# Theory and Methods for Appraising Real Estate

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The Roots and Evolution of Appraisal Methodology

**Introduction**

Lest the reader believe we now know everything about all possible valuation methodologies and approaches, some history will provide a more accurate context. Keep in mind that until recently, public data was kept in county records on physical paper and not in on-line accessible files. Computers and electronic calculators did not exist widely until the late 1980s and early 1990s. As such, real estate records and information was valuable, expensive to collect, and labor intensive to analyze or present.

Appraisal, available data, and methodologies have evolved continuously since Richard T. Ely wrote the first real estate book in 1893 titled "Outlines of Land Economics". If anyone can claim to be the father of appraisal, it is Richard Ely. Born in New York in 1854 Richard T. Ely believed that markets worked fairly well, but that without government intervention child labor and labor abuses in general were likely. Factories in the early 1900s routinely used child labor and exploited immigrants, so this was his context. He helped to found the American Economic Association and Lambda Alpha International, serving in leadership roles with both groups that continue to exist today. While he was considered a liberal by many, he disavowed any support for socialism. Ely established the Institute for Land and Public Utility at the University of Wisconsin (1920) and then the academic program at the University of Wisconsin (1925), a predecessor of the Department of Real Estate and Land Economics that continues today. Perhaps the biggest contribution was the initiation of teaching real estate related principles at the university level and encouraging further research.[1]

Following the leadership of Richard Ely, were three others that tried to establish valuation methods for real estate. These were Richard M. Hurd, Ernest Fisher, Fred Babcock, followed later by Homer Hoyt, Richard Ratcliff, Paul Wendt, Leon Ellwood, Art Weimer, and James Graaskamp.

| Year | Author | Title (work) |
|---|---|---|
| 1903 | Hurd | Principles of City Land Values |
| 1924 | E. Fisher | Principles of Real Estate Practice |
| 1932 | Babcock | Valuation of Real Estate |
| 1939 | Hoyt and Weimer | Principles of Urban Real Estate |
| 1949 | Ratcliff | Urban Land Economics |
| 1951 | Appraisal Institute | The Appraisal of Real Estate (1st Edition) |
| 1956 | Wendt | Real Estate Appraisal |
| 1959 | Ellwood | Real Estate Capitalization and Ellwood Tables |

[1] See "The Academic Roots and Evolution of Real Estate Appraisal" by Norman Miller and Sergey Markosyan, The Appraisal Journal, April, 2003.

In the early 1900s, following the lead of Ely, Hurd, Fisher, and Babcock developed three approaches to valuation. Hurd defined what he called intrinsic value and exchange value. Intrinsic value was defined as the capitalization of the economic rent for a particular property and exchange value as the average of market selling prices for similar property. In essence, the intrinsic value here was an income capitalization approach and the exchange value was a market comparison approach. Hurd suggested intrinsic value could vary with circumstances unique to the property, buyer, or seller, but that exchange values would over time average out the same as the intrinsic values. These definitions contrast with those of today and now we think of intrinsic value as a longer-term equilibrium value based on the productivity of the property and nothing more.

Ernest Fisher worked with Richard Ely in Wisconsin, and worked as the chief economist at the Federal Housing Administration (FHA). Fisher and Babcock overlapped at the University of Michigan, and Richard Ratcliff also studied under Fisher. Fisher also hired Homer Hoyt and Art Weimer at the FHA. It seems that all of the early authors studied with, worked for, or knew each other, making it difficult to separate out unique contributions. Fred Babcock wrote his appraisal book in 1924 outlining eight different methods of appraising property. He asserted that the appropriate method depended on the property type and available data, such as data on income and expenses that could be fed into one of his methods.

In Babcock's second book, he was the first to suggest that the value sought and method relied upon should relate to the purpose of the appraisal. He said that several types of values might exist for the same property, assemblage value (marginal value when added to another parcel), normal sale value, liquidation value, property insurable value, and loan security value (a conservative estimate of liquidity value). He also suggested that values either related to an individual or entities needs or external needs, such as property tax assessment, collateral value, or damage determination from a taking of some interest or portion of the property, such as with eminent domain. In this regard, he was suggesting what we today would call investment values or reservation prices (for individuals or specific buyers) versus other sorts of defined values. Babcock ended up with seven appraisal methods: four income approaches, the market comparison approach, and two cost approaches (one reproduction and one replacement of the function of the property). Babcock tried to suggest income could be analyzed for land separately from the building (improvements) and these could be capitalized separately, but several of his colleagues found this troublesome. Some also criticized his use of so many methods on the same property as being equally relevant. Later Babcock agreed that the cost approach is seldom relevant, nor accurate, but emphasized that the quality of the data should drive the methods used. This remains true today.

