



# Implementing an AVM at large scale on a banded system in the UK

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**INTERNATIONAL RESEARCH SYMPOSIUM**

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# Outline of session

- Overview of Welsh CT Reform Programme & Revaluation
- What is Mass Appraisal & Automated Valuation Models, and how we've used them?
- How have valuers interacted with modelled valuations, including processes & tools?
- Summary and Conclusions
- Questions

# Council tax revaluation in Wales

- CT policy is devolved to Wales. They last had a revaluation in 2005.
- Welsh Ministers had announced a potential revaluation for 2025, which we were prepared for. Following public consultation this has now been set for 2028.
- Welsh Policy aims:
  - Fairer tax system – **bands** closer to current values
  - More transparency – clearer communications
- More efficient: 1.5m properties to value
  - Manual revaluation would cost 25%-50% more
  - Lower resource peak – half previous peak
  - Further benefits in future revaluations (30% saving)
- More transparent and consistent
- Aligned to VOA Strategic Objectives



# Stages of Revaluation

Data – but needs to be good quality

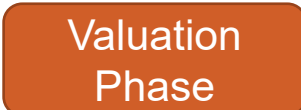


Upfront effort is required to enhance property data bringing it up to date and filling data gaps

Sales is the evidence base that underpins revaluation; its is crucial to verify these.



Valuers need to check and amend model valuations.



\* Then draft and compiled list



Modellers: valuers and analysts use this data to produce model valuations

# High Level Delivery Overview – Wales '25 delivery

2022/23

2023/24

2024/25

AVD 1<sup>st</sup>  
April 2023

Property Data Enhancement

Sales Verification

Model Development

Model Testing &  
Refinement

Valuation Phase:

Value & Band Review

Step Back and Look

Draft List 1<sup>st</sup>  
September  
2024

Live List  
1<sup>st</sup> April  
2025

We have produce a draft  
list for Welsh  
Government, but this will  
not be published

Draft List  
Enquiries

Maintenance  
/ Appeals

Data cleansing & model building

Valuation Phase:  
model **assisted** valuation

Enquiries, Appeals &  
Maintenance

# Mass Appraisal Modelling



# What is Mass Appraisal

- Mass appraisal is the valuation of a group of properties using **common data, standardised methods and statistical testing**.
  - Like single property appraisal, the differences are the scope of work and the tools used to complete the analysis.
  - Can use any of the three traditional approaches to valuation – though we're focussed on comparison.
- For public authorities that base taxes on the market value of property, mass appraisal is an **efficient and cost-effective** way to value all properties in a **fair, transparent and consistent manner**.
- Mass appraisal relies on good-quality data and sound market analysis to develop an automated valuation model (AVM) that estimates property values through mathematical modelling.

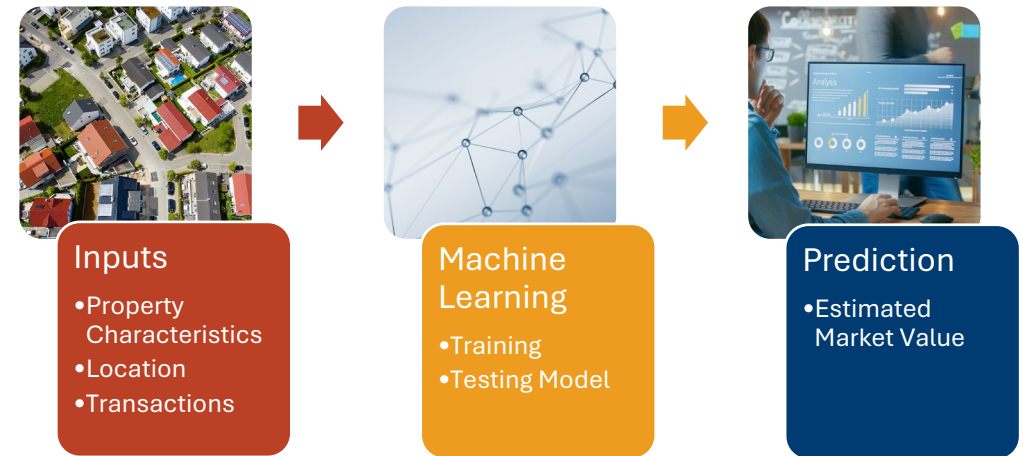
# Data Improvement Summary

- Accurate data key to an accurate model
  - Data Gaps –105k properties with core gaps investigated. 99.9% filled with desk-based research
  - Additional enhancing of parking facilities data – 92k added
  - Data issues sample – 10k sample, mix of random sample and targeted sample
    - From 2.5k random sample: showed 15% of properties had a more major change to property attributes, potentially impacting value
    - From 7.5k targeted sample used intel (3<sup>rd</sup> party data, sale price etc.) to test potential indicators – developed predictive analytics which demonstrated that we could identify properties with 50%+ chance of needing changing
    - Led to model to prioritise further targeted data correction of 25k properties, with 60% having major change.
- Greater attention on sales, with 40k cleaned – to ensure stable tax base.
  - Sales influence the values of many properties.
  - Incorrect data on a property that has not sold just impacts that property.



