Concise Review of All Five Modern Valuation Methods: An overview

Introduction

In seeking the derive market value, the Appraisal Institute, the dominant trade association for appraisers, recognizes three dominant methods of valuation as of 2024.[1] These are the (1) Sales comparison approach aka market approach to value, (2) the cost approach and the (3) income approach. There are variations within each of these, especially the cost approach and income approach, so one might suggest that there are actually more than three general methods. In the UK and Europe, the Royal Institute of Chartered Surveyors (RICS), has a slightly broader view on valuation and they include business valuation and new development valuation as specialties. RICS has similar methods suggested with respect to the sales comparison approach that they call the comparable method, they call the income approaches "investment method" and it includes more than just capitalization techniques, the cost approach is called "depreciated replacement cost" and for specialty properties like hotels, golf courses and gas stations and those including a business, they have the "profits method" and last they have the residual method for new development, which the Appraisal Institute views as a type of income and cost method blend.[2]

Here we are going to suggest five broad methods:

1) Sales comparison approaches
2) Cost approaches
3) Income approaches
4) Regression methods
5) Time adjusted value method

If an analyst were asked to derive investment value or a residual value for a particular developer, then they would be using variations of the income approach with assumptions based on the individual or entity involved. Here we will presume that market value is sought, but it is fairly straight forward to replace general market assumptions with those unique to an investor or developer and generate an investment value that is specific to their needs.

Each method will be briefly described below, but there is absolutely no reason to use all of the methods described here. For most owner-occupied residential property there is really no need to use anything other than a sales comparison approach, and in fact, using other methods that are based on sketchy data quality is a waste of client's money and the appraiser's time.

[1] As of 2024 the Appraisal Institute was still using the 15th Edition of the Appraisal of Real Estate Text.
[2] Red Book (rics.org)

Sales comparison approaches

The sales comparison approach to value utilizes comparable properties or "comps" and assumes that what other buyers will sell similar property for, they would pay for the subject property as well. An analyst must start with the question of where else would a buyer consider and what properties compete with the subject property?

In residential, we usually start with a neighborhood, defined by parameters such as school district, physical barriers, political districts, and similar homes. In commercial markets, the question would be where else would a tenant consider renting? A relevant geographic market need not be contiguous. It simply needs to compete with the subject property, so identifying peer properties or comps are really the most important first step and any factor important to a buyer or tenant is a factor required in determining the scope of the market.

Statistically defining the relevant geographic market for peer properties

Aside from school districts and political boundaries, in the case where markets seem to flow into one another, one approach to defining the market boundaries could be statistical. For example, for the residential market, we could take all the homes adjacent to the subject property using this point as the starting spot and extend in all directions geographically until such time as five consecutive properties are more than 20% larger or 20% smaller or 20% older or 20% younger than the subject property or some combination of size and age. Generally, we will see a change in the price range of adjacent neighborhoods and we can use this as the boundary for the area from which data will be collected. Of course, this method presumes the analyst knows how to use some mapping software that can identify properties by addresses and then link these to the group eligible for finding comps.

For commercial markets, the relevant geographic area is usually fairly obvious as the size, shape, design, and age of the buildings will change. Rarely, does an analyst need to work that hard to define the market, and commercial brokerage firms will have well defined submarkets named.

Once peer properties or comps are identified, the ones closest to the date of the appraisal are utilized. Often this is the current date, so recent sales receive the greatest weight. Some appraisals are back dated or retro-dated, based on an estate settlement, divorce settlement, or when a property is involved in a legal dispute that happened in the past. Other factors used in selecting comps are the age or quality, size, height, design, architect, and features that may include parking, elevators, finishing details, open space, landscaping, location, and access among others. Again, anything that a buyer or tenant would consider important should be part of the process in selecting comps. Potential comps based on the location, selling date, age, size, quality, and features are ranked for comparability. An analysts might consider a weighting system whereby they put weights on factors deemed important, such as:

- ✓ Location 20% including views, waterfront, access to key amenities, employment, and retail
- ✓ Selling date 20%
- ✓ Size 20% this is square feet of usable space, also gross space, or living area indoor and outside
- ✓ Age or quality 15% this could be a composite of several factors or classes A, B, C, D or CoStar's 5 star rating system or appraisal property condition records from prior appraisals, or simply age if no other data is available
- ✓ Design and materials 10%

- ✓ 15% for other features (parking, air conditioning, fireplaces, elevators, landscaping, amenities and so forth)

Similarity scores between a subject property and potential comparable sales is something that can and will be automated in the future. All AVMs (automated valuation models) use similarity scores to determine which comps to use for analysis. We can also expect that appraisers will be using such automated systems to speed up work process and analysis, and that data vendors might even enable systems that will aid in valuation analysis, by suggesting the best comps in rank order.

How many comps should be used?

In traditional appraisal the minimum of three is often the default result, but the answer is that all good comps should be used, as they all provide some information as to what the market will pay for the subject property. More than three may not fit on a typical appraisal form, but multiple forms can be used.[3] It is more often the case that finding three good comps is harder than finding more than a dozen, but on occasion there are larger samples available, and they all provide relevant data.

What is the question being asked for each comp selected?

What would a buyer pay for the comp if it were very much like the subject property? Each comp needs to be adjusted to answer this question. For comps that are superior in some way compared to the subject property, we will need to adjust the price downward. For comps that are inferior, we need to adjust the price upward. If the total absolute percentage adjustments are more than 25% then the comp is not really that great. Still, the appraiser should use the best comps available. How many adjustments are required? Generally, we need at least some adjustment for size differences, quality differences, and a time adjustment to bring the price to the date of the appraisal. Beyond these, only significant differences be considered. More than a dozen extra adjustments for differences are rare and one must assume that omitted variables (factors not considered) result in a mean zero error bias. That is, any errors by not adjusting for minor differences are both positive and negative in terms of their influence on value. More detail on the adjustment process is provided later in the text.

The appraiser should always bring the adjusted prices to the date of the appraisal, so if now is the relevant date and the comp sold several months ago, we need to answer the question, what would it sell for now? To bring each adjusted comp to present time or any date requires an index of the market price trend. The process of developing an index will be discussed later, but it is generally a percentage trend analysis calculated as granular as possible for the relevant market over the time period from before the comp sale to the date of the appraisal.

Utilizing adjusted comp values

Each comp that passes muster will end up with an adjusted price, suggesting that if it were similar to the subject property in size, age, location and so forth, this adjusted price is what the market would pay. A weighted average of these values will provide an estimate of value for the subject value. These weights should be based on the degree of comparability, so those comps with the fewest adjustments should receive more weight. At the same time, no comp should receive more than 50% or

[3] The 1040 appraisal form is typical for Fannie Mae and Freddie Mac financing applications.

else we are using one comp to determine value and no comp should receive such a low percentage that it is irrelevant to the process. Only when there are many good comps, say 30 or more, might an appraiser consider equal weighting.

The conclusion of value is based upon the weighted adjusted prices of all comps.

There are many simple variations on the sales comparison approach, that might provide a rough estimate of value and when there are no great comps but a lot of data these might be employed. For example, sales price per square foot of living area or price per square foot of leasable area, or if the land is all that really matters, sales price per square foot of useable site. For a warehouse, one might sales price per cubic square foot or cubic square meter of space. With such unit comparisons, the final value is based upon the subject property unit times the market-based price per unit, with an update to the date of the appraisal based on price trends since the average of the comp sales considered. These methods are valid, but they will miss the nuances of the subject property and so may still require some adjustments if the subject property is better or worse in some regard.

Cost approaches

The cost approach assumes that the value is inherent in the property being appraised, as opposed to being inherent in the minds of the typical buyer with the sales comparison approach. Traditional valuation texts will suggest that cost new sets an upper limit on market value for the subject property. But that upper limit must bring into account the time required to develop a new property and the chances that a site within the relevant market is available. In many markets, especially on the coasts there will be very few sites available and it may take several years to get all the approvals required for a new development. In such markets, the cost approach does not really provide a reasonable substitute.