Weimer and Hoyt proposed that for commercial property the income method was the soundest approach and encouraged the use of a capitalization method, based on the present value of a long-term stream of income. Hoyt also noted property value trends that he related to demographics, suggesting that mortgage risk and value at risk could be related to the type of buyer. This racial profiling later evolved into what we know as "redlining", which is geographic based bias in loan approval decisions or rates charged. Hoyt approached his work as a statistician and by today's standards would be considered a racist, but in his day, he thought he was utilizing a valid statistical parameter (race) which happened to be correlated with education, income, and ability to make mortgage payments. Even today we might find

that race and average property values are correlated, but it is illegal to use race as a factor in valuation or discriminate in mortgage lending on such a basis, and appraisers should take precautions to be sure that race is not a factor in the valuation process.

Paul Wendt's greatest contribution to real estate may have been his pioneering work trying to compare the risks and returns of stocks versus real estate. With his co-author, Sui N. Wong they published "Investment Performance: Common Stocks Versus Apartment Houses" in the Journal of Finance in 1965.[2] Using discounted cash flow models and data from 1952 through 1962, and including tax effects via an after-tax cash flow analysis, found that real estate provided twice the returns of stocks during this period of time. Wendt and Wong used an after-tax internal rate of return approach to compare stocks and bonds, even though today it is common to criticize the reinvestment rate assumption built into such a measure.[3] There was no adjustment for risk or the lack of liquidity for the real estate investments, nor the degree of leverage on the investments. Still, this was the first attempt at such a comparison and it woke up some investors to the possibility of including real estate in portfolios that were generally 100 percent stocks and bonds, prior to this point in time. Real estate investment trusts (REITs) which are a form of public securitized real estate were in their infancy and not really an option for most investors. Paul Wendt also wrote several books suggesting within them that appraisers needed to understand discounted cash flow analysis, tax implications of investing and present value analysis for measuring rates of returns.

The greatest contributions to appraisal in the last century might be from Leon Ellwood. Leon Ellwood wanted to develop a valuation method that would account for all real estate returns from the time they were received, including cash flows, expected appreciation and principal paid down on a mortgage from the time the investment started to the end of the expected holding period. He developed an Ellwood capitalization rate that was adjusted for all of these three returns. To make the calculations easy in a time before electronic calculators or personal computers, he generated a set of tables with the cap rates and explained how to adjust the cap rates using adjustment factors. These tables were called "Redbooks", and all one had to do was look up and adjust a cap rate and divide it into the net operating income of the property to derive value. He later allowed for a growing income, but he did not consider refinancing as a way to pull out cash. Essentially Ellwood was solving for value using a required rate of return, calculated very much like an internal rate of return, but with some restrictions on the income pattern. This Ellwood method would work fine on a steady flow of income, when we knew the actual required rates of return of typical investors. His techniques never caught on that well, as the math was a bit complicated for most appraisers. Later on, Atkerson provided a simplified version of Ellwood, and Peter Colwell and Jeff Fisher would make further advances with the technique, but the math remained a bit daunting for most appraisers and it was no better than discounted cash flow analysis, which would eventually dominate income valuation for most appraisers who wished to utilize a detailed cash flow proforma. [4] Spreadsheets, discussed below, which came along with the personal computers in the 1980s

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[2] See Investment Performance: Common Stocks Versus Apartment Houses on JSTOR

[3] An internal rate of return approach calculates the discount rate that discounts all future sources of returns, from the time received, back to present value such that they exactly equal the initial investment.

[4] See Atkerson format here: Band Mortgage Equity Capitalization or Atkerson format Ellwood - Eloquens and Jeffrey Fisher "Ellwood After Tax – New Dimensions" *Appraisal Journal*, July, 1977, and "Ellwood J Factors: A Further Refinement" *Appraisal Journal*, January , 1979. In 1981 Peter Colwell and Riger Cannaday wrote "A Unified Field Theory of the Income Approach to Value" published in *the Real Estate*

and 1990s allowed for discounted cash flow approaches to become easier, and allowing Ellwood to disappear from the toolbox for most appraisers.

There have been no major advances on income capitalization techniques since the work of Ellwood, Atkerson, Fisher, Colwell and Cannaday, but we have seen major advances in data availability and large-scale data intensive statistical methods applied to valuation.

**Data**

Prior to 1980 the gathering of comparable sales data sufficient for a minimum sample appraisal required at least a few hours examining County records looking through parcel maps to see if any properties similar to the subject property (the one being appraised) had sold recently, and then the property tax cards could be pulled one at a time to examine the list of physical features and age. If one was lucky the county also included recent selling prices on the property tax card. If not, then a trip to the deed room, searching by grantor and grantee, would reveal a transfer stamp and provide the price. All of this had to happen after a drive around the neighborhood or market in question to identify similar looking property. This data gathering phase took as much or more time than any analysis work on valuation, and it limited the size of the sample that was feasible within the time constraints of the appraisal. This archaic system still exists in many parts of the world and in some countries (France) it is not that easy to get true information on transfer prices. In some states like Texas, price discovery requires reliance on private associations and vendors.