# What is an Automated Valuation Model (AVM)?

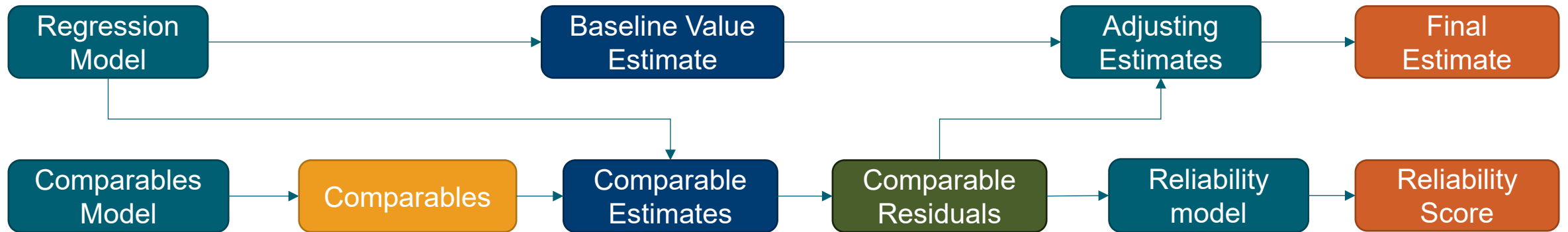
- An Automated Valuation Model uses statistical techniques to provide an estimate of the value of a specified property, at a set point in time.
- Typically, **supervised machine learning** techniques are used where the model is **trained off transactions where the value is known**. The statistical techniques calculate the impact of location and property characteristics on the value of properties.
- Some **transactions are held back** to enable the model to be **tested** and performance understood.
- **Estimated values** can then be made for the **entire stock of properties** based on their location and property characteristics



# Our AVM is really a series of models

1. The **regression model** is a statistical model that considers property attribute data and location. From this model **baseline value estimates** are produced for each property.

3. The **baseline value** is then **adjusted** to account for the **comparable residuals**. For instance, if the model is under valuing all the **comparables** then the **baseline value** estimate should be increased. This fine-tunes the estimate to give a **final estimate**.



2. The **comparables model** suggests the top 5 most relevant sale **comparables**. The regression model is also used to value these comparables, giving **comparable estimates**. The **comparable residuals**, the difference between the comparable estimate and the actual sale price of the comparable, are also calculated.

4. The **comparable residuals** feed into the **reliability model** to understand the reliability of this **final estimate**, giving a **reliability score**

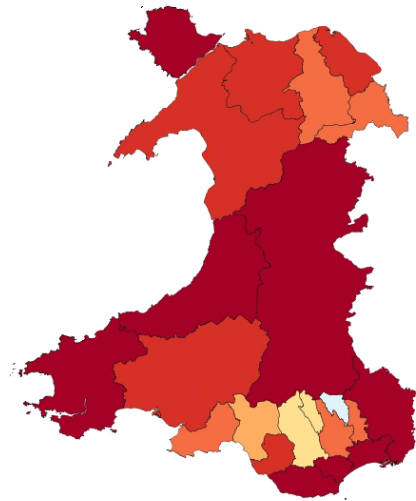
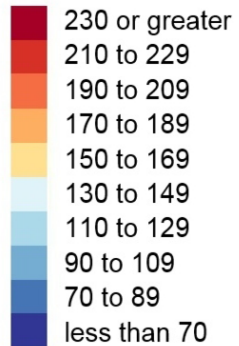
# Regression Model

- Uses the data we hold to derive a statistical model for the impact of different factors on property prices:

## *Location*

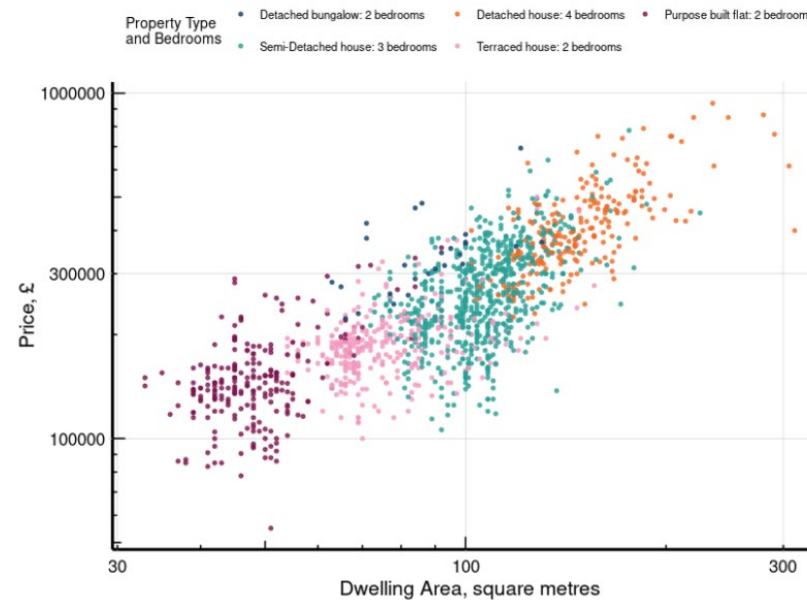
Average price by local authority for Wales (Source Nov 2022 HPI)

