



XXVII FIG CONGRESS

11-15 SEPTEMBER 2022
Warsaw, Poland

Volunteering
for the future –
Geospatial excellence
for a better living

Model-to-model validation: using validation models in real estate assessment

- Luc D. Hermans
- Ruud M. Kathmann
- Marco Kuijper



ORGANISED BY

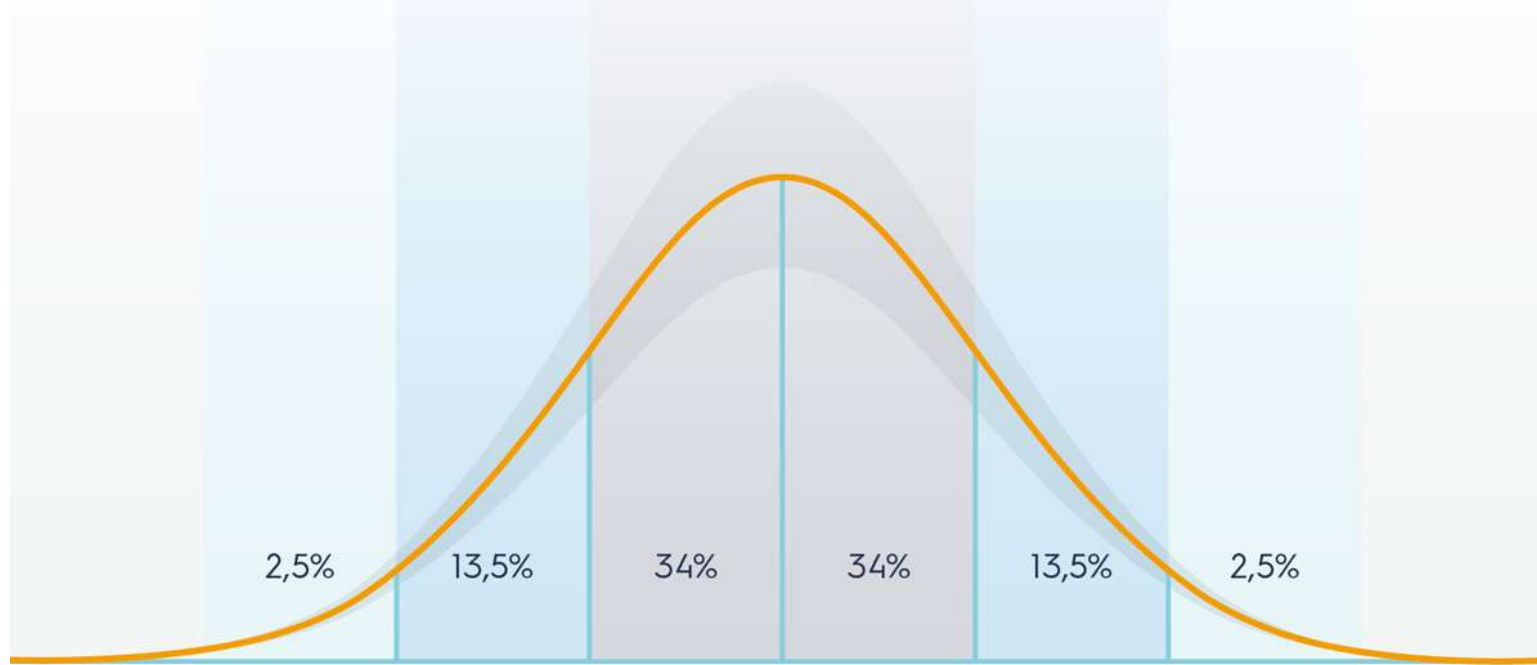


PLATINUM SPONSORS



Automated Valuation Models

“A mathematically based computer software program that market analysts use to produce an estimate of market value based on market analysis of location, market conditions, and real estate characteristics from information that was previously and separately collected. The distinguishing feature of an AVM is that it is a market appraisal produced through mathematical modeling. Credibility of an AVM is dependent on the data used and the skills of the modeler producing the AVM. AVMs should be developed by appropriately qualified market analysts, e.g., appraisers/valuers, who use statistically based applications to analyze data and select the best simulation of market activity for the analysis of location, market conditions, and property characteristics from previously collected data. AVMs are designed to generate value estimates for properties at specified points in time (retrospective or prospective dates as required by client).” (IAAO Standard on AVMs 2018)



A brief history of Automated Valuation Models (AVMs)

- First use around 1920
- Wider use after WWII +/- 1950-1970 (wider availability of computing power)
- Conceptualization of the use of Artificial Intelligence for real estate assessment (+- 1990)
- First spatial aware AVMS (+- 1990 and onwards)

