uch to the chagrin of the general populace of the North American appraisal industry, Automatic Valuation Models (AVMs) are part of the appraisal process. AVMs have a place in this process because the purpose of any appraisal is to arrive at an estimate of worth or Market Value. This largely occurs by the analysis of sales data and the interpretation of that data. Bonbright (1937) said it quite clearly: AAll of the various methods of valuation known to the appraiser make use of inferences from either or both of two sets of data. First, data as to the values that have already been placed upon property by other people. Second, data as to the advantages that the property in question may be expected to confer upon an owner, present or future."

AVMs are capable of accepting and deciphering these two sets of data that Bonbright describes. The exception is that the data is in an electronic format, multi-tudinously abundant and utilizes modern computer technology. Through its process, AVMs can generate an acceptable level of Market Value for a given property for a specific group of users.

AVMs were created to fill a void originated by an extremely competitive mortgage marketplace, the establishment of new lending regulations after the collapse of many savings and loans companies in the United States, smaller profit margins by mortgage lenders, and advanced computer technology. AVMs were not created to replace appraisers, but as an additional tool for real estate practitioners. AVMs are an anticipated evolutionary change considering that no significant deviation from the norm has occurred within the appraisal industry in over 60 years. In some instances, AVMs are analogous with a revolutionary change within mortgage lending markets.

Before we can learn more about AVMs, it is important to provide a definition, since a simple spreadsheet that assists an appraiser in determining Market Value could be called an AVM. An AVM is a computer-based program that incorporates specific real estate, property attributes and demographic data to produce either a range or a single point estimate of value. Generally, AVMs have been restricted to the valuation of single-family, duplex and triplex dwellings. However, there are AVMs that will value commercial properties. AVMs can incorporate a number of methods of determining value and can be more sensitive to changes in prices, residential housing characteristics and amenities than their human counterpart.

There are a wide variety of AVMs in the marketplace and they work utilizing various methods to produce a value. The most common model in Canada is CMHC’s Emili, while, in the U.S., Fannie Mae and Freddie Mac are used by the Federal National Mortgage Association and the Federal Home Loan and Mortgage Corporation respectively. Most AVMs utilize public data, assessment data, price indexes, multiple regression analysis, expert systems and neural networks to formulate a market value of a given property. The overall quality of the AVMs in the North American marketplace varies, and buying an AVM is similar to purchasing a car in that the product is only as good as the materials and workmanship that have gone into it.

In order to obtain a better perspective of how an AVM works, references will be made to the more common styles or forms of the underlying processes.
Regression analysis

Regression analysis is a very generic term for both single and multiple uses of this statistically-based model. Single or simple linear regression analysis is a means for building models that describe how variation in one set of measurements affects variation in another set. In its simplest form, regression analysis involves two variables. The analyst forms a hypothesis that one variable is dependent on or responds to another variable (independent or predictor variable). In real estate value analysis, the dependent variable is often the sale price of a property in total or on a price per unit basis (dollars per acre or hectare). The independent or predictor variable can be a characteristic of the property that is believed to have an influence on the dependent variable—sale price in this example. This might be room size, age of house and condition.

Aided by a computer, regression analysis provides a systematic method for building an equation that summarizes the relationship between the two variables. The resultant equation can then be used for the prediction of value or the impact of given variables on price (coefficients).

Multiple Regression Analysis (MRA) extends the idea of a two variable linear regression model by allowing an analyst to include many explanatory factors to the regression equation. As in simple linear regression, a regression coefficient measures the impact of changes in each explanatory variable on the response variable. In MRA, the coefficient for each variable represents the impact of that variable on the dependent variable while holding the effect of the other variables constant. In addition to its usefulness in prediction, this allows the use of MRA as an exploratory tool where the coefficients can be interpreted as a level of contribution of the predictor variable.

Once the regression model determines coefficients for such items as corner location, room size, age, number of bedrooms, number of bathrooms and basement finishing, the characteristics of the subject property are then input utilizing the results based upon the regression model.

