United Kingdom
Criteria Report

Criteria for Automated Valuation Models in the UK

Analysts
Dr. Atanasios Mitropoulos
+44 20 7417 4317
atanasios.mitropoulos@fitchratings.com

Dr. Weike Wu
+44 20 7070 5823
weike.wu@fitchratings.com

Gregg Kohansky
+44 20 7862 4091
gregg.kohansky@fitchratings.com

This report updates the earlier report titled "*Automated Valuation Models in the UK*" published on 15 December 2005.

Please refer to Appendix 1 for all of the Fitch adjustments that would be applied in relation to a property value provided by an AVM, as well as for an example of the application.

Related Research
- "*UK Residential Mortgage Default Model Criteria*", 5 February 2007
- "*New Treatment of AVMs in U.S. RMBS*", 2 June 2006.

Summary

In the UK, automated valuation models (AVMs) were first developed in the late 1990s and have been applied since 1999. AVMs involve the use of a computer model rather than the expertise of a human being (such as a chartered surveyor) to determine a property value. Some form of automated valuation has existed for longer in other countries, most notably in the US but also in Canada, Sweden and Switzerland.

This report updates the inaugural AVM criteria report that was published on 15 December 2005. At that time, the agency conducted extensive testing of two AVM providers' models using data supplied by the providers themselves and test data from mortgage lenders. In this report, the agency is providing details of further testing conducted on these models as well as additional testing carried out on models from two other AVM providers. This report explains how the agency has used this test data to develop its approach to analysing portfolios that contain mortgage loans where some valuations may have been determined using AVM models. The key changes since the first publication are:

- the inclusion of two new providers
- the increase in the adjustment for low-value properties from 2% to 5%, and the reduction in the adjustment for the highest-valued properties from 7% to 5%.
- the change to the adjustment for default probability in Accuracy Groups 3 and 4.

In publishing this report, the agency is not recommending the use of, or endorsing, any particular AVM provider; nor is it expressing an opinion as to the relative merits of any particular AVM system.

Introduction and Key Results

The value of the underlying property is a key component in the assessment of the risk inherent in a mortgage loan. It determines both the original loan-to-value ratio (OLTV), which is one of the most important drivers of default probability, and the current LTV (CLTV), which affects the estimated loss severity. An accurate and unbiased assessment of the value of the property is thus crucial when estimating the likely risk involved in a mortgage loan. In analysing a mortgage loan for a residential mortgage-backed securities (RMBS) transaction, Fitch stresses the valuation amount to various degrees depending on the rating level. The higher the rating level, the more severe the market value decline (MVD) assumed. For full details of the Fitch UK RMBS analysis approach, see the report entitled "*UK Residential Mortgage Default Model Criteria*", dated 5 February 2007 and available at www.fitchratings.com.

Traditionally mortgage lenders have relied on surveyors to carry out a "full" valuation of the property. This process involves a physical inspection, a comparison with similar properties in the vicinity that have recently been sold and an assessment of market developments in that area. The purpose is to determine the market value of that property with a view to establishing an accurate estimate of the amount that the lender could recoup should foreclosure and sale of the property become necessary. The surveyors used by lenders are regulated by the Royal Institute of Chartered Surveyors, which sets industry standards. They are also covered by professional indemnity insurance, giving lenders further comfort about the way that the valuation is performed. AVM providers are now following suit, offering similar types of guarantees.

In recent years, competition between lenders has been intense and accompanied by a surge in non-purchase mortgage loan products, such as further advances, home equity withdrawal and extensive re-mortgaging following short-term teaser periods. These factors have put pressure on lenders to introduce less expensive ways of valuing properties and cut the time needed for the valuation process. Many lenders now allow "drive-by" valuations (ie an external physical inspection of the property without entering the premises), "desktop" valuations (ie a comparison of the target property with similar properties or house price indices) or an "automated valuation" using an AVM. These more restricted valuations are typically limited to loans with low-risk borrower and property characteristics.

The rapid pace of growth in the use of AVMs, and their inclusion in securitisations, make it necessary to provide a uniform framework for the agency to quantify the additional risk resulting from their use.