Average prices  
£,000



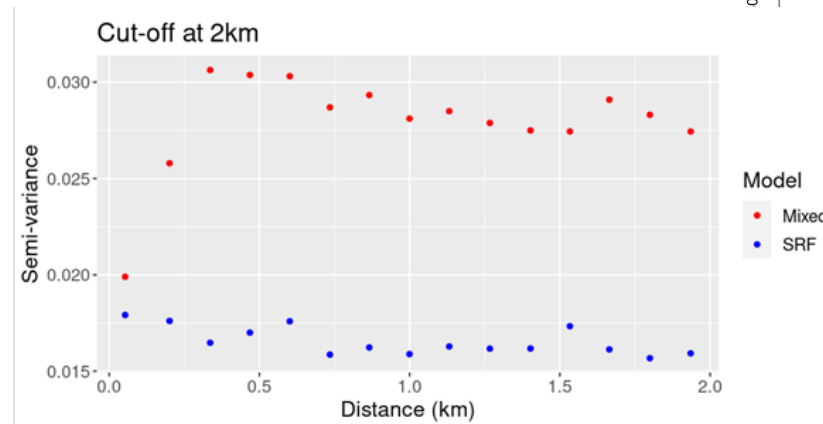
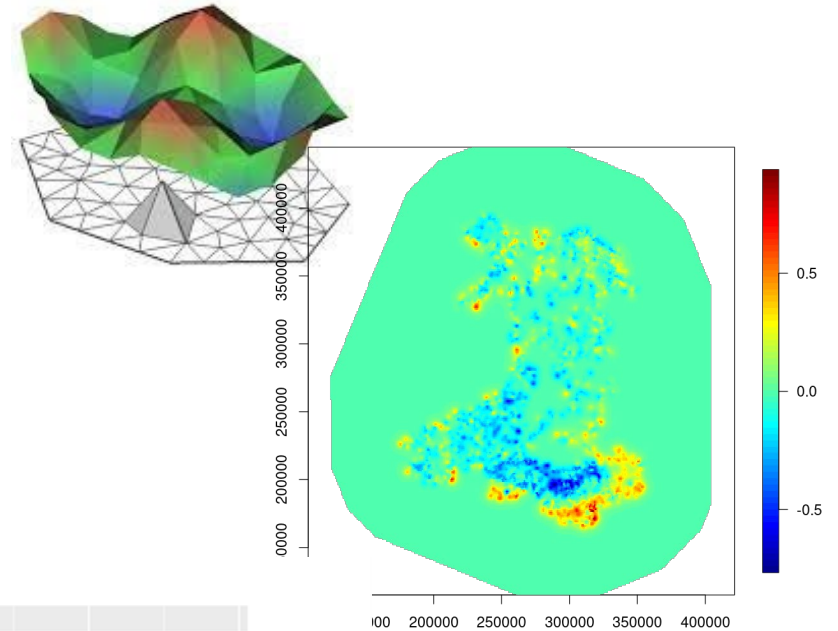
## *Property Characteristics*

Distribution of log prices and log dwelling area within Cardiff for different properties



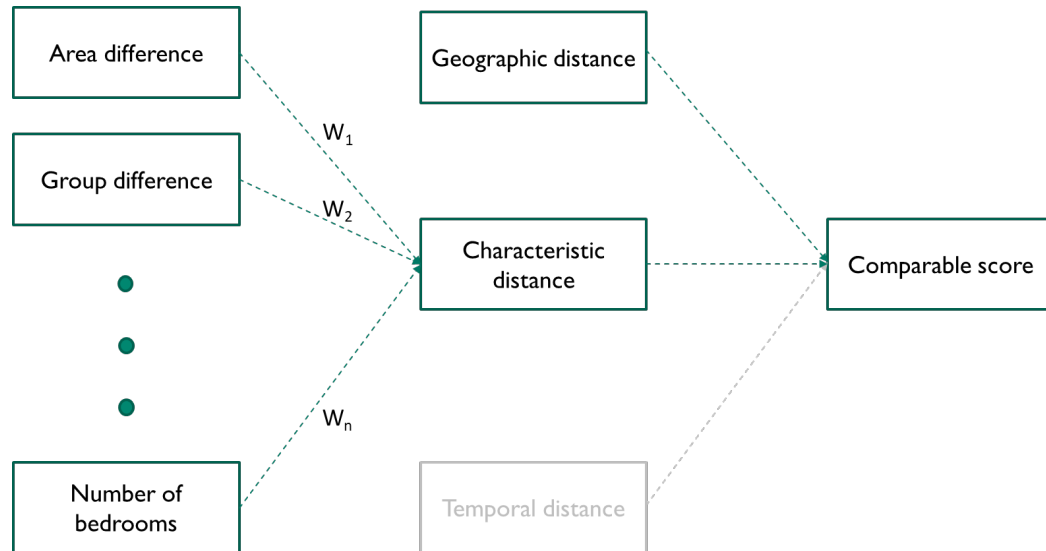
# Modelling location: Spatial Random Field

- Advanced spatial modelling technique used to model location – Gaussian Markov Random Field
- Mesh of triangles used to approximate continuous field of location adjustments
- This improves model performance across all areas of Wales as it is:
  - More able to account for local variance
  - Does not create artificial boundaries
- Also reduces spatial correlation
  - A key limitation of other approaches



# Comparable Model

- Comparables model identifies most relevant sales evidence for each subject property