Regression analysis is an extremely powerful tool when analyzing large blocks of related data. It can determine specific values on the more price sensitive variables within the database and establish price trends. This is important because significant variations in price levels within similar styles and classes of houses can occur, particularly in rising and falling markets. Regression analysis is an affordable type of model.

The user of an AVM utilizing regression analysis must realize that regression runs on the premise that a linear relationship exists between one or more variables (predictor) and (response). In fact, much of the real estate world is generally non-linear and a considerable amount of ‘smoothing out’ of the model is necessary before interpretation of the coefficients is possible. The difficulty using regression analysis is that it requires a large database. This might not always be possible if a specific type of house style has not frequently traded in the marketplace.

Another drawback to this model type is identifying specific variables that might influence the sale price of the comparable(s). For example, some physical features of a house can be expressed very easily such as ‘a car and a half’ garage or ‘built-in,’ but these characteristics are not as easily defined within a linear regression format.

Expert systems

These types of systems are loosely associated with artificial intelligence that is the use of mathematics to replicate human behaviour. The challenge of these expert systems has been the assimilation of the differences between computer language and basic English grammar. Much of the integration of these two different forms of communication came about in the 1980s by using natural language parsing. The expert system is built on a order of rules created by an expert and hence that is why it is called an ‘expert system.’ Expert systems are not true artificial intelligence systems because they cannot generalize and are limited by the rules that have been placed upon them.

The success of an expert system is the programming of the computer to resolve the ambiguities of appraisal terminology. A good example of this is the word ‘sale’ that could have several meanings. One meaning relates to a comparable sale property while another refers to an event or the exchange of money for a specific item. The computer must be programmed to identify these differences. Expert systems generally contain three elements: a system that enables the real estate practitioner to communicate with the underlying model, an inference system that is capable of answering the queries of the user, and finally a database.

Expert systems only mimic the behaviour of the appraiser since the input or programming of the computer is solely determined on how the real estate appraiser would want to sort the data and react to a multitude of situations. A typical dialogue between the appraiser and the expert system would be as follows:

Expert system: What type of property have you been asked to value?
Appraiser: A retail plaza.
Expert system: What is the size of the retail plaza?
Appraiser: Approximately 26,000 square feet.
Expert system: Be specific.
Appraiser: 25,498 square feet
Expert system: What is the address of the subject retail plaza?
Appraiser: 123 Any Street.
Appraiser: Check database for possible sales.
Expert system: Five sales have been identified. Do you want them all?
This process continues until all of the appraiser’s questions have been answered by the model. Since the computer may not know all of the answers to the questions, some of the printed out responses would be blank. The expert system does have some capacity to learn, based upon continued questioning and reprogramming of the model.

The problems with expert systems are that they are not very adaptable to changing environments. They constantly require significant maintenance of the knowledge base and debugging of the underlying engine that drives the model. It is an expensive model to maintain because of the time needed for programmers to accurately quantify the forever changing real estate market and the mental reactions of those changes in the minds of appraisers.

Neural networks

Neural networks utilize advanced forms of statistics and computer programming skills. They are complex to understand and explain. These models are very different from an expert system in that there are no trails that can be followed as to how the model makes decisions. This type of network takes its name from the network of nerve cells in the brain. Many of the biological elements of the brain are eliminated with this model type. Neural networks employ enough of the workings of nerve cells in the brain to duplicate artificial responses to various input data.

Neural networks are massive parallel computer systems that rely on a layered
The arrangement of interconnecting points and data. Back-forward-error propagation is the most common form of network paradigms. Data is input in terms of property characteristics such as size, age and condition. Each characteristic is connected by points to a hidden layer of information that is necessary for processing. Thus, each variable is referred back and forward to each interconnecting point of the processing units. The interconnecting points are assigned a weight and the weights associated with each interconnecting point are adjusted during this back and forth process. The effectiveness of a neural network is within the vast number of interconnecting points.