Fitch believes that the relatively short track record of automated valuations in the UK and the fact that their accuracy has not yet been tested in an economically stressed environment make it necessary to apply conservative adjustments to the values derived from AVMs. As experience with AVMs becomes more extensive, and if their currently good overall performance continues, the agency may need to reassess these adjustments. This is consistent with Fitch's experience in the US, where the AVM market has matured substantially; and issuers who have been able to demonstrate effective use of AVMs over time have not been penalised for using them when underwriting prime-quality mortgages.

Fitch's adjustments reduce the automated value by a certain percentage, which varies depending whether the AVM value is used for the OLTV, the CLTV or both. This percentage is calculated using the four components listed below:

1. a general adjustment;
2. special adjustments to correct observed bias and lower accuracy in specific segments;
3. an adjustment for the standard deviation of the values observed at each provider's respective level of accuracy; and
4. an adjustment applied when the automated value is used to assess the value of the property as at the origination date.

Please see Appendix I for a list of all the adjustments mentioned above, and Appendix II for an example of their application.

AVM Methodology and Modelling

UK AVM Providers

Four AVM providers cooperated in providing the agency with extensive information on their systems and business model. Hometrack Data Systems Limited (Hometrack) and UK Valuation Limited (UKValuation) had already participated in the first review, while Rightmove plc (Rightmove) and Calnea Analytics Limited (Calnea) provided detailed information to Fitch for the first time.

Hometrack is part of the Asset Trust Limited group of companies, a privately owned group.

UKValuation is a subsidiary of First American Corporation.

Rightmove was founded by four of the UK's largest estate agency chains and floated on the London Stock Exchange in March 2006.

Calnea is a privately held company, incorporated in June 2004.

The agency has reviewed representative data sets using the models of these four providers only. Therefore, at the time of publication, this criteria report applies solely to automated valuations that use the systems of these providers.

The criteria may be extended to other AVM systems from other providers in the future, subject to the same degree of testing by the agency and if test results show that the systems concerned attain a certain minimum degree of accuracy.

Techniques

Like desktop valuations, AVMs assign a value to a property without any external or internal inspection performed by a surveyor. AVMs also automatically

select the relevant market information and the appropriate method of aggregation needed to ascertain the value of the property. This method allows an objective valuation that is free of human subjectivity and possible bias. However, to allow for some control over the valuation of an individual property, some AVMs give the option to exert some influence on the valuation process, such as allowing the manual selection of the comparable properties that the AVM will use.

As well as providing a valuation for the subject property, automated systems can also give an indication of confidence in the accuracy of the valuation. The accuracy levels, which are defined and calculated differently by the various AVM providers, allow the lender to establish certain risk management rules when using automated valuations. The greater the degree of certainty indicated by these measures, the greater the probability of an accurate valuation and the lower the likelihood that the AVM will overvalue or undervalue the property by a certain defined percentage.

Model Components

AVMs will typically be an amalgamation of three modelling components:

1. comparables analysis;
2. repeat sales analysis; and
3. a hedonic price component.

Comparables analysis involves the selection of valuation and price information about similar properties that have recently been sold in the vicinity of the target property. Similarity is assessed using the characteristics of the property, such as the number of bedrooms, the property type, the classification of the area and several other variables. The more recent the information and the greater the similarity of the comparable property, the greater is the weight given to that valuation.

The time gap between the point at which the information on the comparable property was provided and the present day is typically filled using some indexing methodology – eg a comparison with the relative appreciation or depreciation of similar properties over time. To ensure that they can draw on a sufficient amount of useful comparables, the valuation companies collect large amounts of information from various sources such as lenders, valuation companies, estate agencies, the Land Registry, the Department of Communities and Local Government and socio-demographic databases.

The repeat sales analysis matches the recent sale of the property to the sale of the same property in the past and calculates the appreciation or depreciation between the two prices. Again, indexation methods are used to account for the change in value over time. Additionally, some AVMs filter out recent surveyor values on the property in question, to ensure that the automated value constitutes an independent valuation rather than a duplication of an already existing recent surveyor value.

Hedonic price models build on regression techniques that estimate the contribution of each feature of the property to the overall price. This technique is a more flexible way of determining an overall value for unique combinations of features, as historical information for similar properties may be scarce.

