Single Parameter Valuations can be tested through Bulk Tests. As Single Parameter Valuations are typically used anecdotally but not to actually value properties on an individual or portfolio basis, usually no such tests are carried out.

Advantages

Single Parameter Valuations are helpful to describe the general level of property prices in a market at a given time.

Limitations

Single Parameter Valuations are not Property-Specific. Only one or a few Property Characteristics, together with geographic area and time period, are taken into consideration. Neither specific Property Characteristics nor the precise location are being considered. Valuations are therefore identical for all properties that fall into the same categories, allowing very limited Accuracy.

8 | Hedonic Models

In a nutshell

Hedonic Models are mathematical equations with pre-calculated parameters that accept multiple Property Characteristics as inputs (e.g., property type, floor area, construction year, number of bedrooms) to calculate a property value. Hedonic Models are multivariate methods as they typically use multiple parameters for estimating property values. Hedonic Models are sometimes also referred to as 'Hedonic Automated Valuation Models' (Hedonic AVM), though they do not necessarily carry out any automated process. Hedonic Models are therefore fundamentally different from Comparables Based AVMs (see section 9).

Description

Hedonic Models are analyses of how various Property Characteristics influence the property value in a given time period and for a given geographic area. The general idea is that each characteristic of the property (e.g., size, age etc.) and of its location (e.g., socio-demographic data like unemployment rates, average residents' age, median income etc.) has a quantifiable influence on property value and that each such contribution can be isolated.

The value of a property is estimated through calculating the result of an equation containing Property Characteristics of the property to be valued, possibly based on its generic location.

Parameters are calculated on calibration data sets, which typically comprise both property data and auxiliary information such as socio-economic data.

Different Hedonic Models vary in the complexity of the mathematical equations involved and the number of Property Characteristics taken into consideration. The functional form of the mathematical equation of a Hedonic Model is selected when the model is being developed. The parameters are calculated on a set of property data for which Property Characteristics, value and the characteristics of the geographical area are known.

Assumptions

Hedonic Models assume that the value of a property is a function of its individual characteristics. Hedonic Models also assume that properties can be allocated to geographic groups within which all properties show the same quantifiable relationship between Property Characteristics and value. Hedonic Models focus on a limited number of Property Characteristics that are analysed and quantified and are thought to determine the property value. Depending on specific market practices, additional Assumptions may be introduced. For instance, it may be assumed that the Subject Property is in average condition.

Intended uses

Hedonic Models are not Property-Specific but may accept individual Property Characteristics as Data Input. Because of that Hedonic Models can value properties, e.g., for mortgage applications and can be used to monitor values, e.g., for capital requirement purposes, if no Property-Specific Valuations are required.

Where market trends are to be monitored Hedonic Models can be an effective tool. However, as they return property values, these must be produced at different points in time and then transformed into a House Price Index in order to fulfil this purpose.

How to use

Typically, Hedonic Models are provided in software applications where the user only needs to input the required Property Characteristics, including property location. Necessary Property Characteristics may also be estimated based on the location of the property so that only the provision of location information is required. Confidence Levels are typically not provided and thus are unavailable for judgements or decisions in the Valuation Process.

Documentation

The origin, type and detail of any data sets being used should be stated. Because the term 'Hedonic Models' is not limited to a certain mathematical model it should also be stated what model is being deployed (e.g., multiple regression). Hedonic Models should be referred to as 'Hedonic Models' or as 'Hedonic AVMs', not simply as 'AVMs'. This is to avoid confusion with Comparables Based AVMs that are a different and more sophisticated Statistical Valuation Method.

Reporting

Reports should contain information on the origin of the property data (i.e., Sale Prices, Asking Prices etc.) as well as information on non Property-Specific data that are used to calculate the value. This should include the Granularity of any data being used.

The result of a Hedonic Model should be presented alongside information on expected Accuracy (e.g., by a Confidence Measure or a Forecast Standard Deviation). The reliability of the Forecast Standard Deviation must be demonstrated through Lender Tests and Bulk Tests to any parties with a legitimate interest in reviewing them, such as users or regulators.

Unlike for Comparables Based AVMs, with Hedonic Models all calculations are typically based on the same data. Because of this aspect, little additional detail can be added to an individual Valuation that cannot be covered by generic documentation. It is technically possible to select comparables from a data base and to present them alongside a Valuation from a Hedonic Model. If that is the case it should be stated on what criteria these Comparables have been selected; e.g., based on similarity of their Property Characteristics to the Property Characteristics of the Subject Property or on their values or price details.

Accuracy testing

Accuracy of the Valuation can be measured in a straightforward manner through Bulk Tests. Bulk Tests should also demonstrate the reliability of any Confidence Measure provided with each individual Valuation.

Advantages

Hedonic Models are typically provided in software applications that are easy to use and do not require any understanding of the actual model. Results are returned within a short timeframe. Hedonic Models do not require location information finer than the smallest geographic area by which the model is segmented. For instance, if the smallest geographic area considered by a Hedonic Model is the municipality, then the complete address does not add any information and therefore does not need to be provided.

Unlike HPIs Hedonic Models do not require a Previous Value, thus being able to value properties even where no previous history is known to the party requiring the Valuation. As they do not require or rely on a Previous Value, Hedonic Models do not carry forward forever any bias that might have affected that Previous Value, e.g., due to fraud, commercial pressure, excessive optimism or other circumstantial reasons.

Limitations

Hedonic Models rely strongly on aggregated information. This is particularly so in terms of geographical aggregation (e.g., postcode, municipality, region etc. instead of individual addresses). Aggregation reduces the degree of Granularity and therefore the level of attainable Accuracy because the specific details of a given property are lost. Because of that Hedonic Models are not Property-Specific.