Today, most county government records including property tax records and sales prices are available on line. Residential multiple listing services (REALTOR.com, Zillow, Redfin, Trulia, and others) now provide a host of other data, such as improvements made to the property and several dozen photos of the property. In the commercial market there is CoStar, LOOPNET, MSCI (RCA), REIS, REALNEX, Realpage, and a host of others providing property information, for a fee, and rents are now available from these same sources as well as Compstak, Apartments.com and a host of other sites. Everything one needs is available online and has been integrated and aggregated by other vendors like Black Knight, CoreLogic, Attom Data, CoStar and others. The data gathering part of the process which was imperfect and labor intensive has been reduced to milliseconds.

With the explosion and integration of real property related data sources, it is now possible to utilize more data to value any given property. Using three comparable sales that fit onto one physical piece of paper, when much more data is available, is akin to using physical yellow pages for a telephone number search when google and other search engines exist. This does not mean that a three-property sample is not sufficient to do a good appraisal, but this requires that all three comps meet the definition embedded in fair market value and as discussed earlier in Chapter 1, we rarely know whether the buyers and sellers are typical of the market as a whole. For this reason, using more data when applicable is preferred.

**Computing Power and Spreadsheets**

Early personal computers (PCs) like the Apple, TR-80, IBM-PC, Osborne were not widely available until the 1980s in the U.S. and they were not much better than glorified calculators, requiring the user to

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*Appraiser and Analyst*, whereby they discussed all the assumptions behind discounted cash flow analysis and the implied impact on capitalization rates.

learn some basic programming in order to use them. VisiCalc, Lotus 1-2-3 became available soon after PCs and Excel was finally adapted to PCs in the early 1990s. We can conclude that prior to the 1980's few appraisers would have had much more than an electronic calculator and a simple one at that. In the 1990s they would have had access to PCs and spreadsheets, but without much knowledge of how to effectively use them. Since the turn of the century spreadsheet templates became more widely available that were taught and shared, and this new computing power created a revolution in terms of dealing with large data sets. Today Excel can handle one million rows of data with sixteen thousand columns or variables. Functions with built in filtering (data sorting or queries) and mathematical functions that include multivariate regression analysis and more are now available. Mapping and advanced graphical software using spreadsheet data is also available so that now there are few limitations as to how much data is utilized in a valuation or market analysis. More advanced systems allow automated retrieval of data from sources like Yahoo Finance and more government sources of economic and finance data proliferate such as FRED (St. Louis Federal Reserve Bank) Federal Reserve Economic Data | FRED | St. Louis Fed (stlouisfed.org). In the time it took to get down to the county records building an analyst can today sort through a million observations of sales and run an analysis of value for several properties, if they know how to tap into data, filter it, and analyze it. This requires more knowledge of software and data sources, but also more knowledge of statistics than ever before.

**Automated Valuation Models (AVMs)**

Automated valuation models are not so much "automated" as they are statistical models an analyst considers to explain the variation in selling prices. Of these the most common is a traditional hedonic pricing model or multivariate regression. A dependent variable, price, is estimated based on its statistical relationship with several independent variables. These independent variables (X1, X2, X3…) typically would include information such as the property age, condition, size, etc. For a residential home models will typically include from three to a few dozen variables. The correlation between the dependent variable price and the independent variable might be linear or non-linear. A consistent linear relationship would result in a statistically significant regression coefficient (β) below, on that variable. For example, if the regression coefficient is .5 then a 1% increase in the variable causes a .5% average increase in the dependent variable, p below. If the regression coefficient is -.25 then a 1% increase in the independent variable will on average decrease of the dependent variable by .25%. We can combine many variables in the equation noting that sometimes we use a variable more than once in simple linear form or in some other form, such as squared or cubed. We also must be concerned about how we interpret the coefficients in that several independent variables might be correlated. More on using such models will be discussed later in the book, but here we want to provide a clear and concise overview.

The formula for Multiple Regression is given below:

$P = \beta 0 + \beta 1X1 + \ldots + \beta nXn + e$

Where, P is the dependent variable, typically price, and

$\beta 0$ = the intercept, a minimum fixed value of P

$\beta 1X1$ = regression coefficient on the first independent variable,

$\beta nXn$ = regression coefficient of the last independent variable, with several Xs possible in between, and

e = variation in the estimate or error.

