Using mass appraisal to support Welsh Government's ambitions for Council Tax Reform

The VOA has reinvigorated its mass appraisal capabilities in-house, meeting industry standards and being recognised for our innovative approach. The following provides further information on what mass appraisal is and how we have used it to support with the Welsh Government's Council Tax reform ambitions.

It also provides further information on the VOA's development of an automated valuation model, or AVM, to support Council Tax reform in Wales.

As set out by the industry, including the International Association of Assessing Officers (IAAO)[1] and recognised by the Royal Institute of Chartered Surveyors (RICS)[2], mass appraisal is the valuation of a group of properties using **standardised methods** and **statistical testing**. It enables public authorities that base taxes on the market value of property to value in an efficient and cost-effective way. The standardised approach ensures fairness and consistency. A key aspect of the standardised method is to utilise statistical models called Automated Valuation Models (AVM) to provide initial valuations.

When the Welsh Government commissioned the VOA to prepare for a potential revaluation of all 1.5m Council Tax properties in Wales – where the VOA must place every property into a new Council Tax band based on its up-to-date value – mass appraisal was the obvious approach. The VOA had last conducted a mass appraisal exercise nearly two decades ago; the technology used had been decommissioned and much of the modelling expertise had previously been outsourced. However, VOA's analytical capabilities had grown since then, with a new cross function team established, as analyst and valuers collaborated to reinvigorate the mass appraisal function in-house.

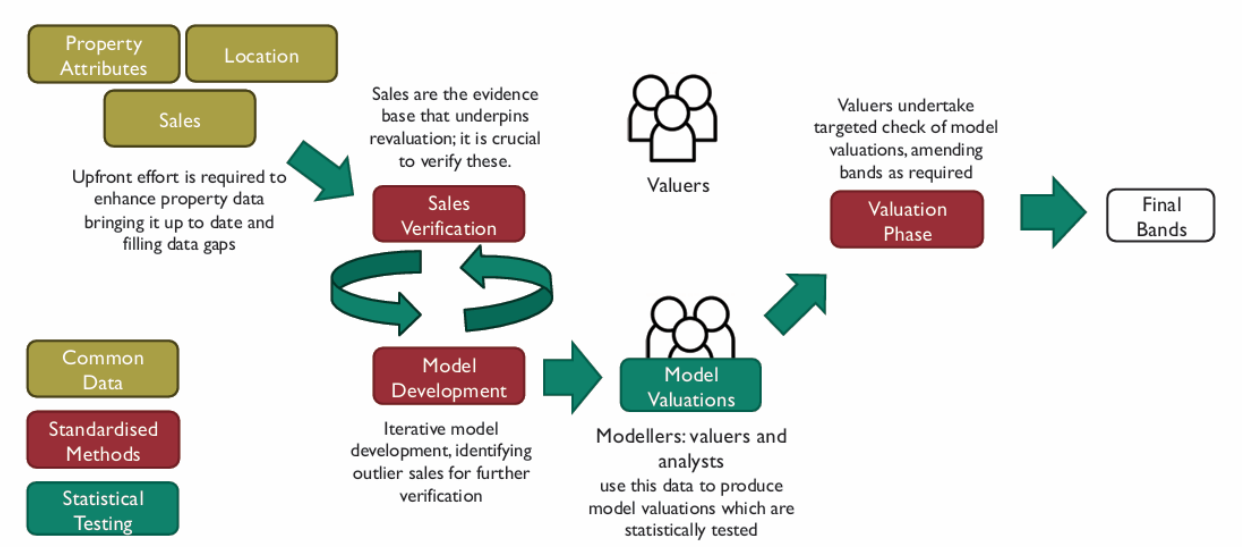
Our mass appraisal approach

Figure 1 sets out the **model assisted** mass appraisal approach we undertook to conduct the revaluation. It shows how the industry best practice principles of **common data**, **standardised methods** and **statistical testing** were embedded into our approach.

[1] https://www.iaao.org/wp-content/uploads/StandardOnMassAppraisal.pdf

[2] https://www.rics.org/news-insights/mass-appraisal#:~:text=Mass%20appraisal%20is%20the%20valuation,direct%20comparison%2C%20cost%20and%20income.

Figure 1: High-level diagram of the VOAs mass appraisal approach for Council Tax Reform in Wales



Common data is the building block of mass appraisal:

- Property attributes - such as the detachment, number of bedrooms and age - all describe a property. If you do not know what you are valuing, it's hard to value. We undertook a significant data enhancement exercise and explored new data sources to incorporate plot sizes.
- Location is a key driver of value. We combined data sources to get the best set of property coordinates available.
- Sales are the evidence base for the revaluation. We combined our records with Land Registry Price Paid data to improve the reliability and completeness of our sales dataset and utilised the House Price Index (HPI) to adjust them to the relevant date. However, as a revaluation is based on open market transactions (amongst other considerations), this data needed cleaning to ensure only these transactions were included, with an automated data pipeline developed.