Limits of Accuracy should be alleviated if a reliable Confidence Measure is provided with each individual Valuation. This is so because reliable Confidence Measures can be used as a filter, keeping only those results that meet a certain Accuracy level.

A major reason for developing Hedonic Models is that only small quantities of property data are available or that data records lack crucial details (e.g., the precise address) preventing them from being used within a method that requires precise location. Through using auxiliary data such as socio-economic data, Hedonic Models are able to cover areas where no property data of sufficient quantity and quality is available. While these aspects allow the development of Hedonic Models if property data are scarce, this comes at the cost of a lower achievable Accuracy. This is so for two major reasons. One is that because some or all of the auxiliary data are only available for entire areas (e.g., unemployment rates by municipality, purchase power by postcode). This causes differences on a smaller scale to be flattened, limiting Accuracy already on theoretical grounds. The other reason is that auxiliary data may contain statistical errors and these are inevitably transmitted to the model and thus into its results.

Hedonic Models assume that all characteristics of property and location that significantly determine the value have been incorporated into the model. As a result, any characteristics that may also have an influence but were not foreseen as relevant and therefore are not included in the model, cannot improve model Accuracy.

9 | Comparables Based Automated Valuation Models (Comparables Based AVMs)

■ In a Nutshell

Comparables Based AVMs are intelligent tools that employ sophisticated algorithms to select Comparables and calculate Valuations for a specified property at a specified date using mathematical modelling techniques in an automated manner. In order to achieve high Accuracy and high coverage Comparables Based AVMs must be based on comprehensive Property Databases. While often they are only referred to as 'AVM', the specific term of 'Comparables Based AVM' emphasises that for each Valuation a bespoke set of Comparables is selected based on the individual Property Characteristics and location of the property to be valued. As such Comparables Based AVMs provide Property-Specific Valuations and therefore differ fundamentally from Hedonic Models (see section 8).

■ Description

Comparables Based AVMs typically comprise two steps. First, they automatically select appropriate Comparables from data bases. These Comparables are chosen according to the Property Characteristics of the Subject Property (e.g., property type, floor area, year of construction) and its location (e.g., proximity, comparability of location), hence resulting in a different set of Comparables for different addresses or different Property Characteristics.

After selecting Comparables, the second step consists of using the values of these Comparables to value the Subject Property itself. Depending on the sophistication of a given Comparables Based AVM, these steps may be iterated and additional data may be taken into consideration.

■ Assumptions

Comparables Based AVMs assume that the value of a property can best be estimated on the basis of a bespoke selection of Comparables for any given Subject Property. It is also assumed that Comparables are best selected based on Property-Specific information. Depending on specific market practices, additional Assumptions may be introduced. For instance, it may be assumed that the Subject Property is in average condition.

■ Intended uses

Comparables Based AVMs can be used for valuations where Property Characteristics and detailed information of the address ought to be considered. Comparables Based AVMs are also useful if for regulatory reasons a property value must be calculated on the basis of Comparables. Because of that, Comparables Based AVMs can value properties, e.g., for mortgage applications, and be used to monitor values, e.g., for capital requirement purposes [10].

[10] see EMF/EAA Joint Paper on the use of Automated Valuation Models in Europe

Comparables Based AVMs are the most appropriate Statistical Valuation Method for Portfolio Valuations, e.g., for Covered Bonds, Non-performing Loans or Asset Backed Securities. This is so because each Valuation is Property-Specific, i.e., each of the residential properties underlying each loan as collateral is valued individually. Depending on the embedding application each Valuation may be accompanied by comprehensive information to facilitate checks and audits, e.g., exhaustive lists of all Comparables used for each Valuation.

Where market trends are to be monitored, Comparables Based AVMs can be an effective tool. However, as they produce individual property Valuations, their results must first be produced at several subsequent points in time and then transformed into an HPI first for this purpose.

Since Comparables Based AVMs are the only Statistical Valuation Method that is an Advanced Statistical Model as defined by the EBA, they can also be used as an effective tool to critically review and to assess the performance of surveyors and the Accuracy of Surveyor Valuations [11].

■ How to use

Comparables Based AVMs can be used to calculate a value for a residential property based on its address (or cadastral reference or other forms of unique property identification) and some of its Property Characteristics. The user provides the required Input Data (e.g., address, floor area, year of built, condition) and the AVM returns the value and additional information. Depending on the AVM and the purpose of use, Property Characteristics may also be drawn from a database and identification of the property may suffice.

■ Documentation

The origin, type and detail of data available to the AVM should be stated. The fact that Comparables are selected should be made explicit to avoid confusion with other methods, in particular with Hedonic Models: In fact, Comparables Based AVMs should typically provide the ability to review a list of (at least some of) the Comparables used for each individual Valuation.

■ Reporting

Valuation reports for each valued residential property should be clear and transparent and contain information on the origin of the property data (i.e., Sale Prices, Surveyor Valuations etc.) as well as information on non Property-Specific data that are used to calculate the value. This includes the Granularity of those data.

Valuations produced by Comparables Based AVMs should be reported in conjunction with confidence information (i.e., Confidence Levels or Forecast Standard Deviation). The reliability of the Forecast Standard Deviation must be demonstrated through Lender Tests and Bulk Tests to any parties with a legitimate interest in reviewing them, such as users or regulators. Because Comparables Based AVM select bespoke sets of Comparables for each Valuation, they should provide a wide variety of additional information to support the Valuation and to increase transparency. At a minimum the report from the AVM should provide information on the number of Comparables selected to calculate the value. Comparables used for each Valuation must be logged and must be available on request by the users. Depending on the circumstances of usage and requirements, it may be useful to display the list of Comparables selected alongside each Valuation. For each Comparable, the type of value (e.g., Sale Price, Surveyor Valuation), the raw data (e.g, price per sqm) and the corresponding time of the value, i.e., the date with potentially some degree of anonymisation, must be stated. By definition, Comparables Based AVMs select Comparables based on Property Characteristics. Any deviation from this approach, e.g., selection of Comparables based on property values, must be clearly stated. Similarly, an indication should be provided as to whether a list of Comparables displayed alongside an AVM result is complete or limited to just the most significant ones.