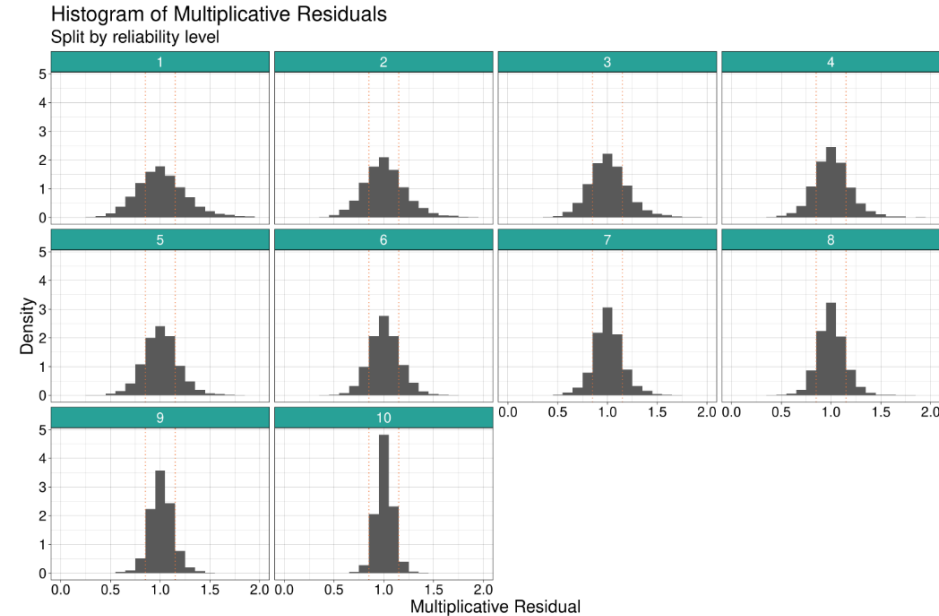


- Which can be adjusted by the regression model to give alternative estimates

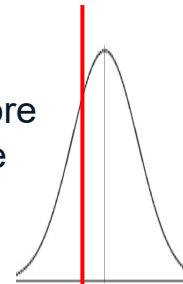
|                           |  | Predicted Price | Similarity Score / Weight | Multiplicative Residual |  |
|---------------------------|--|-----------------|---------------------------|-------------------------|--|
| subject                   |  | £265,000        | 2.5                       | 1.00                    | <b>Weighted Average Multiplicative Residual</b><br><br>0.98<br><br><b>Comparable adjusted prediction for subject (using multiplicative residual)</b><br><br>= £ 265,000 × 0.98 = <u>£260,000</u> |
| Top n comparables (n = 5) |  | £265,000        | 1.00                      | 0.93                    |  |
|                           |  | £233,000        | 0.95                      | 0.70                    |  |
|                           |  | £200,000        | 0.95                      | 1.09                    |  |
|                           |  | £225,000        | 0.92                      | 1.12                    |  |
|                           |  | £243,000        | 0.89                      | 0.98                    |  |

# Model Performance & Reliability Scores

- Not just a point estimate, each estimate assigned a reliability level which gives a range of possible estimates.
- But bands make things more complex. Reliability, but also proximity to the band boundary
- So need to prioritise by probability of being in the incorrect band

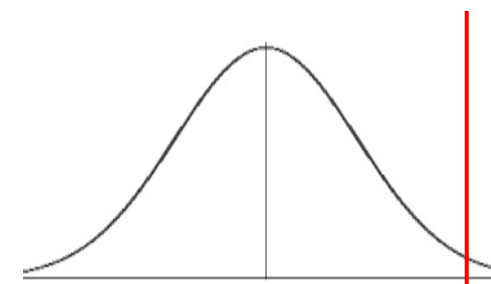


High reliability score  
= reliable estimate  
= tight distribution



High reliability, but  
close to band margin,  
so need to check

Low reliability score  
= less reliable  
estimate  
= wide distribution

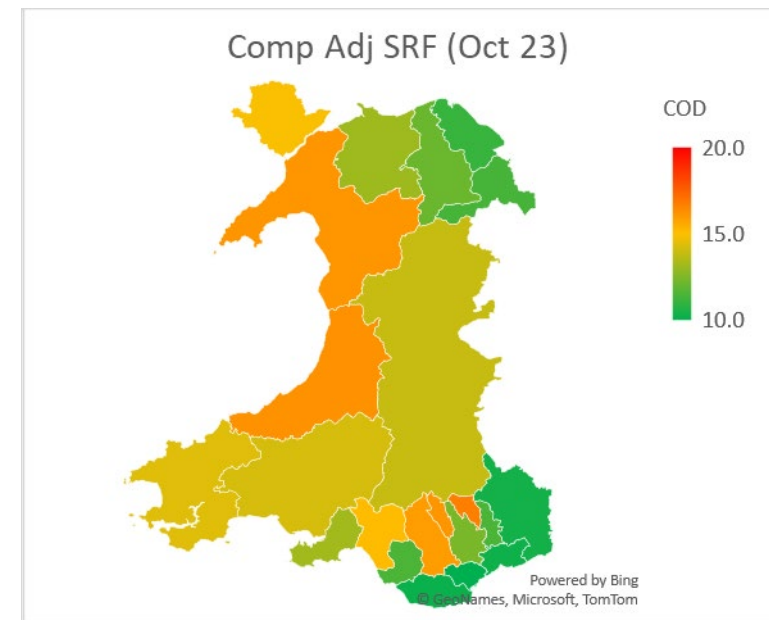
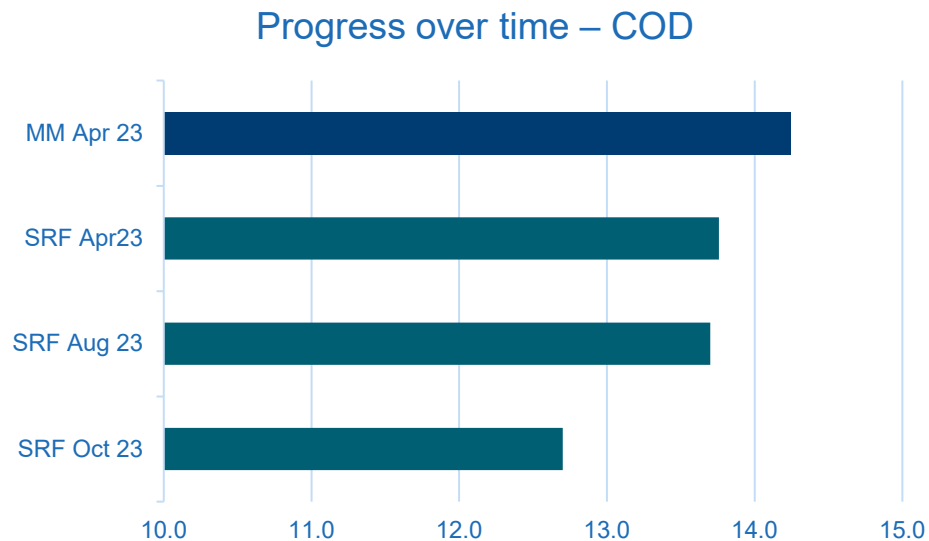