Standardised processes were developed throughout the exercise, with model valuations giving a consistent starting point:

- Model development was an iterative process. From an initial base AVM, to exploring different techniques and data, our estimated valuations improved over time. Analysts worked closely with valuers to understand model performance and areas for further development.
- Sales verification was undertaken by valuers to further ensure the accuracy of the evidence base. It was two-fold, with some sales further investigated due to issues highlighted by the sales cleansing process and others identified as outliers where the

modelled estimates and actual sale prices varied. This identified sales that were not typical open market values or where our property data needed further enhancement. Verified sales were fed back into the final model used to produce the final model valuations.

The model only provides an initial first pass estimate: our activities are **model assisted** but still require assurance by professional valuers. As part of model testing, valuers undertook targeted reviews of the modelled values, checking and amending the Council Tax bands as required. Properties were grouped into batches for efficiency, with our understanding of the reliability of the model estimates and their proximity to band margins aiding the prioritisation of batches. The output of this will give us our final bands, which could then be used for a revaluation.

As well as the collaboration within the VOA between valuers and analysts, we also drew on external expertise. Rigorous **statistical testing** ensured the model valuations met recognised standards and were of sufficient accuracy and fit for purpose. The VOA commissioned the International Association of Assessing Officers (IAAO), as a recognised world authority on AVMs, to carry out a review of the model development process. The IAAO stated:

"These findings are more than satisfactory and should lead the VOA to have confidence in the quality of the new valuation project conducted in Wales".

Benefits of mass appraisal

Our early assessments of the benefits of using mass appraisal include significant reductions in cost and timescales, as well as benefits to customers through greater consistency and quality of valuations. Initial estimates place the reduction in cost of a revaluation by one-third, compared to carrying out a manual valuation. Moreover, by providing an initial valuation the VOA can prioritise cases for manual valuation and can better target our professional valuer resource to where they will have the greatest impact, providing more rewarding roles for our staff.

Where next for mass appraisal?

The Welsh Government consulted on several options for delivering Council Tax reform, including a revaluation in 2025 and 2028. Having opted for 2028, the development and use of the model means that the VOA has a strong foundation to deliver this revaluation.

We have built up a successful partnership between analytical and valuation professionals in establishing an in-house valuation modelling capability. The speed in which this capability has been established, and our innovative approaches has been recognised by the Institute for Revenue, Rating and Valuation (IRRV), winning their Excellence in Innovation Award[3]. With the capability established, the VOA will continue to explore the potential of **model assisted** valuations in other areas.

[3] https://www.irrv.net/awards/live/winners2024.php

In focus: the VOA Automated Valuation Model supporting Wales Council Tax reform

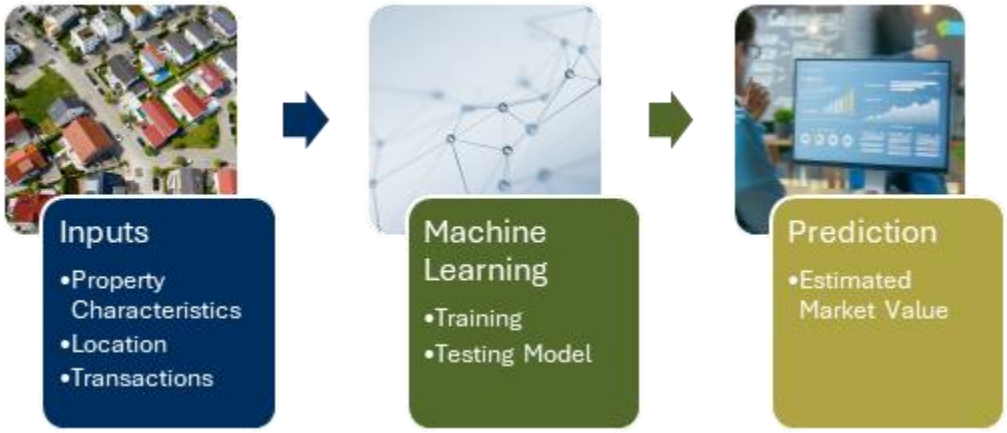
Automated Valuation Models (AVMs) are a key part of the standard process that underpins the mass appraisal approach the Valuation Office Agency (VOA) is using to support Wales Council Tax reform. AVMs use statistical techniques to provide an estimate of the value of a specified property, at a set point in time. The following provides further detail on how the VOA's AVM works and the innovative approach the VOA has utilised to model location.