Additional Information, such as measures of the dispersion of Comparables' values, a map of their locations etc. may be provided depending on the circumstances of usage and requirements.

Finally, the report at the end of the Valuation Process at the point of origination should also contain a description of the property – including information on its current use, the property type, quality, age and state of preservation – as well as information about its legal attributes, the local market conditions and the liquidity, legal and actual attributes of the property, and any other information that may affect its value in the short term [12].

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[11] see Art. 214 and 233, EBA/GL/2020/06

[12] see Art. 213, EBA/GL/2020/06

Accuracy testing

The Accuracy of Valuations can be measured through Bulk Tests and Lender Tests as described in section 4. These should also demonstrate the reliability of any Confidence Measures provided for individual Valuations.

Advantages

Comparables Based AVMs are cost-effective and easy to use, and typically return a result within a very short time. They also offer a number of other advantages.

Comparables Based AVMs operate at a much greater level of Granularity than any other Statistical Valuation Method, by selecting the most appropriate set of Comparabels upon which to base the Valuation of each individual property. As a result, the Accuracy of Comparables Based AVMs is typically higher than that of other Statistical Valuation Methods. This is the case because Comparables Based AVM do not or only to a small degree rely on pre-defined geographic areas (e.g., postcode districts, municipalities, regions etc.) and on data that is tied to such areas. Furthermore, characteristics of the property to be valued and its location can be taken into consideration explicitly as well as implicitly. This is because individual Comparables are selected that carry non-explicitly stated properties in their value information.

Comparables Based AVMs do not necessarily require each Property Characteristic to always be available as input; they are able to back-fill missing information. With that ability, Comparables Based AVMs allow to value more accurately even in cases of missing details that otherwise would have had to be valued through a less advanced Statistical Valuation Method.

Unlike HPIs, Comparables Based AVMs do not require a Previous Value either, thus being able to value properties even where no previous history is known to the party requiring the Valuation. As they do not require or rely on a Previous Value, Comparables Based AVMs do not carry forward forever any bias that might have affected that Previous Value, e.g., due to fraud, commercial pressure, excessive optimism or other circumstantial reasons. On the contrary, by using fresh Comparable Evidence every time a Valuation is requested – just like a surveyor would – a Comparables Based AVM is able to reset any such historic issues.

Comparables Based AVMs include a Confidence Measure as output with each Valuation result, thus providing an indication of Accuracy at a property-by-property level. This is a critical piece of information for the user of these Valuations, as it indicates to what extent they can be relied upon and allows, e.g., the filtering of only a subset of results on which sufficient confidence can be placed.

Because Comparables Based AVMs can disclose the set of Comparables selected for each individual Valuation, it is also possible to assess the plausibility of each individual Valuation. This is not the case for other Statistical Valuation Methods.

Further Considerations

Comparables Based AVMs have a high potential of accurately estimating property values. They were specifically designed to address shortcomings of other Statistical Valuation Methods. Accuracy, however, depends on the quantity and quality of the property data available.

Because Comparables Based AVMs do not require the aggregation of Property Characteristics or of characteristics of the location, they draw on the smallest Granularity of all Statistical Valuation Methods. This greatly enhances their Accuracy. Furthermore, their Accuracy can be enhanced almost indefinitely, e.g., to meet the specific operational requirements of any given user, by leveraging the fact that they are also capable of producing a Confidence Measure associated with each Valuation result. This can be used as a filter to reject certain results and thus retain only those exceeding the desired level of Accuracy.

Appendix

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A | Schematic Overview of the Full Range of Valuation Solutions