Lower reliability, but further from band  
margin and much smaller chance of being  
in wrong band – not a priority to check



# Progress over Development cycle

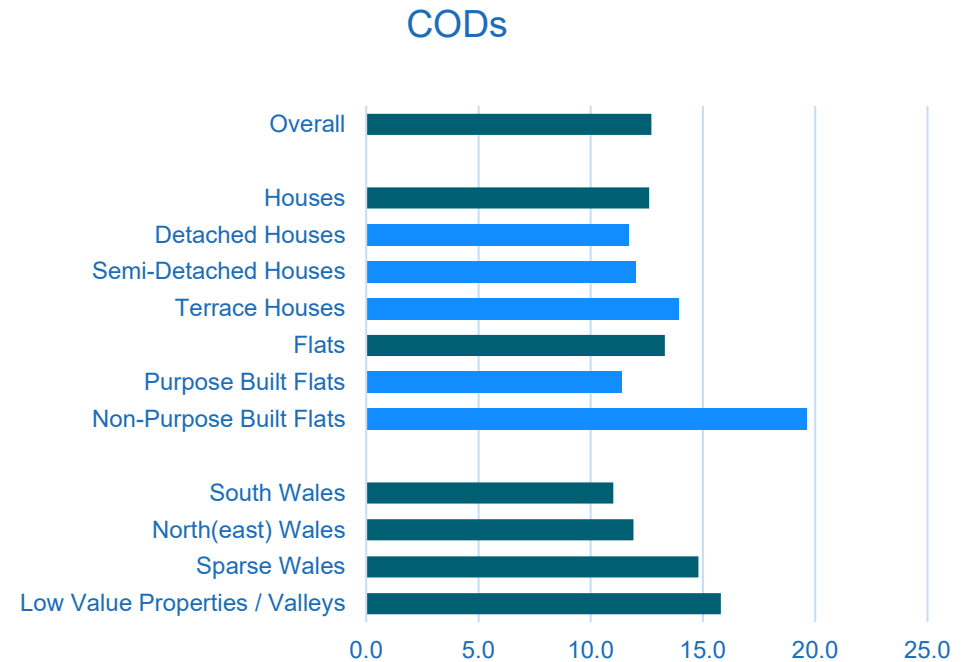
- Modelling developed over 2 years with various phases



# Latest Performance

- VOA commissioned IAAO to carry out a full and independent review of our AVM. The outcome was excellent and best summarised with a quote in the report conclusion:
- “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”.

|               | +/-<br>10% | +/-<br>25% | COD  | PRD   | PRB    | Median<br>Ratio |
|---------------|------------|------------|------|-------|--------|-----------------|
| October Model | 53.3       | 88.3       | 12.7 | 1.026 | -0.038 | 0.997           |



# Mass Appraisal Valuation

# Tools and Valuer Oversight

- Model **assisted** valuation approach with valuers reviewing significant volumes of bandings.
- Series of IT tools developed in-house to enable valuers to complete the revaluation:

## Sales Verification Tool

— enabling valuers to assess sales and record where they are not open market value or update the attribute data accordingly

## Value & Band Review Tool

— enabling valuers to assess the accuracy of model valuations for batches of properties

## Stand Back & Look (with Exception Reports)

— enabling valuers to undertake target assurance of all bandings, ensuring consistency between properties and targeting anomalies

# Sales Verification Tool

Key data on sales can be viewed on a single screen



Sales Verification Records can be created and maintained



All Sales also made available through dashboard

## Dwelling & Transaction Info

UARN 63917202  
 Address 149 HOWE WAY, KH56 3EX  
 Post Code KH56 3EX  
 Transaction Date 10/03/2023  
 Sale Price £176,000  
 Outlier Flag HB06