When property is fairly new, and at its most probable use, then the cost approach can be used as a valid substitute for sales comps. Still sales comps would be better in almost all cases, and remember cost does not necessarily equal value.

The cost approach should almost never be used on existing property, unless it is the only approach possible, based on a lack of sales or income data, or once again, because the property is fairly new. Examples of properties where one might use a cost approach could be churches, schools, police or fire stations, museums, or historical buildings. We might also use the cost approach, applied only to the building, when the value sought is replacement cost for insurance purposes. Generally, a general contractor will be required to get an accurate estimate of cost new, but many appraisers use indices and data such as Marshall & Swift (CoreLogic), but this will generally be a less accurate resource than that from a local general contractor.

Keep in mind that cost new includes developers' fees, hard and soft costs, plus site cost. The site is usually valued using site comps or separating out land value, which will be explained later in the text. Hard costs are the materials and labor and soft costs are the design, legal costs, financing costs and other expenses required for a site to be approved for construction.

There are two variations on the cost approach. One is a **reproduction** cost. To reproduce a building is to build a replica, with the same design, materials, and workmanship. This approach is nearly impossible to

utilize, since the materials may no longer be available, the craftsmanship might be scarce and the original building may have taken years or decades to build. Still, if one were asked to estimate the value of a historical structure, say Notre Dame in Paris, or Sagrada Familia in Barcelona, such an approach would be valid, albeit difficult.

For most property the value is inherent in the function and so **replacement** costs would be used. **Replacement cost is based upon replacing the function of the building,** but with modern materials and design. If one were replacing a school, one might estimate the cost of replacing the classrooms and administrative areas, but again, with the most modern of materials and design. This approach is easier to use since it is based on current skills, materials, and designs. Here a contractor would still be advisable, but cost guides such as Marshall and Swift would be more valid.

After the cost new is determined, one must subtract from this value an estimate of depreciation.

Depreciation is a result of wear and tear over the economic life of the property, as well as changes in the market conditions that might influence location value. If using reproduction costs there would need to be additional deductions for functional obsolescence as well, but again the use of reproduction cost is rare. Depreciation estimates are quite difficult, but are based on determining an economic life for the property, then prorating the portion of this which has passed based on actual age or effective age.

What is the economic life of a building?

The economic life of a building over which it remains profitable to use with normal maintenance. Physical life could be much longer if the building is retrofit and converted or in some cases abandoned. We lose some buildings to fire, earthquakes, floods, and war and in zones where such risks are higher the economic lives should be shorter.

As a result of changing technology and robotics affecting how we use and maintain property, the economic life of most buildings is likely less than once thought. Some buildings, like famous train stations, were built as magnificent structures under the assumption they would be used for a hundred years or more. As a result of more affordable cars, highways and air travel, most train stations became obsolete in part or full within fifty years. Below are some guesses, by the author, as to average economic lives for major property types, prior to the need for major renovation:

Type	Economic Life in Years	Comment
Residential	80	Both single family and multifamily can last a long-time if maintained.
Industrial Warehouse	30	Technology changes how wares houses are designed and used.
Manufacturing	20	Technology changes very quickly for manufacturing.
Retail Strip Center	40	These are simple structures so they last longer.
Retail Mall	20	Malls require major overhauls more often.
Hotel	25	Hotels require heavy maintenance and repair.
Self-Storage Centers	40	These simple structures should last a long time.

Data Centers	15	Technology will require major overhauls.
Schools	30	While these are used for many decades, technology suggest they will need to adapt more quickly in the future.

Note that several of the above property types have real depreciation that is faster than the accounting depreciation schedules allowed by tax authorities, 39 years for commercial and 27.5 for residential in the U.S. We are only discussing real depreciation here, not IRS rules, and most properties require major periodic expenditures for maintenance in order to keep property economically viable.