The weights attached to these hidden computer codes can be negative or positive depending upon the overall input. For example, if a property characteristic shows that it has little or no influence on price, it would be allocated a higher weight than the other variables that are placed within the input data. The back-forward-error propagation learning algorithm does a comparison of the retained sales data to the desired value of the subject property and continually analyzes this error factor with other input data in a simultaneous fashion until the error factor is as low as possible. As more input data is placed into the neural network, the program continually adjusts and modifies itself and learns. In essence, the computer goes through this back and forward motion within the various layers of data and interconnecting points, summarizes all its inputs (weights), and produces a value of the property under appraisal.

The chief problem of the backward-forward-error propagation algorithms is that the model can get stuck on the initial ‘run’ and not be able to improve upon it. The negative and positive influences on the weights tend to stop working as some of the input property characteristics attract larger weights. In other words, the model will only continue so far and it will stop improving. Eventually, this type of algorithm becomes unstable and tends to forget what it has already learned as it becomes embroiled with learning new facts.

Another type of neural network is the use of genetic algorithms. This type of computer programming is based upon the inspiring theories of evolution by Darwin and had been invented in 1975 by John Holland.

Genetic algorithms start with a set of solutions that are represented by the chromosomes in a human body. This set of solutions could be a quantity of sales data or a sample from a large population that would have similar characteristics to that of the subject property. Each sample provides the appraiser with another solution to the problem of determining a value. Solutions from one sample data set could be taken and combined with another sample data set to create a newer sample data set and another possible solution. This new set of sampling data is referred to as ‘offspring’ and, according to their measure of fit, are used to create other data sets. This condition is repeated over and over again until the ‘best fit’ that references the data of the subject property is found. In short, the genetic model is optimizing or finding the minimal differences between the subject property and the input comparable sales data.

Genetic algorithms are extremely flexible and are able to solve complex appraisal solutions because of this ability to continually generate ‘offspring’ data that eventually leads to the ‘best’ value solution. They can analyze the diversity of ‘noisy’ residential real estate markets whereby subtle variations in market prices can easily be identified and analyzed. The problem with this type of model is that it requires enormous computing power that is beyond most appraisal firms.

Conclusion
AVMS and real estate appraisers have one thing in common, and that is to produce an estimate of value. The methodology by which this value is determined is pro-digiously varied. Likewise, the quality of the results depends upon the caliber of the appraiser or the AVM. Both of these valuation systems are commonly linked to one undeniable need: market data. This data is in the form of actual sales comparable(s), price indexes, inflation rates and other economic indicators and trends.

The role of the AVM is directly linked to the needs of the user. In many instances, the user would be satisfied with a value determined by an AVM because it is less expensive than a form report appraisal completed by a qualified appraiser and it is less time consuming to obtain. For many large lending institutions, AVMS are the perfect vehicle to be able to provide some evidence of value. The market values required for their lending purposes are for ‘in-house’ only, since the mortgage will not be ‘shopped’ around. These would include first mortgages, home equity loans, lines of credit and some secondary mortgage financing. Those lenders that can market mortgage money features that include no costs and almost an hourly approval on applications will be the most successful in the market place. The demand for residential mortgages is large and within a global society and the Internet, residential financing is not necessarily limited to a specific country, province or state.

The long-term potential of AVMS is extremely promising, but it is also subject to macro and mini economic changes to mortgage markets. Their performance will be measured against actual loss by mortgage defaults, falling housing prices and mortgage frauds, as have their human counterparts in the past. They are simply another tool necessary to transact a specific type of business arrangement. There may come a time when even a value by an AVM may not be required to fulfill the practice of lending mortgage money. Until such time, any user of an AVM should be familiar with the rules and regulations of conduct when using an AVM, particularly their method of employment.◆

References
5. AVMs - What’s the future for appraisers?, 1999, Appraisal Today, 8 and 9

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