Create new sales verification code

| Sales Pipeline/Model       |            | Location                 |                   | Hyperlinks               |  |
|----------------------------|------------|--------------------------|-------------------|--------------------------|--|
| Overall Flag               | No flag    | Billing Authority Code   | 5905              | EPC                      |  |
| Outlier Flag               | HB06       | Middle Super Output Area | Conwy & Afon Roe  | Google Maps              |  |
| Ratio                      | 1.24       | Lower Super Output Area  | W01000131         | Streetview               |  |
| Predicted Price            | £216,202   | Output Area              | W00000665         | Zoopla                   |  |
| Reason                     | No flag    | Postcode                 | KH56 3EX          | Rightmove                |  |
|                            |            | X-Coordinate             | 240704            | VMS                      |  |
|                            |            | Y-Coordinate             | 249621            |                          |  |
| Property Attribute Details |            | Sales Information        |                   | Repeat Sales Information |  |
| Group                      | Type       | Age                      | Area              | Rooms                    | Beeds                                  |
| 31                         | ES         | H                        | 74                | 3                        | 2                                      |
|                            |            |                          |                   | 1                        | 1                                      |
|                            |            |                          |                   |                          |  |
| Dwelling Effective Date    | 17/11/1999 | Transaction Price        | £176,000          | HPI Adjusted Price       | £176,709                               |
| Geospatial Plot Size       | 244.32     | Transaction Date         | 10/03/2023        | Previous Ratio           | (Blank)                                |
| Geospatial OS Area         | 243.83     | Sale Source              | both              | Later Ratio              | (Blank)                                |
| EPC Rating                 | D          | SDLT                     |                   | Land Registry            |  |
| EPC Date                   | 16/12/2020 | SDLT ID                  | S_WSFA078F851_286 | LR ID                    | (F87E72F8-B99F-176C-E053-8B04A8C0D2BE) |
|                            |            | Type of Property         | R                 | Type of Property         | S                                      |
|                            |            | Transaction Price        | £176,000          | Price                    | £176,000                               |
|                            |            | Transaction Premium      | (Blank)           | Tenure Type              | F                                      |
|                            |            | Tenure Type              | FP                | Same Day Transactions    | single bn                              |
|                            |            | Same Day Transactions    | single bn         | Price Paid Category      | A                                      |
|                            |            | Transaction Type(s)      | (Blank)           | OldNew                   | N                                      |
|                            |            | Lease From               | (Blank)           |                          |  |
|                            |            | Lease Term               | (Blank)           |                          |  |
|                            |            | Ground Rent              | (Blank)           |                          |  |
|                            |            | Ground Rent Information  |                   | SDLT Vendor Information  |  |
| Composite                  | N          | SDLT Vendor Information  |                   |                          |  |
| Band Reference Date        | 20/09/2005 |                          |                   |                          |  |
| Banding Reference ID       | 50578897   |                          |                   |                          |  |
| Band                       | D          |                          |                   |                          |  |
|                            |            | GORDON                   |                   | ALMIRON                  |  |

## Create a new sales verification code

UARN 4486743000  
 Address 195 WILSON ROAD, H9 4IB  
 Post Code H9 4IB  
 Transaction Date 02/07/2020  
 Sale Price £240,000  
 Outlier Flag [Blank]