What is effective age?

Most of the time effective age, or the age that a property appears to be when compared to other buildings, is its actual age. If maintenance has been deferred, then the effective age might be higher than actual and if maintenance has been above normal, the effective age will be lower than normal. This is a high subjective assessment and no one knows the exact right answer. For most property the best assumption will be to take the actual age since built and divide it by the economic life and use this as a simple measure of depreciation to be applied to the building.

Example: A multifamily property of 20 units is 20 years old and appears to have been maintained normally. Using an economic life of 80 years, what is the depreciation to be applied to the building improvements (cost new)? The answer is simply 20/80 or 25%. More examples will be given in the chapters below.

How do we determine site value?

Site valuation is a topic covered in more detail in the chapter on the cost approach to value, but as an overview, we use comparable sales when possible and units of comparison (typically price per square feet or square meter) to determine the value of the subject property site. When similar empty site comps are not available, as is usually the case, other methods must be considered.

When property is newly constructed it is easier to calculate the site costs. Normally, the assessor's office of the county, or other record keepers, will have a break down of the initial site and improvements. We can use the assessment break down as one measure of site value for an improved site, as the assessor uses an estimate of the depreciated building value to separate the two values. For example, if a property sold for $1.4 million dollars and the assessor had the building at $1 million, the land would be $400,000 and one could take the useable site area and find the price per square foot. Another approach is to simply try to calculate a depreciated building value on the comp sale and separate out land. This requires taking the original cost new of the building, bringing it to the time of the appraisal, and using its age and economic life to estimate depreciation. The net building value is then subtracted from the sales price of the total property to separate out the land value. All of these estimates will not be accurate, but then recall that the cost approach to value is rarely accurate and does not reflect value. It is used when there is no other method available, because of data limitations, with the recognition that it may not reflect market value. It is a default method.

The last step in the cost approach is to add together the value of the site, including land value and any necessary improvements to the site, and the cost new of the building less depreciation.

Income approaches

The income approaches all assume that the value of a property is based on what typical investors will pay as a function of the net operating income, or cash flow, and all other sources of returns including mortgage principal repaid and net appreciation if any. Critical in such an analysis is the required rate of return for similar risk and similar income growth potential investments, which will be expanded upon in the income approach chapter.

All income approaches are variations on present value analysis. As such, the reader must understand how to discount future values to present value. The simplest form of discounting presumes a steady flow of net operating income that goes on for infinity. Let us review the basic calculation of net operating income followed by a discounting formula. For each year we will have the following calculations required:

Item to Calculate	How?	Comment
Potential Gross Income, PGI	This is the sum of what is possible to collect as rent, if the building were fully, 100% occupied, based on all useable areas.	If the building has leases in place, we would start with the contract rents and add them up. If it does not have leases, we would use the typical rents of peer property, after a reasonable absorption period for such property.
Less Vacancy and Collection losses	We would start with the typical vacancy among competing properties in the market. We might use something lower or higher, if we feel the property is more or less competitive.	Lenders always insist on some vacancy, even if the property is 100% leased.
Add other income	There may be other income such as laundry rent, parking fees, percentage rents on retail leases, and all these other sources of income would be added.	For residential, the two typical items are laundry and parking fees, but there may also be bike and storage locker fees or others. For commercial property, we may also see participation in sales (percentage rents).
Effective Gross Income, EGI	This is what the owner expects to collect each period, noting that each of these has a trend.	When using the simplest discounting method, we want to use a fully stabilized rent and net operating income estimate, based on a reasonable lease up period.
Subtract Operating Expenses	When not paid by the tenant, this could include utilities, property taxes, property insurance, on site management, asset management, security, landscaping, maintenance and repairs and anything else required to keep the property leased and operating.	For commercial property, many of these items are passed through to the tenant. For residential it is unusual to pass these through, except for utilities that the tenant may pay directly (electric, gas, water and sewer, cable fees, internet fees, phone service) depending on the terms of the lease.
Equals Net Operating Income, NOI	This is what is available to the owner and lender who provide the capital to buy the property.	Each year we will have an NOI estimate.