Each AVM provider will make different use of the data, assigning more or less weight to particular components of their models. The end result is an AVM value that is statistically optimised against the collected data.

As previously mentioned, AVM providers may supplement their property valuations with an additional variable indicating the accuracy that can be expected from that valuation. The measure of accuracy is directly related to the variance between the automated values and surveyor values.

Updating and Back Testing

Typically, AVMs are recalibrated every month. This involves an update of all databases, a comparison between past automated valuations and new surveyor and price information, and a re-estimation of the parameters of the model. This ensures that the performance of automated valuations is continuously monitored and that, on average, the automated values are consistent with valuation information available up to the last update.

Limitations

All three model components are reliant on available information about the target properties and on the existence of a sufficient amount of similar properties that have been sold recently in the vicinity of the target property. Conversely, properties that have unique features (eg a swimming pool) or are located in sparsely populated areas (eg the Scottish Highlands) or, more generally, are located in areas with low property turnover will typically be harder to value than properties with common features (eg terraced two-bedroom houses) or in densely populated areas with high turnover (eg London). Consequently, a significant reduction in the number of open-market transactions reduces the accuracy of automated valuations.

Furthermore, the automated valuation has a natural tendency to overvalue low-value properties and

undervalue high-value properties. This can be mitigated only by sophisticated filtering and adjustment techniques, whereby the comparables are subjectively chosen in the low- or high-value ends of the ranges. However, the degree of difficulty in determining the value of a particular property is typically reflected in the reported degree of accuracy. These degrees of accuracy, as mentioned before, are unique to each AVM provider.

Finally, at present, AVMs map purely historical values to the current market value of the property. This is because lenders typically base their lending decision on the present value of the property rather than the expected future price. However, the calibration of the AVM may lag by up to one month, meaning that the latest market trends may not be captured. This could be remedied by introducing a predictive component into the valuation model. Indeed, some valuation companies are working to fill this gap by introducing econometric forecasts into their models.

If this predictive element proves robust enough for sufficiently long periods, lenders may in future turn to basing their lending decisions on future price projections for individual properties rather than the current market value. In the meantime, Fitch adjustments will reflect the inherent risk arising from the one-month time lag, which is outlined below under the *General Adjustment* section.

Uses of Automated Valuations

Lenders currently use AVMs mostly for underwriting non-purchase mortgage applications such as further advances and home equity withdrawal – and only for less risky mortgage applications that are limited by constraints to affordability, credit and LTV. The values are thus primarily used to determine the loan amount for a mortgage. However, automated valuations have also been used as part of a quality control review of appraisal quality. In securitisations, they have additionally been used to update property values on a loan-by-loan basis as of the closing date, and for the surveillance of performance after closing.

Automated valuations may be less appropriate where data is limited or unavailable, the property to be valued is unusual in some aspect, or significant improvements have been made to the property since its last sale. In addition, full appraisals will provide more accurate valuations in rapidly changing market conditions because of the delay in data collection and because appraisers, knowing their local market well, can react to changes far more quickly. However, in many instances AVMs provide less expensive, unbiased and potentially more accurate valuations, especially for non-purchase mortgages. In addition, because the automated systems provide measures of accuracy, the lender receives a more balanced picture of the likely range of a property's true value.

Performance Analysis

Fitch reviewed the performance of AVMs based on test data provided by Hometrack (47,953 valuations), UKValuation (64,571), Rightmove (50,000) and Calnea (22,682). The data received is a representative cut of the respective companies' valuation portfolios. The data included information provided by several major UK lenders. The data sets provide information on the original surveyor value, the automated value as at the same date and several variables describing property characteristics.

Definition of Performance

Fitch measures the performance of the automated values purely through comparison with the corresponding surveyor values. The agency is aware of a few studies supporting the view that surveyor values can be biased depending on the circumstances of the valuation (eg loan purpose, market pressure) whereas automated values are intrinsically ignorant of these factors. However, Fitch's view is that, at the present time, surveyor values are commonly accepted values and market participants have become accustomed to basing their lending decisions upon them. Consequently, they naturally lend themselves as the best basis for comparison.