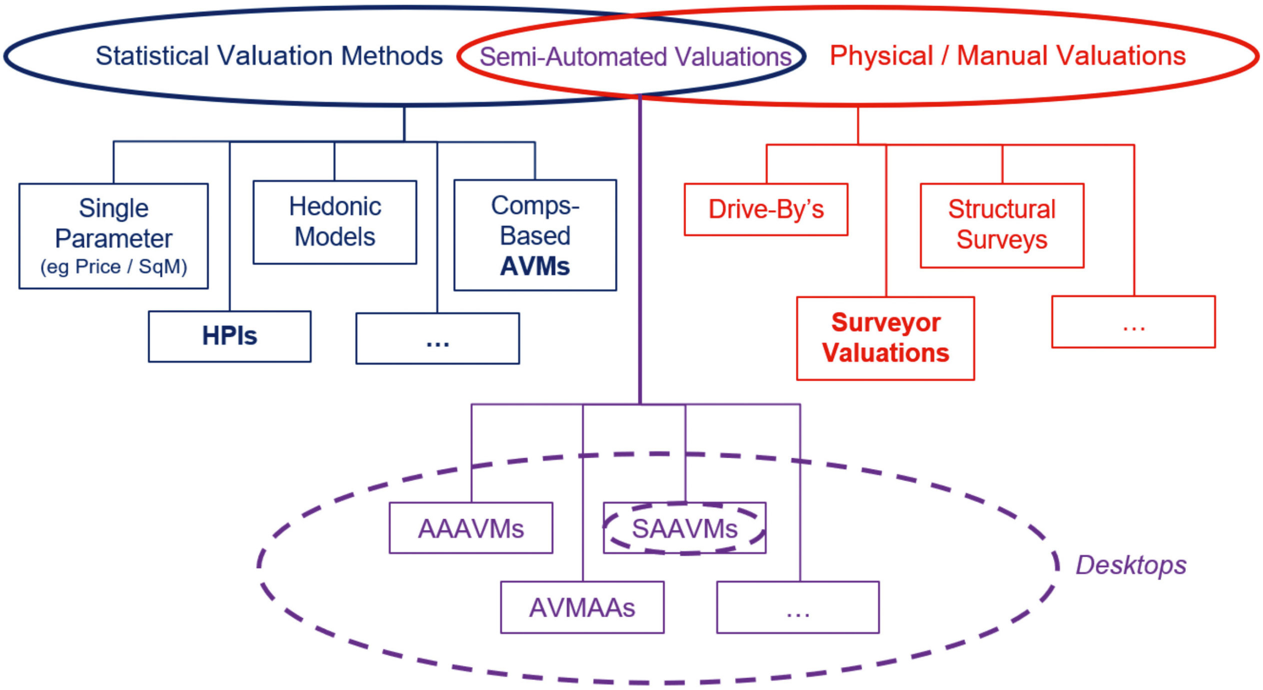

Figure 2: Schematic overview of the full range of Valuation solutions, based on the earlier version initially published in the EMF/EAA Joint Paper on the use of Automated Valuation Models in Europe, May 2016.

B | Key Features of Statistical Valuation Methods

	House Price Index	Single Parameter Valuation	Hedonic Models	Comparables Based AVM
Produces Location Specific Valuations	yes	yes	yes	yes
Does not require a Previous Value to estimate a value	no	yes	yes	yes
Can provide Confidence Levels with each individual Valuation	no	no	typically not the case	yes
Can produce Property-Specific Valuations	no	no	no	yes
Can be considered Advanced Statistical Model	no	no	no	yes

Figure 3: Key features of Statistical Valuation Methods

C | Glossary of Terms and Definitions

Term	Definition	Remarks
Accuracy (of a valuation method)	Collective term referring to the ability of a valuation solution (typically a Statistical Valuation Method) to produce results close to the respective Benchmark Values.	Accuracy incorporates the following broadly separate dimensions: ■ Bias (typically quantified by the Average Error or preferably by the Median Error) ■ Dispersion (typically quantified by the Standard Deviation, or the Average Absolute Error, or the percentages of results within 5%, 10% etc. of the Benchmark Value). Please note that some widely used Accuracy measures may capture elements of both dimensions, e.g., the percentages of results less than 10%, 15%, 20% etc. above the Benchmark Value. Please also note that, as it postulates the existence of a Benchmark Value, the assessment of AVM Accuracy can only be performed in circumstances where this is available, e.g., in the context of backtesting.
Advanced Statistical Model	A Statistical Valuation Model fulfilling the criteria laid out in the »Guidelines on loan origination and monitoring« by the EBA (EBA/GL/2020/06).	The criteria posed by the EBA for Advanced Statistical Models relate, among other things, to uncertainty, Granularity, Accuracy, validity, Property-Specific Characteristics, representativeness, data quality and regular quality assurance. Following from the above, only Comparables Based AVMs can be regarded as Advanced Statistical Models.
Analyst Assisted AVM (AAAVM)	A Semi-Automated Valuation that relies on the experience and judgment of a professional, but not necessarily a qualified surveyor, to validate and supplement the output of an AVM.	Please note that the modifications or manipulations introduced by the analyst onto the AVM output and/or the Comparable Evidence removes the objectivity and integrity of the fully automated process and it may compromise its unbiased nature.
Appraisal	See Surveyor Valuation (preferred terminology).	Appraisal is the term used in American English, whereas Surveyor Valuation is the one used in British English, hence typically across Europe. They are entirely equivalent.
Arm's Length Transaction	A property sale transaction where the buyer and seller act completely independently of one another and the Sale Price is unaffected by any undue stimulus (e.g., a family relationship, Right-To-Buy discount etc.).	

Term	Definition	Remarks
Asking Price	The price advertised by a seller when putting a property on the market to be sold. It may or may not be met by the Sale Price, the latter typically being lower, sometimes significantly so.	
Assumptions	A set of suppositions that underly and apply to a Valuation, which are taken to be true.	There are certain Assumptions -about facts and conditions underlying the subject of or approach to a Valuation- that do not need to be individually verified and which the Valuer is not required to prove to be true. This applies to all Valuers, no matter if they are a surveyor or a provider of a Statistical Valuation Method.
Automated Valuation Model (AVM)	A system that provides an estimate of value (a Valuation) of a specified property at a specified date, using mathematical modelling techniques in an automated manner.	■ As it only requires a property to be specified, an AVM can function merely based on property address, or cadastral reference or other forms of unique property identification (and possibly a few basic property characteristics), but it does not necessarily require any Previous Values of the property to be provided as input. An AVM, just like a Surveyor Valuation, can therefore value even properties that have never transacted before or whose history is not known to the user. This feature is one of the key differentiators between AVMs and HPIs. ■ As it deploys modelling techniques, hence the »M« in the acronym, an AVM is typically a lot more complex and therefore more accurate than just applying a simple adjustment to a Previous Value: again, this is one of the key differentiators between AVMs and HPIs. Typically, an AVM consists of sophisticated mathematical formulae requiring the deployment of bespoke technology and it includes elements of a Comparables based valuation approach, similar to Surveyor Valuations. ■ As it is an automated solution, hence the »A« in the acronym, an AVM operates without any human intervention post-initiation, making it an entirely objective tool, whose results are completely independent of the circumstances of the Valuation. Clearly this rules out, for example, any manual selection of Comparables or any other ad-hoc subjective adjustments and it is one of the key differentiators between AVMs and Surveyor Valuations.
Average Absolute Error or Mean Absolute Error	Literally the average of the absolute Error, i.e., of the Error taken without its + or – sign.	A frequently used measure of Dispersion.