Valuation formula: Using the stabilized NOI, we will need to know what investors pay for similar properties in terms of risk and rental growth potential, adjusted for expected vacancy, other income, and operating expenses. The formula is:

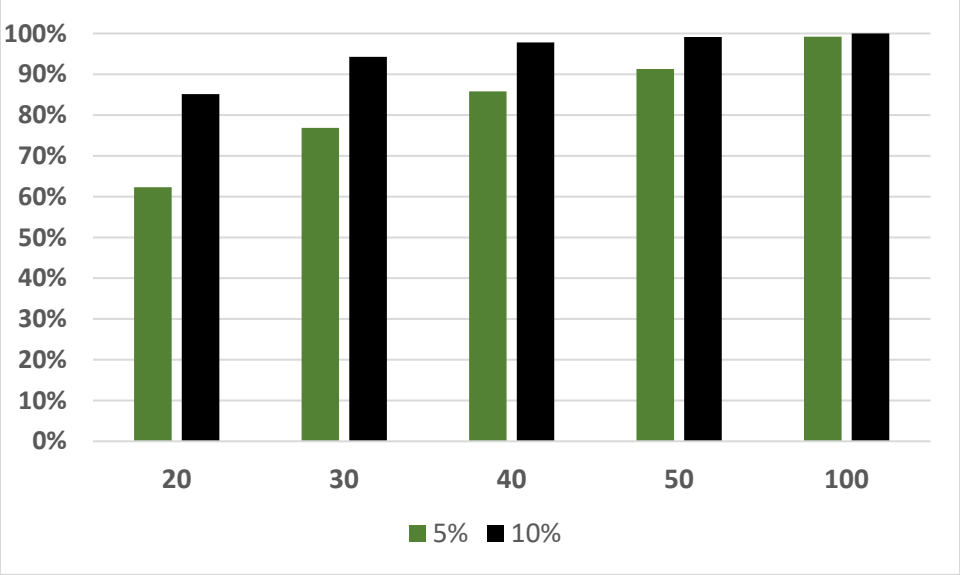
Value = Net Operating Income/Market Capitalization Rate from Similar Property

We may use symbols, such as V for value, NOI for net operating income and R for the market capitalization rate or cap rate.

V = NOI/R

To demonstrate the simple math, assume that the subject property NOI is $100,000 and that market based (from comparable property) R is .05 or 5%. Then the value of the property is $2 million. Criticisms of this approach include the argument that no property has an infinite life and no NOI is stable for infinity. This is true, but how much does it matter that we are discounting for infinity? And doesn't the cap rate reflect the expected growth trend in NOI? Both questions are addressed next.

Proportion of Infinite Value Represented by the Years Shown for 5% and 10% Cap Rates



What we observe in the calculations above is that when using a relatively lower cap rate, 5%, the proportion of the present value represented in the first 20 years is 62.31%, rising to 91.28% by year 50 and at year 100 we have 99.24% of the value. In other words, when discounting at 5% there is pretty much no value for any property beyond 100 years. It does not matter if we use an infinity formula. In the case of a cap rate at 10%, we reach 99.15% of value by the 50th year and pretty much nothing after that. The point is that using a mathematical formula that assumes infinity as the duration does not really matter as the bulk of the value is within the first fifty years.