The analysis has been based on the following performance measure:

- Percentage error based on automated value =. $\frac{SurveyorValue - AVMValue}{AVMValue}$.

The performance error definition determines the likely range of surveyor values given the automated value. This definition is necessary to determine adjustments once a surveyor value is no longer available. For example, on receipt of a pool of loans with AVM values, surveyor values will not be available, so the percentage adjustment that Fitch makes will be based on the AVM value that was received. Consequently, when determining the adjustments, the differential between the AVM and the surveyor value should be taken as a percentage of the AVM value.

These percentage errors were analysed by AVM provider, region, property value, property type and reported accuracy levels. Distributions were compared using both standard measures (eg mean, standard deviation) and measures known to be more robust in the presence of outliers and skewness (eg median, interquartile range).

Results

Overall, the results support the view that errors are mostly unbiased and distributed roughly according to a normal bell-shaped distribution. This is true for all the AVMs reviewed. The results are summarised below.

- Low surveyor values are typically overvalued by AVMs as a consequence of the sampling method. The variance between the two valuations will cause properties that happened to be valued particularly low by surveyors to be (on average) valued higher by AVMs. An illustrative example would be an ex-local authority right-to-buy flat in Notting Hill, which may be valued quite low by a surveyor who has performed both the internal and external assessment, but which may be valued higher by an AVM that has based its valuation on comparable properties in the vicinity.

- High surveyor valuations are more often undervalued than overvalued by AVMs. Typically, in these cases, the surveyor can exploit certain positive information about the specific property (ie a special view from the veranda or a swimming pool) which the AVM ignores. Conversely, if the automated values are taken as a base, high automated values often overvalue surveyor values. This will typically be because the surveyor has considered specific negative information about the property which the AVM ignores, such as roof rot or dampness.

- As expected, there is more variation in less populated and less homogeneous segments of the pool, such as flats and bungalows, and properties located in areas with less historical information.

■ Criteria and Justifications

Fitch acknowledges the overall good performance of the tested AVMs to date. However, since automated valuations have only been applied in the UK for a few years, and calibration and back-testing could only be observed in the context of a rather benign environment, the agency considers it appropriate to apply adjustments to automated valuations to minimise the risk that an AVM value will be higher than a full surveyor value.

Adjustments are applied in four steps:

1. a general adjustment;
2. an adjustment correcting for bias and lower accuracy;
3. an adjustment by accuracy level; and
4. an additional adjustment by accuracy level if the AVM is used to assess the original value of the property.

The first three adjustments, which are applied every time an AVM is used, capture the effect of overvaluation or undervaluation on the loss severity of a loan. The fourth adjustment, which is applied only when the AVM value is determining the original value of the property, captures the additional effect on the default probability.

New AVM providers would need to undergo the same review process before the adjustments could be assessed. If valuations from more than one AVM provider were available for a single property, Fitch would expect a prudent lender to use the lowest of the valuations. If more than one AVM provider was used to value loans within a securitised portfolio, Fitch would expect to be provided with AVM values from each provider for each loan in the transaction where an AVM has been used.

The agency applies the same adjustments at all rating levels. The assessment performed is one of fact regarding the accuracy of the AVM systems and does not vary in relation to the credit scenarios applied by the agency to rate RMBS tranches at different rating levels.

Finally, Fitch will reassess these adjustments on an ongoing basis by back-testing test data from time to time.

General Adjustment

All automated valuations are reduced by 2% to take into account the time lag between market developments and the update of the valuation models. The 2.0% adjustment is deemed to be conservative since the largest-ever monthly decline observed in UK house prices was approximately 3.0% in real terms (i.e. corrected for inflation), which took place in the London region during the second quarter of 1990. It also compares with a maximum observed 12-month rolling average one-month real house price decline of 2.2%.

Adjustments for Special Segments

Table 1: Adjustments for Special Segments

	Adjustment (% of AVM value)
Fitch low-value bucket	5.0
Fitch high-value bucket 1	2.0
Fitch high-value bucket 2	5.0

Source: Fitch

Certain segments of the pools showed significant overvaluation and/or higher standard deviations per reported level of accuracy. These are addressed by using the adjustments outlined in Table 1.