Term	Definition	Remarks
Average Error or Mean Error	Literally the average of the Error.	A frequently used measure of Bias, although Median Error is the preferred measure for that. See also under Bias.
AVM Assisted Appraisal (AVMAA)	A Semi-Automated Valuation that relies on the experience and judgment of a qualified surveyor, to translate the output of an AVM into Valuation complying with all legal requirements applicable to appraisals. Please note this is obtained without conducting a physical inspection of the Subject Property, although it is supported by Comparable Evidence, which may or may not incorporate data from the AVM.	Please note that the modifications or manipulations introduced by the surveyor onto the AVM output and/or the Comparable Evidence removes the objectivity and integrity of the fully automated process and it may compromise its unbiased nature.
Basis of Value	A statement of the fundamental Assumptions of a Valuation, underpinning its purpose and usability.	Typical Bases of Value include for example Market Value, insurable value, mortgage lending value, repossession value, value for taxation purposes etc.
Batch Valuation	The process where a large number of results are obtained through a Statistical Valuation Method without individual manual submission.	
Benchmark Value (BV)	The property value against which the Accuracy of a Statistical Valuation Method is measured.	It is intended as the correct Market Value; hence it typically consists of either a reliable Surveyor Valuation or Sale Price, which of the two often depending on the established market practice in different jurisdictions.
Bias	Any tendency of a Statistical Valuation Method to systematically overvalue or undervalue properties when compared to the Benchmark Value.	Bias can be quantified by the Average Error, but in order to minimise the effect of a few potentially spurious outliers, e.g., due to questionable Benchmark Values, the more robust Median Error is usually preferred.
Blind Test	An Accuracy test where the valuation is carried out without access to the Benchmark Value.	This may require removal of certain pieces of information by the provider of a Statistical Valuation Method before running the test or removal of certain cases by the AVM user after the test. Blind testing is critical to meaningful Accuracy assessment.
Bulk Test	An Accuracy test for a Statistical Valuation Method where the Subject Properties and their Benchmark Values are extracted from a Property Database.	The provider of the Statistical Valuation Method still ensures that these be Blind Tests by not using the Benchmark Value for the purpose of computing the result, but the user has to take this on trust and has no way of validating the integrity of the test. This is the main disadvantage of the Bulk Tests, their main advantage being the ability to source very large samples and conduct very specific analyses on cases with only certain given characteristics.

Term	Definition	Remarks
Comparable	A property used during the Valuation Process as evidence in support of a Valuation of a different property.	The description of the Comparable typically includes its address, some value information such as Sale Price at a particular date and some indication of the similarities with, or differences from, the Subject Property.
Comparables Based Model	A Valuation Model seeking to identify recent Comparables that resemble the Subject Property in terms of location and attributes, possibly adjusting their values to compensate for any dissimilarities, to produce an estimate (a Valuation) of Market Value.	
Comparable Evidence	A set of Comparables used in support of a Valuation.	
Competitive Test	A Lender Test where the client is assessing the Accuracy of several Statistical Valuation Methods on the same test sample.	Please note that in the context of a Competitive Test, the suitability of the Benchmark Values becomes key, e.g., any cases whose Benchmark Value (or proxy of it, e.g., Asking Price, Customer Estimate etc.) may already be available to some of the AVMs being tested must be excluded. For this reason Competitive Tests should focus on very recent cases not yet captured in any publicly available sources, e.g., national cadastres, and on Remortgage cases, whose Property Characteristics and/or proxies of values have not been advertised.
Confidence Interval	See Value Range (preferred terminology).	
Confidence Level (CL)	A predictive measure expressing the estimated Accuracy of each result of a Statistical Valuation Method, typically only offered for Comparables Based AVMs, and as such directly translatable into a Forecast Standard Deviation. It is typically given on the EAA's 0 to 7 proprietary scale.	Please note that the degree to which the Confidence Level actually correlates with the Accuracy of the results of a Statistical Valuation Method when compared with the Benchmark Value is key to the assessment of AVM Accuracy.
Confidence Measure	Similar to Confidence Level, but intended as a looser term, which may be given on any scale of less universal use, e.g., defined by and specific to a given AVM provider.	
Confidence Score	See Confidence Level (preferred terminology).	

Term	Definition	Remarks
Coverage of a Statistical Valuation Method	Collective term referring to the ability of a Statistical Valuation Method to produce an acceptable result.	Coverage depends on all of the following 1 | The quality of the data provided as input (completely independent of the performance of the Statistical Valuation Method) 2 | The Input Requirements and the ability to interpret and backfill incomplete and/or invalid data of the Statistical Valuation Method (key to Coverage) 3 | Hit Rate (key to Coverage) 4 | User-defined Output Rules (typically dependent on AVM Accuracy) The overall Coverage of a Statistical Valuation Method is typically quantified by its Success Rate, but it can really only be meaningfully measured in the context of a given test sample, where the variability introduced by the points 1) and 4) above is removed. This is because these two points are not dependent on the Statistical Valuation Method. Otherwise Hit Rate is the measure most often quoted independently of a given test sample, but it needs to be considered in conjunction with the strictness of the Input Requirements.
Data Cleansing	The process of merging and reconciling data from different sources relating to the same property and rejecting or re-weighting any values deemed as spurious or possibly unreliable, in order to maximise the Accuracy of a Statistical Valuation Method.	It is typically applied in two separate contexts: 1 | in the creation of the Statistical Valuation Method 2 | in the validation of a Subject Property's inputs
Data Input	The information available to a Statistical Valuation Method to produce a Valuation.	Comprising elements for property identifications (e.g., address, governmental unique identifier etc.), any known Property Characteristics and possibly transactional information from the property's history (e.g., Previous Values etc.).
Description Data	The information within an Property Database that relates to Property Characteristics, i.e., typically of a static nature.	Examples include floor area, number of bedrooms, approximate construction year, parking facilities etc.
Dispersion	The relative frequency of all different sizes of Errors.	This typically displays the shape of a Bell curve with a tall narrow peak and thin tails if Dispersion is low, or a low broad peak and thicker tails if Dispersion is high.
Effective Date	The specified date as of when the Statistical Valuation Method is requested to value the Subject Property.	