- Wide range of available statistical methods to build Automated Valuation Models (now)
- Use of multiple AVMs to work **alongside** each other



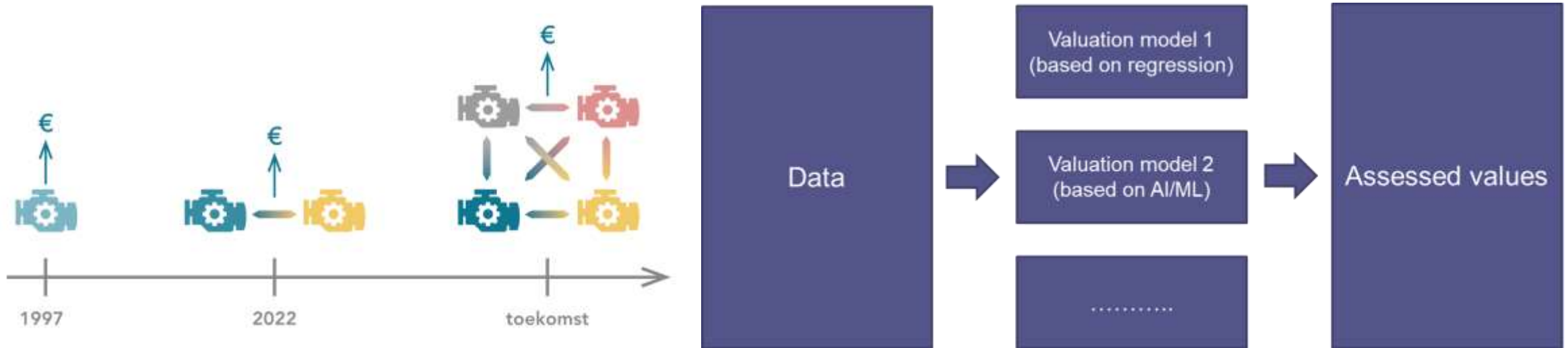
Categories of different statistical approaches to build AVMs

- General Linear Models
 - Location through “Distance to ..” or Dummy variables
 - Functional form transformations
- Spatially aware models
 - Geographically weighted regression (GWR)
- Artificial Intelligence based models
 - Neural Networks, Random Forests, Gradient Boosting Machines
- Cross Category Models

Developments in AVM applications (1)

- Use of AVMs is now widely accepted
- Current models:
 - MRA
 - Cluster approach
- AVM vendors are pushing AI-based models
 - Most commonly sold as “validation models”
 - Equality principle
- NCREA points towards the availability of spatial models
 - Research focusses mostly on Spatially Aware Models

Developments in AVM applications (2)



Working with validation models (1)

- Should pass IAAO Ratio Studies
 - Allows for the assessed value to be used as a value indicator
- Therefore, we can form an assessment to model value ratio

$$ASR = \frac{\text{Model Value}}{\text{Sales price}}$$

$$AMR = \frac{\text{Initial Model Value}}{\text{Validation Model value}}$$

<u>Initial model</u> (N= sold properties)
<u>Median Ratio (ASR)</u>
<u>COD (ASR)</u>
<u>PRB (ASR)</u>
<u>PRD (ASR)</u>
<u>MAPE</u>
<u>RMSE</u>
<u>AIP within 20%</u>
<u>AIP within 10%</u>
<u>Within 5%</u>

<u>Validation Model</u> (N= sold properties)
<u>Median Ratio (ASR)</u>
<u>COD (ASR)</u>
<u>PRB (ASR)</u>
<u>PRD (ASR)</u>
<u>MAPE</u>
<u>RMSE</u>
<u>Within 20%</u>
<u>Within 10%</u>
<u>Within 5%</u>

<u>Model-to-Model</u> (N= all properties)
<u>Median Ratio (AMR)</u>
<u>COD (AMR)</u>
<u>PRB (AMR)</u>
<u>PRD (AMR)</u>
<u>MAPE</u>
<u>RMSE</u>
<u>Within 20%</u>
<u>Within 10%</u>
<u>Within 5%</u>