As to the second question: The cap rate reflects the required rate of return and the expected growth rate for the NOI. We use the Gordon Growth rate model in simplified form to explain. The Gordon Growth Rate Model (GGRM) was developed by Professor Myron J. Gordon in 1956. It was used to approximate

stock values where the stock price is equal to the annual dividend divided by the required rate of return less the growth rate of the dividend. If we use RRR for the required rate of return and GR for the growth rate, and substitute the NOI for the dividends we get the following:

V = NOI/(RRR-GR) and in this case RRR-GR = R

We can also use this relationship to rewrite R = RRR-GR as follows:

If we know R from the market and we know the required rate of return, RRR, we can estimate what the market thinks about the growth rate:

GR = RRR-R and we can estimate the RRR if we know the R and have an estimate on the growth rate of NOI, as follows:

RRR = R+GR

These relationships are very useful to calculate, since it is often hard to know what the market requires as a rate of return or assumes in terms of growth rates. We may want to use the RRR in a discounted cash flow analysis as another approach at income valuation, discussed later.

The best way to think about our formula above **V = NOI/R** is to think of it like a market-based multiplier of income. In the stock market, there is much emphasis on the price earnings multiple.

Stock value = Earnings x PE Ratio or the PE Ratio = Stock Price/Earnings

A high PE Ratio suggests that investors will pay a lot for the current earnings because they believe the earnings will grow fast. Growth stocks have high PE Ratios and value stocks, that are not expected to grow as fast, will have low PE Ratios. Our cap rate, R, is identical to a PE ratio, except that it is in an inverse form, so we divide it into income instead of multiplying it. A stock PE ratio of 20 is identical to a 5% cap rate, as 1/20 = .05.

In summary, market-based cap rates are approximations of what investors will pay per dollar or other currency units of net operating income. If the comparable property growth rates are expected to be similar to the subject property, then they have implicitly the primary sources of returns built into this valuation model.

Weighted Cost of Capital Approaches to Deriving the Cap Rate, R

Traditional appraisal texts suggest several variations on what are called “mortgage-equity” techniques to derive a cap rate, or “band of investment” approaches. The simplest ones will have a mortgage cost of capital and equity cost of capital, weighted by the percentage of the capital stack, and multiply this by the required yield for each. The timing of returns is not considered, nor any explicit calculation of appreciation. The formula is:

Mortgage Loan to Value Ratio x Effective Mortgage Rate (annualized) =

\+ Equity to Value Ratio x Required Rate of Return =

Sum = R = Cap Rate

The mortgage rates are possible to secure from lenders, but it is a challenge to find the RRR in the second band. Asking investors will often provide results biased on the high side. Research by the author with colleagues suggests that many investors overstate expected returns. Other investors will understate expected returns and in either case the data will be unreliable. There are many variations on these mortgage equity techniques, and for the most part, none of them are as reliable as using market-based comps. However, one variation, the Ellwood technique that considers the timing of returns and which can be combined with a growing NOI converted to a stable annuity, is closer to what we would have with a discounted cash flow model. That will be demonstrated in the chapter on income approaches, along with some additional multiplier techniques.

Aside from a market-based cap rate approach, a discounted cash flow approach would be suggested as the next best alternative or a complimentary analysis, to provide one more indication of value.

Discounted Cash Flow (DCF) Valuation

The best approach for income property valuation, where a detailed rent and operating expense history is available, is generally to use a discounted cash flow approach. A primary advantage of DCF analysis is that the specific cash flow pattern can be considered, along with any unique capital expenditure required on the property. Sensitivity analysis may also be useful once the cash flow pro-forma is developed in order to look at multiple concerns such as cash solvency, debt coverage, initial yield, and longer-term returns to be sure they meet market criteria at the time of the valuation.

The method can be applied before or after tax, and with or without leverage. If financing is typical on the property under analysis, then it makes sense to value the supportable mortgage and present value of the equity separately.