Clear all values

### Is this sale useful?

Yes  
 No

### PADs status

Reviewed, not amended

### PADs status notes (optional)

You have 1,000 characters remaining

### Condition

Property Attribute Details of Sales

Sale Status: Multiple selections

Sale Date: 02/04/2017 - 30/04/2024

MSOA: All

BA: All

Group: All

Age: All

Beeds: All

Postcode Prefix: All

Type: All

Rooms: 0 - 6000

VSC: 8

Postcode: May 15, 2024 12:00:20 PM

Area: 0 - 6000

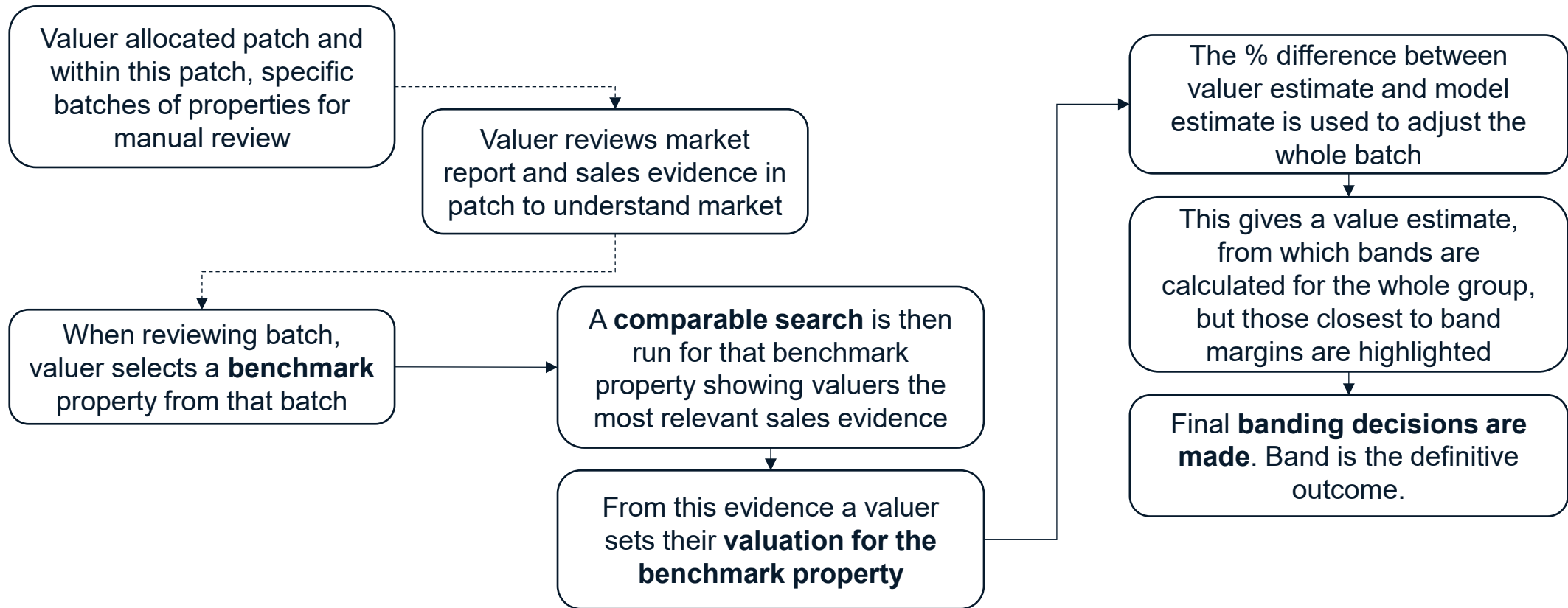
Plot Size: 0 - 2884751

Postcode: 30

Sale Count

| UARN       | Address (VMS) | Sale Price (Rightmove) | /m2    | Sale Date (Zoopla) | Adj Price | /m2    | G  | T  | Ag | Ar (EPC) | R-B-B-F (GSV) | FLV | P  | VSC | Plot | Sales Status (SVT) |   |
|------------|---------------|------------------------|--------|--------------------|-----------|--------|----|----|----|----------|---------------|-----|----|-----|------|--------------------|---|
| 42163202   |               | £275,000               | £2,273 | 08/03/24           | £270,292  | £2,234 | 01 | HS | A  | 121      | 6-4-1-2       |     |    |     | 1026 | A                  |   |
| 41315202   |               | £410,000               | £2,030 | 04/09/20           | £481,293  | £2,383 | 45 | MC | A  | 202      | 9-7-2-        | 03  | SP |     |      | G                  |   |
| 106894202  |               | £215,000               | £2,905 | 19/04/24           | £212,773  | £2,875 | 20 | HT | D  | 74       | 4-3-1-2       |     |    | G1  | ZL   | 235                | A |
| 212362202  |               | £620,000               | £3,212 | 26/09/23           | £568,698  | £2,947 | 35 | HD | K  | 193      | 6-4-2-2       |     |    | G2  |      | 153                | G |
| 180901202  |               | £195,000               | £2,438 | 09/12/22           | £189,229  | £2,365 | 31 | BD | H  | 80       | 4-3-1-1       |     |    | G1  |      | 534                | G |
| 3432368000 |               | £495,000               | £2,324 | 28/04/21           | £547,256  | £2,569 | 32 | HT | L  | 213      | 5-3-2-3       |     |    | O2  | VO   | 113                | G |

# Overview of Value & Band Review Process





# Value & Band Review - Screen Overview

View Batch and Select Benchmark

Comparable Search

Value Benchmark

Band Batch

## View Batch

private\_W01000131\_detached-bungalow\_60s-and-70s\_2024-02-22

Pause Batch View Sales on Batch

Select Benchmark



## Sales Evidence on Benchmark

To view comparables, hold ctrl on keyboard, select preferred comparables properties within the PowerBI then click on Select Comps button.

Pause Batch

### Update search parameters

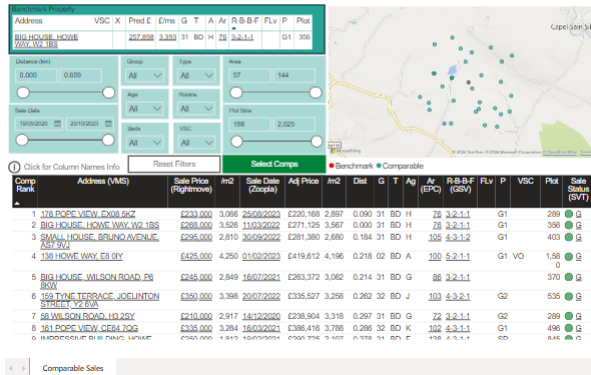
Enter a distance in kilometers

0.672

Show all sale outcomes?

Yes

Update Search



## Calculate benchmark adjustment

### Benchmark Information

UARN 64564202  
Address BIG HOUSE, HOWE WAY, W2 1BS  
Model Value €257,898

### Benchmark Comparables

| UARN     | Address                            | Transaction Date | Sale Price | Adjusted Price | Rank |
|----------|------------------------------------|------------------|------------|----------------|------|
| 66304202 | 176 POPE VIEW, EX08 5KZ            | 25/08/2023       | €233,000   | €220,168       | 1    |
| 64564202 | BIG HOUSE, HOWE WAY, W2 1BS        | 11/03/2022       | €268,000   | €271,125       | 2    |
| 64537202 | SMALL HOUSE, BRUNO AVENUE, AS7 9VJ | 30/09/2022       | €295,000   | €281,380       | 3    |

### Enter your proposed benchmark price

The price used to calculate the adjustment for all predicted values in the batch

€ 250000

Batch Adjustment -3.06%

### Remarks

You have 999 characters remaining

Band Properties Save for later

## Band Batch

Band batch dashboard (opens in new tab)

| Address *                                      | Proposed |      |             | Manual decision |  |
|--|----------|------|-------------|-----------------|--|
|  | Value *  | Band | Proximity   | Band            | Reason   |
| BIG HOUSE, BRUNO AVENUE, M5 7TF                | €208,548 | D    | 4.3% above  | D               | Sufficient evidence to justify band [ ]<br>You have 962 characters remaining |
| 137 GIVEN ROAD, JOELINTON STREET, MF36 0XE     | €211,579 | D    | 5.8% above  |                 | You have 1,000 characters remaining  |
| BIG HOUSE, SHEARER WAY, BRUNO AVENUE, F178 1NL | €211,915 | D    | 6.0% above  |                 | You have 1,000 characters remaining  |
| BIG HOUSE, POPE VIEW, EQ0 2SU                  | €220,629 | D    | 10.3% above |                 | You have 1,000 characters remaining  |

# Stand Back & Look (with Exception Reports)

## Exception Reports

Inconsistencies:

- Properties on the same street with identical or very similar attributes which are in different bands

Anomalies:

- Properties which have seen a large change in band (both up and down) between the 2 valuation dates
- Properties where the area appears large or small for the accommodation captured in the attribute data
- Properties where the area or other attribute data has reduced despite alterations/extensions being carried out to the property

## Stand Back and Look Tool

Interface to view and amend / correct bandings.