Term	Definition	Remarks
Error	The relative difference between a valuation result and the Benchmark Value, expressed as a percentage of the Benchmark Value (not of the AVM): (valuation result – Benchmark Value) / Benchmark Value	
Forecast Standard Deviation (FSD)	The Standard Deviation of the Error distribution predicted for a set of results from a Statistical Valuation Method with a given Confidence Level.	
Fraud Detection	A specific application of an Advanced Statistical Model, i.e., a Comparables Based AVM, being used as a Second Opinion. It requires that the Surveyor Valuation be provided as input when the AVM is run, so that the AVM can produce a Y/N flag as to whether the Surveyor Valuation is likely to be overstated. The sensitivity of the flag can be tuned to meet the user's operating requirements, while the underlying AVM result and Confidence Level may not be necessarily disclosed.	
Geocoding	The process that attaches spatial coordinates to a property record.	
Granularity	Measure of the degree of detail at which location is identified and Property Characteristics are captured, e.g., Property-Specific (unique to a given individual property) or Location-Specific (based merely on more generic locations like postcode, neighbourhood, city, region etc.).	See also Location-Specific (Valuation) and Property-Specific (Valuation).
Hedonic Model	An analysis of how various Property Characteristics influence property value in a given time period and geographic area. These Valuation Models typically describe property value as a function of the attributes of both the property itself and of its location.	
Hit Rate	The ratio of cases where a valuation has been produced using a Statistical Valuation Method divided by the number of cases where an AVM can be attempted (after points 1. and 2. to do with Coverage have been considered).	Unlike the Success Rate, Hit Rate can be quoted in general terms, regardless of a given test sample.

Term	Definition	Remarks
House Price Index (HPI)	A time series capturing the price development of residential properties over time.	This can be used as a set of multipliers to be applied to a Previous Value in order to update it to a subsequent point in time, thus producing an Indexed Value. An HPI can be computed following different methodologies, e.g., Repeat Sales, Hedonics, Weighted Averages or other techniques adjusting for differences in location, characteristics and condition of the properties available as data: this often results in contrasting figures from different HPI providers. Also the use of an HPI within an Indexation Model to produce an Indexed Value clearly requires a Previous Value and Previous Valuation Date to be known for the Subject Property and to be provided as input. As a result, this technique cannot be applied to properties that have never transacted before or whose history is not known to the user. This feature is one of the key differentiators between AVMs and HPIs.
Indexation Model (or Index Model)	A computation that applies a House Price Index to a previous property value in order to update it to a subsequent point in time.	See House Price Index.
Indexed Value or Indexed Valuation (IV)	The valuation result resulting from an Indexation Model.	
Input Requirements	The pieces of information needed for a Statistical Valuation Method to attempt a Valuation. They often vary depending on intended use, e.g., for mortgage origination vs portfolio revaluation vs Fraud Detection etc., and as the Subject Property needs to be specified, they also define which identifiers are acceptable, e.g., cadastral reference and/or property address.	Please note that ■ adopting stricter Input Requirements may result in an apparently higher Hit Rate, but may actually reduce overall Coverage ■ if an unformatted or un-normalised address is also acceptable as input, the Address-Matching Rate too needs to be considered in conjunction with the Input Requirements.
Input Rules	User-defined rules preventing a Statistical Valuation Method to be attempted, not because the Input Requirements are not met, but because the user does not wish to employ the Statistical Valuation Method in those circumstances.	
Lender Test	An Accuracy test for a Statistical Valuation Method where the Subject Properties are controlled by a Lender and their Benchmark Values are disclosed to the provider only after the results have been delivered to the Lender.	This aims to ensure that the exercise be truly a Blind Test, hence the typical requirement for the Lender to use only recent cases, whose Benchmark Values or any other indications of value (e.g., Asking Prices, Customer Estimates etc.) should not yet be available to the Statistical Valuation Method being tested. The main disadvantage of the Lender Tests is the resulting relatively small sample, as well as sometimes the reliability of the Benchmark Values.

Term	Definition	Remarks
Loan-To-Value (LTV)	The ratio between Loan Balance and property value, widely used as a key measure of mortgage risk.	Please note that the details of the LTV definition and its calculation can vary significantly, e.g., see Origination LTV, Updated LTV, LTAVM etc.
Loan-To-AVM (LTAVM)	Loan-To-AVM, the ratio between the loan balance and the property value as computed by an AVM. It can be produced at origination or at any point in the future life of a mortgage, e.g., to update key risk measures to the current date.	
Location-Specific (Valuation)	A Valuation is Location-Specific, which is a less stringent feature than for example Property-Specific, when it is not based on information that is unique to an individual property, but simply on information referring to a larger class of properties, e.g., within a given locality like postcode, neighbourhood, city, region etc.	See also Property-Specific (Valuation).
Market Value	For the purposes of immovable property, the estimated amount for which the property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion.	This definition is taken from Article 4 (76), Regulation (EU) No. 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms.
Mass Valuation	The practice of valuing large numbers of properties as of a given Effective Date by the systematic and uniform application of Valuation Methods and techniques that allow for statistical review and analysis of the results.	
Match-Pair Analysis	An analysis conducted on a sample of properties whose Benchmark Value is known at two distinct points in time.	This allows for a direct comparison of the Accuracy of an HPI to other Statistical Valuation Methods.
Median Error	Literally the median of the Error.	See also under Bias.
(Valuation) Method	An approach or tool used to execute a Valuation.	A Valuation Method may refer to Assumptions and/or data from various sources, but makes no implication as to the degree of complexity, sophistication or nature of the procedures followed. Some Valuation Methods may be statistical, deterministic etc. (hence objective), whereas others may be empirical, manual etc. (hence subjective).