Again, the X variables can be in many formats, ordinary digits, taken to a power, or in zero or one format known as dummy variables to denote something that exists or does not exist, such as a feature like a fireplace. We can also use log forms which convert and standardize variables into percentage changes. Using multiple regression models to estimate property value requires some study and practice and experience, just like with any method of valuation.

There are other types of AVMs, aside from multiple regression. These can include grid adjustment appraisals similar to those utilized by appraisers, but where we utilize linear programming to optimize the estimate of value by minimizing the possible error from all of the adjustments to comparable sales in a grid format. There is also the possibility of generating a value using an index of price trend for the relevant market (defined submarket within which the property competes) and using this index to adjust an old selling price to a new one. For example, in a given neighborhood the price per square foot was $323.53 per square foot and is now, some ten years later, $550.00 per square foot, an increase of 70%. If our subject property sold ten years ago and is typical of the properties in the area, we might apply this 70% increase to the price and estimate what it is worth today. This is a legitimate valuation method, a time index adjustment method, that can derive an accurate value, if the property is not unusual compared to the peer properties utilized in the index calculation. The point is that having access to more data than ever and utilizing such information is what we gain with most AVMs.

It is not the experience of the AVM that matters, but rather the experts that develop and use the AVM. Hybrid AVMS might aid an appraiser by providing a list of possible comparable sales and ranking them, and then allowing the expert to make final decisions on which comps to include. The AVM might then suggest adjustments and a final value, again, which an expert might tweak. This is the future of appraisal, with large arrays of data pulled automatically and sorted ready for the appraiser to determine which type of model to use and what tweaks to the process they wish to override. Any appraiser that does not utilize such automation in the process will not be able to compete on speed, fee or with an efficiency level that allows professional level earnings. Further, AVMs are especially valuable and efficient for quick accurate portfolio valuations. See the chapter below on Portfolio Valuation.

**Machine Learning (ML) Models and Artificial Intelligence (AI)**

Machine learning models are the common term for more advanced statistical models. These go beyond traditional regression techniques where the independent variables only influence the dependent variable. With ML approaches, models that consider the interaction between the explanatory variables is sometimes captured. Think of it more like a matrix of variables, all interacting with one another and with the variable of interest, the dependent variable. There are many forms of such models and the general term for those using a matrix is “neural networks” based on the metaphor of a nervous system and a brain. When using several explanatory variables, and tens of thousands of observations, the computational power required for ML models can be quite high and take hours to run. The general process of learning what works is called “training” and seldom can a ML model work well without several thousand observations. For some research and applications, like scanning an Xray for cancer, ML models have proven better than humans. But for real estate, seldom do we have enough data to do anything close to proper training to generate models that are better than an experienced regression analyst would

produce and in much less time. Some day we may make sufficient advances to apply ML to improve real estate valuations, and many companies already claim to have such models, but the reality is that they are more likely enhanced regression models and nothing more. Even more unlikely is that any of the models are true artificial intelligence. The AI term is used for hype and marketing, but as of 2024 does not actually exist. It is commonly used when the machine learning is based on unstructured data and repeated learning systems. ChatGPT, an advanced search algorithm, can produce a lot of information with internet searches, but it has no accuracy filter for what is true or false out in the real world. It has no human judgement; thus, it is not reliable. Likewise, if AI really existed as of 2024, the user of such a modeling approach would not need so much data, so much filtering, so much expert tweaking of the variables and training of models in order to get something usable. The program would be able to do all that without an expert overseeing the model development, and no such program exist yet. AI models are really ML models and require lots of expert help in order to be able to use them. They may someday produce results better than less complicated statistical approaches, but for now, they are mostly marketing hype and the models are black boxes that remain uninterpretable. We will not know when ML models will not work as well as we do not know what is really in them. There are no regression coefficients to interpret and so they must constantly be retrained and retested. Future analyst should experiment with such tools, but for now, the benefits of a neural network ML model to estimate value is unproven.

**Summary**

Appraisal has evolved in many ways. Data acquisition that once took the majority of time required to estimate value is now accomplished in milliseconds. Methods and models to value property have evolved from several to three traditional general methods (sales comparison or market approach, income approaches and cost approaches) and today to at least five approaches today, worth using on occasion, with one more on the horizon:

- ✓ Sales comparison approach
- ✓ Income approaches (capitalization techniques and discounted cash flow analysis)
- ✓ Cost approaches (seldom applicable but a default approach when no other method is possible)
- ✓ Hedonic pricing models (regression models of various sorts)
- ✓ Time adjusted price model (utilizing a price trend index to adjust a prior selling price)
- ✓ Machine learning models (more advanced algorithms that remain uninterpretable, but might be usable for valuations in the future)