Total Market Value = Present Value of Equity + Supportable Mortgage Using Market Terms

The discount rates or required rate of return should be based on the typical return requirements for similar property. This might be derived as a spread against longer term treasury bonds, based on recent history, or from actual transactions if they can be deciphered. Value of the equity is as follows, where CF equals the cash flow in each period (year) based on a proforma that considers current leases, vacancy rates, market rents and operating expenses each year. PV_e is the present value of the equity. Rrr is the required rate of return, T is the number of years of compounding used until the CF is received, and the projected resale cash flow is based upon the net selling price expected after all selling costs and mortgage payoff.

$$\text{Equity Value} = PV_e = \frac{CF_1}{1 + Rrr} + \frac{CF_2}{(1 + Rrr)^2} + \ldots + \frac{CF_T}{(1 + Rrr)^T} + \frac{\text{Projected Resale } CF_T}{(1 + Rrr)^T}$$

If the required rate of return was based on a specific investor and different from the other participants in the market, or if the rent roll was based on unique attributes of the buyer, then we would be calculating investment value and not market value, but with the same method. In the chapter on income approaches, we will expand on DCF models and review the process in more detail.

Regression methods of valuation and machine learning

Regression is a statistical approach that analyzes the relationship of a dependent variable, in this case selling price, versus a set of dependent variables, and then uses those relationships to estimate value. Relationships might be linear, or non-linear. Such models are also referred to **Hedonic Pricing Models**, as they "price" the utility of different attributes that together create value. Sample size matters in statistics and generally the analyst would like at least a sample of 30 or more properties as market comparable sales. Usually, such models are based on much larger samples, but with property not quite as comparable as with the traditional sales comparison approach. That is, properties might be selected from a larger geographic area or further back from the date of the appraisal in order to procure a larger sample. Variables included can be judged for statistical significance based on the variance of the coefficients generated by the model. The general format of the model is:

Sales Price = **a** + B1(X1) + B2(X2) + B3(X3) + Bn(Xn) + residual error

Where **a** above is an intercept or fixed value estimate for omitted variables. Each **Bn** variable is a coefficient of variation for each attribute **X** that influences value such as size, age in years, lot size, class of property, location, height, construction materials, parking spots, and on and on. For example, if the B2 value were 1.5 then for every unit change in X2, the selling price changes by 1.5 times a unit of X2. If X were square feet and the coefficient on square feet were $412, then for every unit change in square feet, the price would change by $412. Note that variables might sometimes work better in exponential or log form, but experience is required to use such models. Multicollinearity, or correlation among independent variables makes it difficult to interpret each coefficient as the appropriate impact on price, independent of the other variables in the model. However, as a group, when taken together, they will work to estimate price. In application, once the intercept is determined and a set of statistically valid variables are found to explain selling price well enough, the same model can be used to estimate the market value of the subject property. In practice, many vendors of such models will explain well above 80% of the variance of selling price, sometimes well above 90% using only a handful or more independent variables. How to calculate the coefficients and use such models will be reviewed in more depth in the chapter on automated valuation. These models will become increasingly used in the future and any appraiser of residential property where they are most commonly used, must become familiar with such models as well as hybrid models that assist the appraiser providing comps and adjustment suggestions, but allowing the appraiser to make final decisions.

More advanced regression techniques and machine learning ML models are now being utilized as valuation methods. A major problem with ML methods is that the analyst can not tell how much impact the variables included in the model have. That is the coefficient of impact are not only impossible to decipher but they may include several layers of interaction between independent variables. As such, there is the potential for bias to creep into such models, as a result of factors correlated with race or gender or age or religion, unbeknownst to the user. These models and neural networks will be discussed in more depth later in the text, but it is questionable if they should be utilized for individual appraisals. For portfolio value updates in aggregate form, they are appropriate and defendable.

Time adjusted value method

The time adjusted value estimate is not an officially endorsed method by the Appraisal Institute, but it can be just as good as the other methodologies and can produce an excellent estimate of market value. The two key assumptions behind this approach are that, 1) is that the prior sale of the subject property was a normal arms-length transaction and it represented market value at the time of the sale, and 2) that no significant or unusual capital improvements or changes have been made to the property since the last sale, aside from changes that all properties undertook.