Term	Definition	Remarks
(Valuation) Model	A special type of (Valuation) Method deploying mathematical techniques to estimate or predict a given quantity.	Unlike many Valuation Methods, a Valuation Model is defined by being complex, sophisticated and of a mathematical nature, thus always being entirely objective, whereas a Valuation Method may include subjective elements.
Mortgage Origination	The circumstances and purpose where a Statistical Valuation Method is used to underwrite a new or amended mortgage. It therefore includes all of the following Transaction Types: Purchase, Remortgage and Further Advance.	
Open Market Value	See Market Value (preferred terminology).	
Outliers	Extreme values in a distribution.	
Output Rules	User-defined rules preventing a Statistical Valuation Method to return a result, not because it could not be produced, but because the user does not wish to employ the Statistical Valuation Method in those circumstances, e.g., minimum CL requirements, minimum LTV or LTAVM etc.	
Pass Rate	The ratio of valid AVM results from a Statistical Valuation Method passing the Output Rules divided by the total number of results.	This refers specifically to point 4. to do with Coverage, which is both sample-dependent and user-dependent. As such the Pass Rate can really only be meaningfully measured in the context of a given test sample, e.g., in a Competitive Test, not quoted in general terms, unlike Hit Rate.
Percentage within 10%, 15%, 20% etc.	The percentage of results (from a Statistical Valuation Method) with an Error ≤ 10%, 15% or 20% respectively, regardless of its + or – sign.	This is the most often used measure of Accuracy for AVMs, capturing the Dispersion of the Errors in perhaps a more intuitive way for the layman user than the Standard Deviation or other indicators that may be preferred by the statistician.
Performance of a Statistical Valuation Method	Generic term used to refer collectively to Coverage, Accuracy of Statistical Valuation Methods and the reliability of the Confidence Levels.	Not be confused with System Performance of a Statistical Valuation Method.
Portfolio Valuation	The circumstances and purpose often defining a distinct AVM product, where Batch Valuations are used to value a large number of properties, e.g., for capital modelling, provisioning, whole loan trading, surveyor management etc.	This specifically excludes Valuations for the purpose of Origination, hence typical features of this AVM product include long response times and reduced outputs (e.g., no Comparable Evidence).

Term	Definition	Remarks
Previous Valuation Date	The date applicable to the Previous Value.	Naturally it always precedes the Effective Date.
Previous Value (PV)	A property value, typically the most recent available, produced at a point in time preceding that being considered, i.e., belonging to the history of the property. It may be provided for example by a Sale Price, a Surveyor Valuation or a Statistical Valuation Method.	Naturally it is never available for new-build properties. Even for non-new-build properties, where it may exist, it may not be known to the user or Valuer.
Property Attributes	See Property Characteristics (preferred terminology).	
Property Characteristics	The attributes describing the features of a property, e.g., Property Type / Style, floor area, number of bedrooms, approximate year of construction, parking facilities etc.	See also Property-Specific Valuation.
Property Database	The database of property information available to an AVM to draw Comparable Evidence and produce a Valuation.	It includes both Description Data and Transaction Data, typically address-matched, Geocoded, merged, reconciled and cleansed by the AVM provider, hence it is typically proprietary.
Property-Specific (Valuation)	A Valuation is Property-Specific, which is a more stringent feature than for example Location-Specific, when it is based on information that is unique to an individual property and distinguishes it and its value from every other property.	For example, Geocoding must have occurred in such a way that the property can be located individually (e.g., at rooftop level). This means that the assigned coordinates must refer exactly to the very building in question and not to a whole street or other locality like postcode, neighbourhood, city etc. Typically, also the attributes of the property should form the basis of a specific treatment, e.g., the selection of a list of Comparables unique to that property, not used simply in the context of non-Property-Specific Valuation Methods, like HPIs, Single Parameter Valuations (e.g., price per square metre) or Hedonic Models (which apply to whole classes of properties in the same way). This point may be illustrated more clearly as follows. For example, a Hedonic Model may accept Property Characteristics that refer to a given property, but instead of using the precise address, the model only uses the postcode. All Property Characteristics being equal, in such a case there is no differentiation between properties within that postcode. Such a Valuation is not Property-Specific. On the other hand, Comparables Based AVM selects a specific list of Comparables for each Subject Property based on its individual location (full address), as well as on its specific Property Characteristics. Such a Valuation is Property-Specific. Property-Specific Valuations are a key feature of Advanced Statistical Models. See also Location-Specific (Valuation).