The definitions of the value buckets follow the definitions for high- and low-value properties described in Fitch's "*UK Residential Mortgage Default Model Criteria*" report, which are reproduced in Table 2. These categories are updated every quarter to most accurately reflect current house price market movements. As at February 2007, these bucket values were as depicted in Table 2.

Table 2: Definition of High- and Low-Value Properties

(GBP)	Low-value bucket	High-value bucket 1	High-value bucket 2
London and Outer Metro	<=112,550	>=698,579	>=1,047,740
South-East, South-West, East Anglia	<=75,531	>=492,779	>=755,983
All other regions	<=76,875	>=484,261	>=679,033

Source: Fitch

Fitch received insufficient information on certain segments and will therefore apply additional adjustments for specially built properties on a case-by-case basis.

Valuations in Scotland and Northern Ireland will also be adjusted on a case-by-case basis, as the extent of the data and the accuracy of the AVMs differ by provider.

Adjustments Accounting for Standard Deviation by Accuracy Level

A portfolio's average error is less dispersed than the error of a single valuation. For example, it is quite likely that a single valuation may be overvalued by more than 10% (even if the valuation is unbiased), whereas it is highly unlikely that a large pool of properties will be overvalued by an average of more than 10%. Fitch therefore adjusts each individual automated value by the potential average overvaluation of the pool.

The adjustments based on the standard deviations associated with each AVM provider's accuracy level definitions are detailed in Table 3. These were derived using the following methodology:

- Fitch assumes an unbiased normal distribution for the deviation of the surveyor value from the AVM value;
- the central limit theorem is applied to a portfolio of valuations, thereby reducing the standard deviation of errors by the inverse of the square root of the portfolio size (as explained in Appendix 2).
- the 99th percentile of the resulting distribution is used to determine the adjustment by portfolio size and by the standard deviation of the individual valuation. Given the assumed normality of the distribution of individual errors, this means that for 99% of all analysed portfolios the average overvaluation for the whole pool will be less than the adjustment.

The resulting table is generic in the sense that the adjustments, which are linked to the Fitch observed standard deviations, can be applied to any AVM provider once the agency has conducted appropriate testing on the AVM. The specific mapping to the performance of the AVMs is done by comparing the reported level of accuracy with the actual standard deviation of errors that Fitch observed in the sample data sets.

The standard deviations reported in this study may differ from any published by the AVM providers because the agency considers all properties in its analysis – regardless of their specific features – whereas AVM providers typically filter out properties for which an automated value would not be recommended.

Adjustment Accounting Only for the Effect on Default Probability

Fitch's analysis shows that an overvalued AVM value has a disproportionate effect on the expected loss of a loan. Specifically, where the AVM is used to determine the original property value (rather than

Table 3: Adjustment for Severity by Accuracy Level

Group of accuracy/confidence	1	2	3	4	5	6
Standard deviation (%)	32	24	21	17	13	9
Hometrack confidence level	0–2	2.1–3	3.1–4	4.1–5	5.1–6	6.1–7
UKValuation confidence level		0.1~1.0	1.1~2.0	2.1~3.0	3.1~3.5	3.6~4.5
Rightmove standard deviation		0.211~0.25	0.171~0.21	0.121~0.17	0.091~0.12	0.001~0.09
Calnea confidence score	1~3	4	5	6~8	9	10
Adjustment (%)	3.3	2.5	1.5	1.2	0.9	0.6

Source: Fitch

to update the original surveyor value at the point of securitisation), an additional risk arises from a potentially mis-specified original LTV of a loan and its resulting impact on default probability. In the event of an overvaluation, both loss severity and default probability rise simultaneously. As a result, the expected loss on the loan increases by a larger amount than if there had been a corresponding, equally sized undervaluation of the property.

In its recent review the agency conducted a full simulation of the effects of under- or overvaluation on the expected losses for various types of loans. The results showed that the adjustments for Accuracy Groups 3 and 4 had to be raised to 2.5% and 1.5%, from the previous levels of 1.5% and 1.2%, respectively.