Overview of regression model

Regression models are typically at the core of an AVM. As shown in figure 2, these:

- Rely on common data of good quality across properties, including their property characteristics, location and sales transactions.
- Typically use supervised machine learning techniques, where the model is trained using known transaction values. Statistical techniques are used to calculate the impact of location and property characteristics on the values of properties.
- Hold some transactions back to enable the model to be tested and performance understood.
- Are then used to estimate values for the entire stock of properties based on their location and property characteristics. AVMs enable efficient and consistent valuations that can be applied on a large scale.

Figure 2: Overview of the AVM supervised machine learning approach



Depending on the data used there are two main ways in which variables can impact the valuation.

Indicator variables are used for categorical data, for instance which broad location (e.g. local authority or postcode sector) you are in or what property type the property is. These are binary, either you are a detached house, for instance, or not. So the model gets adjusted by a fixed amount for that property type, otherwise there is no effect. Figure 3a demonstrates how average property values vary by local authority in Wales.

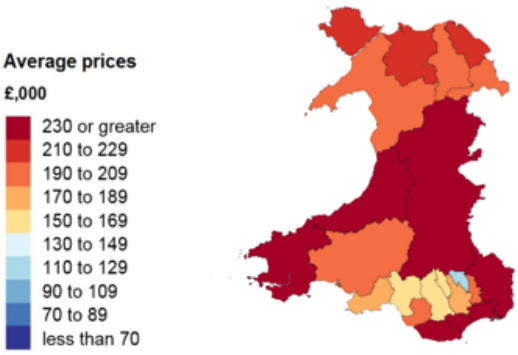
Numerical variables, like dwelling area are continuous. So for each increase in dwelling area the value goes up by a set amount. This relationship can be seen in figure 2b.

It's a little more complex than that though, with mathematical transformations, such as taking the logarithm (note the graph in figure 3b is on a logarithmic scale) and normalising data, used as needed. An iterative approach is used to find the right combinations of variables including interaction terms, such as whether the impact of dwelling area should change with the type of property.

Trained analysts, supported by valuers with expert subject knowledge, determine what variables should be included and how they should be transformed or interacted.

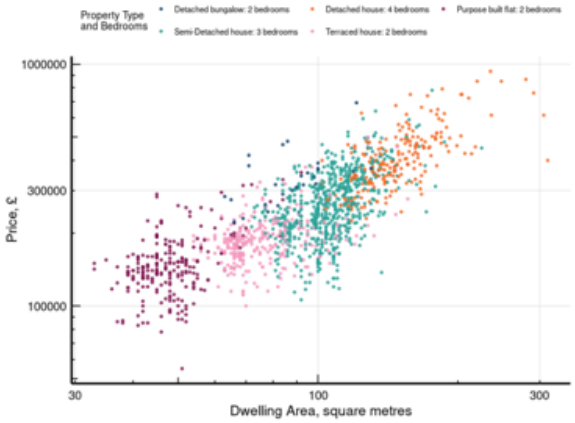
Figure 3: Graphs demonstrating the impact of different variables on property values

a) Average price by local authority for Wales



Source: HM Land Registry HPI statistics Apr 2023

b) Distribution of prices and dwelling area within Cardiff for different properties