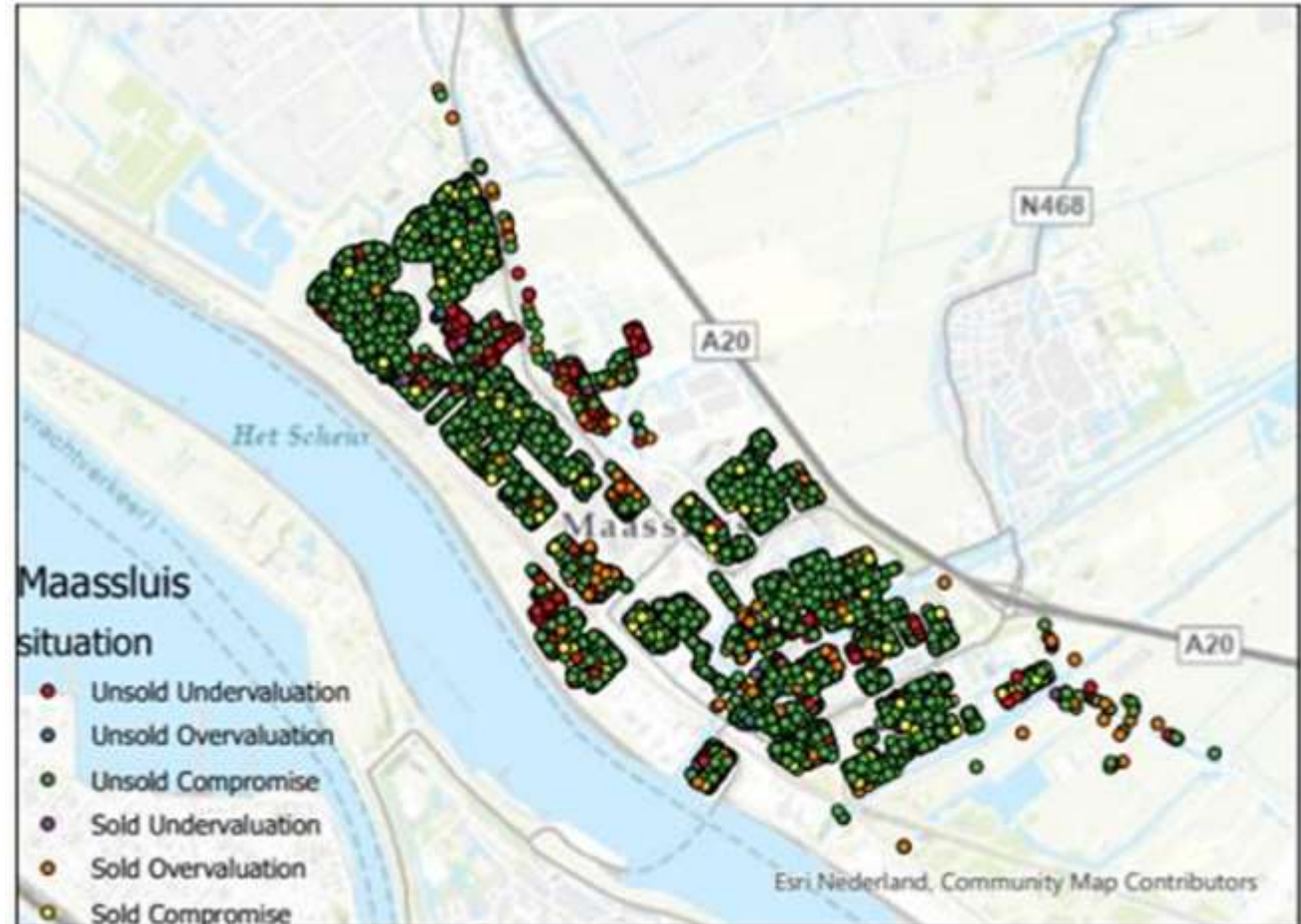
Working with validation models (2)

- 9 possible situations:

Scenario	Description	Initial model value	Validation model value	Observed sales price	AMR	ASR
1.	Unsold Undervaluation	200.000	240.000	X	0.83	X
2.	Unsold Overvaluation	200.000	160.000	X	1.25	X
3.	Unsold Consensus	200.000	200.000	X	1	X
4.	Unsold Compromise	200.000	195.000	X	1.03	X
5.	Sales Price Chasing	200.000	240.000	200.000	0.83	1
6.	Sold Undervaluation	200.000	240.000	250.000	0.83	0.80
7.	Sold Overvaluation	200.000	170.000	160.000	1.18	1.25
8.	Sold Compromise	200.000	195.000	205.000	1.03	0.98
9.	Absolute Agreement	200.000	200.000	200.000	1	1

Working with validation models (3)

- Spatial visualization allows for identification of pockets of situations



Future Research and developments

- Future research should focus on combining multiple automated valuation models to assess real estate
- Future research should focus on making combinatory techniques spatially aware
- Theory and semi-automatic automated valuation model are tested as an integrated part of the oversight strategy in the Netherlands
 - Semi-automatic meaning:
 - Automated modelling process and data trimming
 - Automated documentation

Questions and further reading

- L.hermans@waarderingskamer.nl
- Further reading (available on request):
- Hermans, L. D., Bidanset, P. E., Davis, P. T., & McCord, M. J. (2022). Using property-level ratio studies for the incorporation of validation models in single-family residential real estate assessment. *Journal of Property Tax Assessment & Administration*, 19(1)