To account for this additional bias, Fitch will adjust the AVM value if it is provided as at the origination date as a substitute for a surveyor value. The agency carried out extensive simulation analysis and found that the impact was negligible for higher levels of accuracy but rose rapidly as the standard deviation attached to a valuation increased. The resulting additional adjustments are detailed in the last row of Table 4 below.

Results and Conclusions

Effects on RMBS

The haircuts applied to the AVM valuations are applied on a loan-by-loan basis, and therefore affect the LTV of each loan secured by a property that was valued via an AVM. This procedure reflects a conservative assessment of the risks inherent in these loans.

If AVMs are used only to update the values of underlying property for an RMBS transaction, the effect will be limited to the determination of the loss severity and the recovery rate. This procedure normally compares favourably with an update of property values based on an indexation table, which the agency performs automatically if no updated property value is provided. Fitch applies 50% credit for any price increase reflected in the indexation table since the last available valuation, while any price decrease is accounted for in full.

If AVMs have been used when originating the loan, the haircuts affect the default probability as well, since it is dependent on the LTV ratio at origination.

Accordingly this assessment feeds through to the calculation of foreclosure frequency and loss severity at the portfolio level and, consequently, the gross credit enhancement.

Ongoing Review

Fitch will continue to monitor the performance of the four AVM systems by examining valuation performance test data from the AVM providers on a periodic basis. The aim is to ensure that there has been no deterioration in the accuracy of these systems that might require a revision of the adjustments outlined in this report.

The agency will also expect AVM providers to inform it of any material changes to their methodology or accuracy measures that could affect the analysis of their systems. Marked changes in the accuracy of the systems over time may require a re-assessment of the agency's adjustments.

Likewise, if Fitch becomes aware of new AVM systems that become available, it will aim to review similar data for these systems to determine whether their results give a sufficient degree of accuracy for the same adjustments to be applied.

Future Outlook

Fitch will continue to monitor market trends and the use of automated valuations to ensure that the adoption of these methods follows rigorous testing and that they are only used where appropriate, based on the robustness of the AVMs used.

Home Information Packs

When the government first announced plans to introduce Home Information Packs (HIPs), it seemed likely that this would facilitate the widespread use of AVMs. The HIP was to include a Home Condition Report (HCR) giving an overview of the physical condition of the property but, crucially, no valuation figure. This would have left the valuation figure as the only component missing when assessing the property for underwriting – a gap that could have been filled by AVMs.

Table 4: Adjustment for Default Probability by Accuracy Level

Group of accuracy/confidence	1	2	3	4	5	6
Standard deviation (%)	32	24	21	17	13	9
Hometrack confidence level	0–2	2.1–3	3.1–4	4.1–5	5.1–6	6.1–7
UKValuation confidence level		0.1~1.0	1.1~2.0	2.1~3.0	3.1~3.5	3.6~4.5
Rightmove standard deviation		0.211~0.25	0.171~0.21	0.121~0.17	0.091~0.12	0.001~0.09
Calnea confidence score	1~3	4	5	6~8	9	10
Adjustment (%)	13.0	3.0	2.5	1.5	0.0	0.0

Source: Fitch

After several amendments to the initial plans, the HCR was finally made optional and early tests on the take-up of HIPs show that HCRs are conducted fairly infrequently, mainly due to the associated cost.

However, this does not seem to have hampered the growth of AVM usage. Although HIPs are unlikely help AVMs significantly expand their share in the valuation market, lenders have shown increasing interest in using automated valuations for various parts of their business.

Basel II

Automated valuations may also help lenders to reduce regulatory capital on their mortgage portfolio by conducting frequent re-evaluations of their assets. Since the LTV is a crucial input for calculating the probability of default and loss given default, a frequently updated LTV can lead to a lower risk assessment – particularly in times of high house price appreciation.

Lenders will be able to choose between AVMs and public house price indices when updating their asset values, as the Financial Services Authority has announced that it will recognise both methods for the calculation of regulatory capital. The extent to which regulatory capital can be reduced still depends on the results of ongoing discussions regarding adjustments to Pillar 2 of Basel II, and, for the internal ratings-based approach (IRB), on the outcomes of the internal risk models.