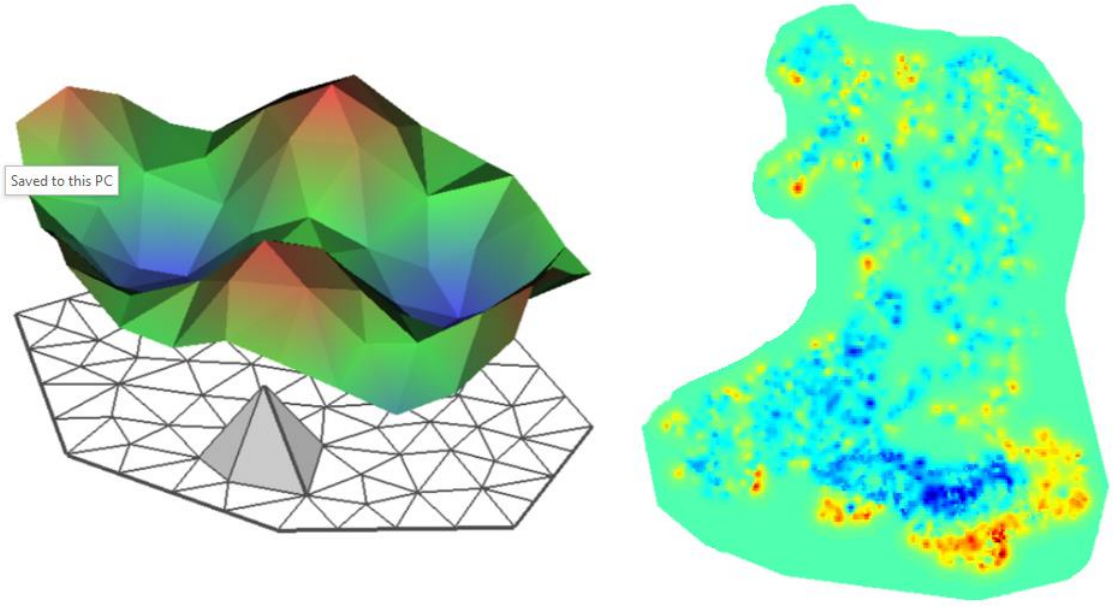


Location impact

Typically, location impacts are through indicator variables. More sophisticated techniques can use hierarchies of nested geographies, but these still lead to a set effect for a specific broad location. In truth variations in value can be much more granular, but also more gradual than imposing artificial boundaries between one broad location and the next. We utilised an advanced spatial modelling technique called Gaussian Markov Random Fields to estimate location impacts.

This utilises a mesh of triangles to approximate a continuous field of location adjustments (see figure 4). This enabled location adjustments to be estimated continuously over the whole of Wales rather than varying between fixed geographical regions. This has allowed lower-level spatial patterns to be accounted for and resulted in better model performance.

Figure 4: Diagram of triangular mesh and location factors output by the model

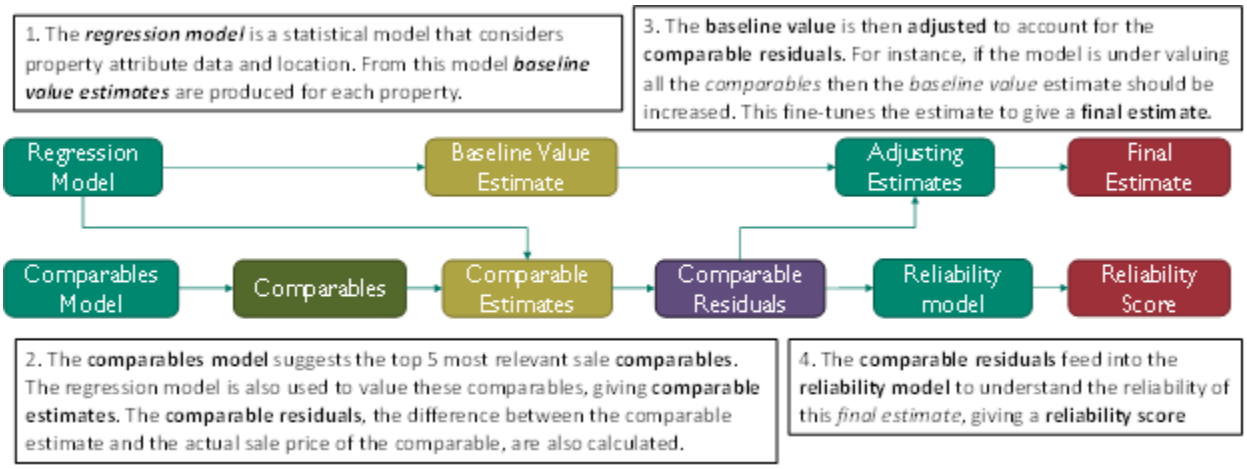


Source: Figure taken from https://ourcodingclub.github.io/

Full AVM

The regression model is the core component of the AVM, however there are several other elements to our AVM for Wales as illustrated in Figure 5:

Figure 5: Diagram of the various components of the AVM



Assurance and support

As well as the collaboration within the VOA between valuers and analysts, utilising external expertise was also crucial. Critical friends from the Centre for Appraisal Research and Technology, experts in Mass Appraisal provided advice during the model development and experts in spatial models, who usually applied the techniques to other areas of research, were also consulted.

The VOA commissioned the International Association of Assessing Officers (IAAO), as a recognised world leading authority on AVMs, to carry out a review of the model. They acknowledged the results of the VOA's innovative and collaborative approach:

"The unique model structure of the VOA's program is the first of its kind in both structure and scope and, based upon our statistical testing, produces a set of statistically reliable estimates of value for domestic properties in Wales. Significant credit should be given to both the modelling and valuation staff at the VOA for their efforts to ensure the success of this ambitious project."

Conclusion

Although the AVM developed is a complex statistical model, the above information shows how it is built from intuitive approaches, such as from trends in data that can be observed in simple graphs. Location is often referenced as a key driver of valuation, and the VOA's approach enables a more granular location adjustment and has been acknowledge by industry experts.

A more detailed specification of the model used for Council Tax reform in Wales is available.