Term	Definition	Remarks
Property-Specific Variable	A Property Characteristic that refers specifically to an individual property.	See also Property Characteristics (preferred terminology).
Property Type	The Property Characteristic that expresses which wide category of residential real estate a given property belongs to, e.g., house or flat.	Property Type is often accompanied by Property Style, i.e., a secondary classification that applies within a given Property Type. For example, when the Property Type is a house, typical Property Styles may be Detached, Semi-Detached and Terrace (or End-Terrace and Mid-Terrace); when Property Type is a flat, typical Property Styles may be Converted and Purpose-Built.
Purchase	A transaction where a property is sold. It comprises both cash transactions and transactions financed through a mortgage.	Mortgage originations for a Purchase attracts the strictest underwriting procedures, because the property (and often the borrower as well) are typically unknown to the lender, who tends to pass all costs onto the borrower.
Purchase Price (PP)	See Sale Price (preferred terminology).	
Random Error	The intrinsic value range due to the fact that for any individual property at a particular point in time, different prices are possible due to different circumstances of sale, differing buyer preferences, different buyer information sets or other factors.	
Reference Value	See Benchmark Value (preferred terminology).	
Repeat Sales Index	One type of HPI computed through a specific methodology that only uses pairs of Sales Prices of the same property at two or more points in time, thus removing any effects from spatial factors and Property Characteristics.	Examples of a Repeat Sales Index include the Case-Shiller index in the US and the Land Registry Index in the UK. Other methodologies to compute an HPI include for example Hedonics (e.g., the Halifax and Nationwide indices in the UK), Weighted Averages etc.
Sale Price (SP)	The price agreed between buyer and seller within an Arm's Length Transaction.	
Second Opinion	The circumstance where an AVM is used at origination as a check for, not as a replacement to, a Surveyor Valuation.	

Term	Definition	Remarks
Semi-Automated Valuation	Generic term used to indicate all valuation solutions that comprise both automated and manual elements.	They include for example all of AAAVM, SAAVM and AVMAA. Please note that, as they comprise a manual element, Semi-Automated Valuations can be subjective, unlike fully automated Valuations that are entirely objective.
Single Parameter Valuation	A Statistical Valuation Method that estimates property value on the basis of one Property Characteristic, e.g., most often floor area or Property Type.	The concept can be extended to comprise a combination of two or more Property Characteristics, e.g., number of bedrooms and property type / style (like 4-bedroom detached houses). These can be referred to as Multiple Parameter Valuations.
Standard Deviation	Frequently used measure of the Dispersion of the Error, computed through its well-known statistical formula.	
Statistical Valuation Method (SVM)	A mathematical tool or approach used to estimate property value (a Valuation) through deterministic computations rather than human judgment.	Different Statistical Valuation Methods can vary widely in the degree of their complexity, both from a mathematical as well as from a technical point of view. They comprise the following main types: ■ Single Parameter Valuations ■ House Price Indices ■ Hedonic Models (also called Hedonic AVMs) ■ Comparables Based Automated Valuation Models (also called Comparables Based AVMs or simply AVMs) The techniques underlying the various Statistical Valuation Methods can comprise a variety of different analytics approaches, such as linear and non-linear regressions, genetic algorithms, neural networks and fuzzy logic, among others. Statistical Valuation Methods are entirely objective in the sense that the values are calculated on the basis of measurable characteristics of the property and its location without applying any element of subjectivity.
Subject Property	The specified property being valued.	
Success Rate	The ratio of cases producing a valid result using a Statistical Valuation Method (after all points 1. to 4. to do with AVM Coverage have been considered) divided by the total number of cases.	As point 1. is sample-dependent and 4. is user-dependent, the Success Rate can really only be meaningfully measured in the context of a given test sample, e.g., in a Competitive Test, not quoted in general terms, unlike Hit Rate.

Term	Definition	Remarks
Surveyor Assisted AVM (SAAVM)	A Semi-Automated Valuation that relies on the experience and judgment of a qualified surveyor, to validate and supplement the output of an AVM.	Please note that the modifications or manipulations introduced by the surveyor onto the AVM output and/or the Comparable Evidence removes the objectivity and integrity of the fully automated process and it may compromise its unbiased nature.
Surveyor Valuation (SV)	The Valuation produced by a qualified surveyor following the full internal physical inspection of a property.	
System Performance of a Statistical Valuation Method	Generic term used to refer to speed and up-time of a Statistical Valuation Method.	
Transaction Data	The information within an Property Database that relates to property values, i.e., typically of a dynamic nature.	This includes, e.g., Surveyor Valuation, Sale Price, Valuation Date, Valuation Type, Transaction Type, data source etc.
Transaction Price	The value associated to a property in the context of a commercial or legal transaction, e.g., its Sale Price or Surveyor Valuation.	
Transaction Type	The circumstance leading to the production of a property value, e.g., Purchase, Remortgage, Further Advance, Arrear Management.	
True Value	This is a subjective term. The term Benchmark Value should always be used in the context of AVM Accuracy.	
Unique Property Identifier	The field(s) used by the AVM to uniquely reference individual properties, e.g., cadastral reference, UPRN, AddressPointToid, 3D coordinates etc.	
Usable Hit Rate	See Success Rate (preferred terminology).	
Valuation	The act or process of providing an estimate of value of a specified property at a specified date.	
Valuation Date	Ambiguous term that may refer both to the Effective Date and/or to the date when a Valuation was conducted.	

Term	Definition	Remarks
Valuation Process	The temporal sequence of procedural and operational steps taken in support of a property Valuation, from the receipt of instructions to the recording of relevant information, like purpose, property characteristics and other circumstantial details.	Please note that these procedural and operational steps typically precede or follow, hence are quite distinct from the algorithmic step whereby the valuation result is actually computed, which may be proprietary (e.g., for the most advanced Statistical Valuation Methods) or undocumentable (e.g., in the case of human judgment).
Valuation Type	The process producing a property value, e.g., Sale Price, Asking Price, Surveyor Valuation (full internal), Drive By, Desktop, Statistical Valuation Method.	
Valuer	An individual, group of individuals or a company who possesses the necessary qualifications, ability and experience to execute a Valuation in an objective, unbiased and competent manner.	
Value Range	The value range within which the Market Value is expected to fall with a given level of confidence, hence a result of the Forecast Standard Deviation.	For example, a Value Range of ±1FSD is expected to include the Market Value with approximately 68% confidence; a Value Range of ±2FSD is expected to include the Market Value with approximately 96% confidence and so on.

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on-geo

Austria
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tinsa

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Sweden
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