For the standardised approach, a 35% risk weighting is applicable to residential mortgage loans with LTV values of 80%, while a higher risk weighting is applicable to loans with higher LTVs. For the IRB approach, too, LTV measures strongly influence how banks group or classify their residential mortgage exposures, for the purposes of determining regulatory capital. Valuations therefore have a major part to play with respect to regulatory capital under Basel II owing to their influence on LTV.

Given ongoing intense competition and the imminent implementation of Basel II, many lenders are seeking new ways to lower costs and create efficiencies. AVMs are likely to play a role in this, and Fitch expects their use by lenders to grow further.

Appendix 1: Summary of Adjustments and Working Example

General Adjustment: 2.0%

Adjustments for Special Segments

	Adjustment (%)
Fitch low-value bucket	5.0
Fitch high-value bucket 1	2.0
Fitch high-value bucket 2	5.0

Source: Fitch

Additional adjustments apply depending on the amount of data available on rare property types and regions with little historical data.

Adjustment Accounting for Standard Deviation by Accuracy Level
Adjustment Accounting for Effect on Default Probability

Group of accuracy/confidence	1	2	3	4	5	6
Standard deviation (%)	32	24	21	17	13	9
Hometrack confidence level	0–2	2.1–3	3.1–4	4.1–5	5.1–6	6.1–7
UK Valuation confidence level		0.1~1.0	1.1~2.0	2.1~3.0	3.1~3.5	3.6~4.5
Rightmove standard deviation		0.211~0.25	0.171~0.21	0.121~0.17	0.091~0.12	0.001~0.09
Calnea confidence score	1~3	4	5	6~8	9	10
(3) Adjustment for severity (%)	3.3	2.5	1.5	1.2	0.9	0.6
(4) Adjustment for default probability (%)	13.0	3.0	2.5	1.5	0.0	0.0

Source: Fitch

Note that the mapping of the companies' reported accuracy levels does not allow for a statement regarding each company's overall ability to make a precise valuation. A true comparison between the companies would require there to be several properties for which automated values from all companies were available. Fitch is not in a position to perform such an analysis nor is it pursuing such a comparison.

Working Example – Minimum Adjustment

AVM values provided by any of the four AVM providers assess a terraced house in Crawley (the south-east region) to be worth GBP200,000 at Accuracy Level Group 6. The property value is used only to update the property value at the date of securitisation. The resulting value of the property is assessed as follows:

Example Calculation for an AVM Valued Property

Step	Remark	Adjustment (%)
General adjustment	Applied to all properties that have been valued by an AVM	2.0
Adjustments on special segments	No adjustment, as the value is neither in the low-value nor the high-value bucket, and the property type and its location are fairly common.	0.0
Adjustment for severity	An Accuracy Level 6 is associated with a standard deviation of 9%. The value in the corresponding column determines the adjustment.	0.6
Adjustment for default probability	This valuation is not being used to determine the original property value; therefore there is no adjustment.	0.0
Sum		**2.6**

Source: Fitch

The value of the property for the purposes of securitisation is assessed as:

- Adjusted Value = 200,000 * (100% - 2.6%) = 194,800

Maximum Possible Adjustments

Listed below are the Maximum Fitch Adjustments that could be incurred for an AVM value based on Fitch-derived standard deviations. Please note that these adjustments will be reassessed from time to time. In addition, the adjustments for certain segments, on a case-by-case basis, are not captured in the table below.

Maximum Adjustments by Accuracy Level

Group of accuracy/confidence	Standard deviation (%)	General adjustment (%)	Adjustment for severity impact (%)	Adjustment for default probability impact (%)	Total adjustment (%)	Adjustment for low/high value bucket (%)	Maximum possible adjustment (%)
1	32	2.0	3.3	13.0	18.3	5.0	23.3
2	24	2.0	2.5	3.0	7.5	5.0	12.5
3	21	2.0	1.5	2.5	6.0	5.0	11.0
4	17	2.0	1.2	1.5	4.7	5.0	9.7
5	13	2.0	0.9	0.0	2.9	5.0	7.9
6	9	2.0	0.6	0.0	2.6	5.0	7.6