The screenshot displays the Stand Back and Look Tool interface. At the top, there are filter controls including 'Case Type' (All), 'Reset Filters', and 'Graphs'. Below this, various filters are set: 'Patch' (All), 'UARN' (All), 'Sale Date' (03/04/2017), 'Batch' (MSOA), 'MSOA' (Llanelli West), and 'Sale Date' (15/07/2024). Further down, filters for 'Billing Auth' (All), 'Group' (All), 'Type' (HS), 'Area' (0 to 5765), 'Street' (Multiple selections), 'Age' (All), 'Rooms' (All), 'Plot Size' (2 to 19656814), 'A/M/S' (All), 'Sale Status' (All), 'Beds' (All), and 'VSC' (All) are visible. A map on the right shows a residential area with a yellow highlighted street and several purple markers. Below the map is a data table with columns for UARN (Edit Band), Batch (Edit Batch), A/M/S, Address (VMS), G, T, Ag, Ar (EPC), R-B-B-F (GSV), P, VSC, Plot, Bmk, Band, Adj Price (Rightmove), Sale Date (Zoopla), and Sales Status (SVT). The table contains several rows of property data.

| UARN (Edit Band) | Batch (Edit Batch)      | A/M/S | Address (VMS) | G  | T  | Ag | Ar (EPC) | R-B-B-F (GSV) | P  | VSC | Plot | Bmk | Band | Adj Price (Rightmove) | Sale Date (Zoopla) | Sales Status (SVT) |
|------------------|-------------------------|-------|---------------|----|----|----|----------|---------------|----|-----|------|-----|------|-----------------------|--------------------|--------------------|
| 12585219         | C4-S46-semi_house-847-7 | M     | 2023-11-09    | 04 | HS | B  | 126      | 5-3-1-2       | O1 |     | 309  | N   | C    |                       |                    |                    |
| 12586819         | C4-S46-semi_house-847-7 | M     | 2023-11-09    | 04 | HS | B  | 126      | 5-3-1-2       | O1 |     | 219  | N   | D    | £244,054              | 09/09/2022         | G                  |
| 12588319         | C4-S46-semi_house-847-7 | M     | 2023-11-09    | 04 | HS | B  | 126      | 5-3-1-2       | G1 |     | 192  | N   | C    |                       |                    |                    |
| 12587619         | C4-S46-semi_house-847-7 | M     | 2023-11-09    | 04 | HS | B  | 128      | 5-3-1-2       | G1 |     | 499  | N   | C    |                       |                    |                    |
| 12600019         | C4-S46-semi_house-847-7 | M     | 2023-11-09    | 04 | HS | B  | 128      | 5-3-1-2       | G1 |     | 813  | N   | C    |                       |                    |                    |

# CT Reform in Wales – Key Achievements

**We have reviewed & successfully updated missing details on over 160k properties**

**More than 99.9% of our property records have key data completed**

**We have reviewed & updated the attribute data of over 40K sales within the valuation window**

**1.5m modelled values provided to WG in August 2023 to support CT Reform Policies**



**Delivered estimates with supporting comparables in October 2023 for operational review**

**Valuation and banding phase started in November 2023 supported by around 40 operations colleagues**

**Delivered full list of 1.5m bands to Welsh Government in October 2024**

**Supporting Welsh Government with updating the proposal and appeal process for CT in Wales**

# Challenges...

## Operational Productivity

Trial of tools but  
not at scale -  
productivity  
uncertain

Adapted process  
to improve  
grouping of work,  
but still challenges

## IT Environment

Wider system  
transformation not  
ready in time

Concerns about  
using *legacy*  
estate.. but no  
feasible alternative

## Politics (/media)

Uncertainty on  
final banding  
structure...  
exacerbated by  
changes within  
WG

UK General  
Election

### Welsh Labour using satellites to spy on homeowners and hike tax

Sir Keir Starmer's party refuses to rule out repeating the move in England

Wales has been brave enough to  
completely rethink the hated council tax.  
Take note, England

# CT Reform next steps: Revaluation '28

- Our innovative approaches meant we were prepared for 2025 revaluation, however, following consultation, the Welsh Government have opted for a 2028 revaluation.
- This gives the opportunity for us to build on foundations and collaborate and innovate further:
  - Further improvements to the AVM, including improving the usability of the comparables model
  - Refinement of the value and band review process to simplify how modelled valuations are utilised in banding
- Building key activities into BAU processes, particularly sales verification and data enhancement
- Working on transformation of proposal and appeals process to increase transparency and trust
- Aspirations to improve transparency of property attribute data for all domestic properties in Wales
- Build strategic IT solutions including:
  - a digital portal with customer authentication and verification to allow a secure two-way exchange of information
  - fully integrating the AVM into our IT systems so it can be utilised in real-time.
  - Ability to sort banding queries out without lodging proposals by building trust and confirming our data with our customers



# Conclusion

**Strong collaboration between Valuers, Analysts and Data Specialists – built our own valuation modelling function**

**Effective partnership working with Welsh Government policy team**

**Internationally recognised valuation product using the latest technology and analytical techniques**

**Delivered draft list of 1.5 million valuations to Welsh Government to aid further policy development**

**Continually Improving the Quality of our Data including through innovative approaches**

**Learning from valuation and banding process delivered at pace will help improve processes for '28**





*Thank You!*

**INTERNATIONAL RESEARCH SYMPOSIUM**

Amsterdam, The Netherlands · December 4 - 5, 2024

OFFICIAL