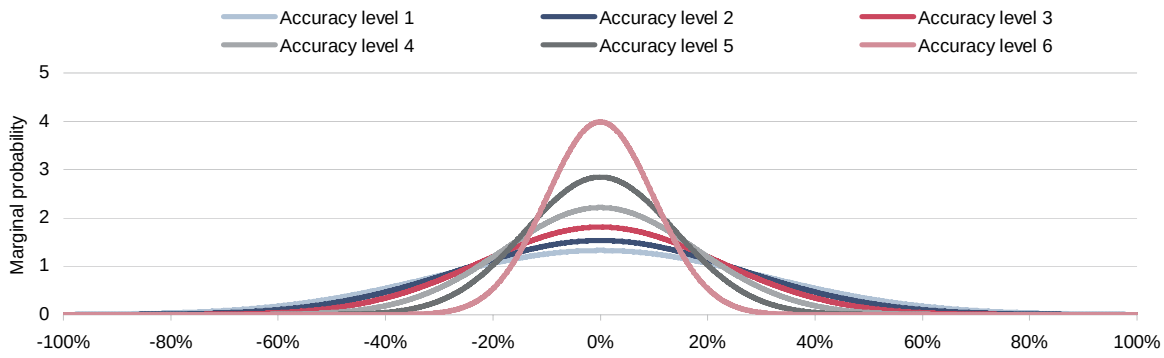
Source: Fitch

Appendix 2

Application of the Central Limit Theorem

The empirical distribution of errors is calculated on a loan-by-loan basis. This distribution ideally looks like a normal distribution centred on 0. The width of the distribution depends on the standard deviation, which differs by level of accuracy.

Distribution of Errors for a Single Property by Accuracy Level



Source: Fitch

When looking at a pool of assets, one has to take into account that overvaluations for some properties are offset by undervaluations for other properties: ie it is quite likely that one specific property is overvalued by 20% or more, but it is quite unlikely that all properties within a large pool are overvalued by an average 20% or more. Thus, the independence of over- and undervaluations of properties has to be taken into account at a pool level.

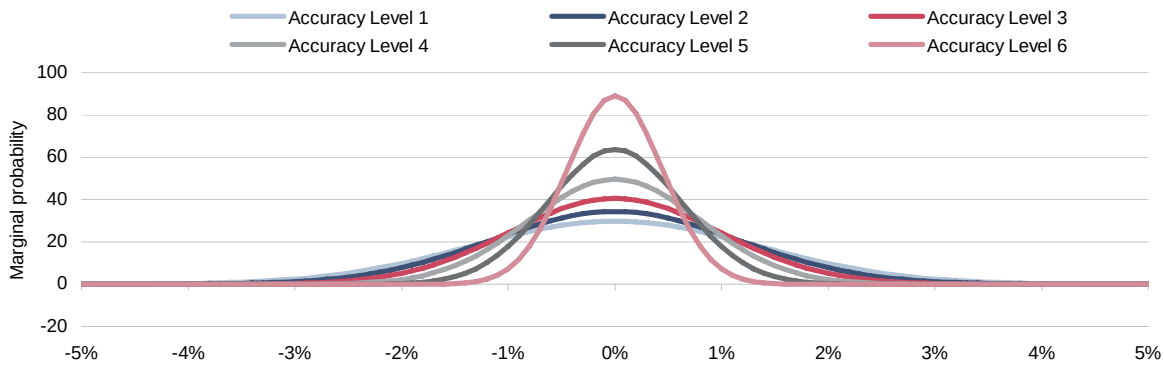
The central limit theorem offers a convenient formula for estimating the distribution of valuation errors at a pool level as it refers only to the characteristics of the single-property error distribution and the pool size. It basically states that the standard deviation of the pool error is equal to the standard deviation of the single-property error divided by the square root of the number of properties in the pool:

StDPool = StDProp / SQRT(# Properties)

The formula assumes normally distributed single-property errors, independence of valuations and a sufficiently large number of loans in the pool. However, it is a good approximation for any kind of distribution if valuations are performed independently of each other and the number of properties is sufficiently large. The number of properties adopted (1,000) is considered sufficiently large for the purposes of this analysis.

The resulting distribution at a pool level is thus much “narrower” (note the difference in scale on the x-axis).

Distribution of Errors for a Pool of Properties by Accuracy Level



Source: Fitch