An index is used to bring the prior sale price to the current date or date of the appraisal. Constructing an index can be done in many ways, but the ideal index is fairly localized around the subject, reflects the general market trends and is not unduly affected by a non-representative sample used to calculate the index. For example, if some properties have been improved with major renovations, but the subject property has not, then we will get a positively biased index for the change in values over the period in question. The index allows a simple valuation:

Market Value = Prior Sales Price of Subject x Index of Price Change Since the Last Sale

If the index of price change, based on a sample of similar properties, is 157% since the last sale of the subject, then we simply multiply the prior sales price by 1.57 to estimate the market value. The index if most often based upon a filtered property sample adjusted for size, such as price per square foot. This method can be accurate if the subject property has been subject to the same influences and market trends as other properties, and will become one of the main methods of appraisal for both residential and commercial property in the coming years. Such a method was not that easy to calculate when the vast amount of data required to construct an index was not readily available as it is today. A detailed example of the method is provided in a latter chapter.

Data quality and quantity

Within the scope of real estate data are public and private records.

Most developed countries have a fairly robust and widely available set of public record data. In the US the data resides primarily at the county level and will include a history of past and current transfer deeds and prices, property tax records, mortgage deeds, liens of any sort, legal descriptions of the site that include boundary details, and many other physical attributes of the property. All such records are known as “public” record data, since it is managed by a government unit (i.e. assessor, treasury, county administrators).

There are also private records, generally derived from one of several multiple listing services, managed by trade associations (i.e. REALTORS) or private firms (i.e. Zillow, Redfin, Trulia, Home.com or in the commercial world, CoStar, MSCI, REIS, CompStak, RealPage, Reonomy and others). Private records often include similar information as the public records, but may include more detail such as images and updated property improvements, asking rents, tenants, effective rents, property owners, whether the property has energy efficiency ratings or sustainability credentials (i.e. Energy Star or LEED or GRESB or BREAM).

Data that includes demographics, employers, credit records, traffic flows, noise levels, elevation, flood zones, within geographic units is also provided by both governmental units and private vendors, often with mapping systems that complement the use of the data. Such data may originate from the Census, the Bureau of Labor Statistics, FEMA (Federal Emergency Management Agency), and many other governmental units or trade associations like the National Multi-Housing Council, or many others. It is also provided by market research firms such as ESRI (See ESRI.com), or the Site to Do Business (see STDB.com) and a host of data aggregators. Among the largest data aggregators are Black Knight (owned by ICE, the Intercontinental Exchange, Inc.), CoreLogic, Attom data, and others that integrate geographically coded layers of data, making them easy to search by geographic areas. These firms will filter and put in user friendly access formats all of the information available, geocoded at the latitude and longitude of the property or corner of the property in question.

Simple addresses and a zip code often suffice for a data search that may start at the individual property level, move out based on driving time, such as five minutes or thirty minutes, or submarkets, cities, counties, school districts, counties, states and for the entire nation.

It is up to the individual business whether they subscribe to data via vendors or use only public sources and also at what geographic level to subscribe. Most large real estate consulting and valuation firms will need national level data at the granular level of individual addresses. Such data is expensive, but it is less expensive and more comprehensive than using research assistants to try and collect, aggregate, and make it readily available without the private data vendors.

Real time data is essential for current valuation work, and successful firms will invest heavily in access.

Statistical expertise

Modern day valuation estimation requires more than simple math and some basic algebra, for discounting and adjustment calculations. In order to consider using the regression methods, or third-party vendors of such models, and time adjusted valuation approaches, one must at a minimum understand:

Calculations and visualization of means, mode (most frequent result), medians (middle number in a sequence).

Standard Deviation: A standard deviation is the degree of variation or dispersion of a set of values. The formula is, s, for standard deviation = $s_N = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}$, where N is the number of observations, x_i is each observation in the series, $\bar{x}$ is the mean of the data series X. The mean of the series is subtracted from each observation and squared. These squared values are summed and divided by N or n-1 to be conservative when the sample size is not extremely large. The square root of the entire sum is the standard deviation, a measure of the dispersion of the series. Lower standard deviations result in more valid statistical conclusions.

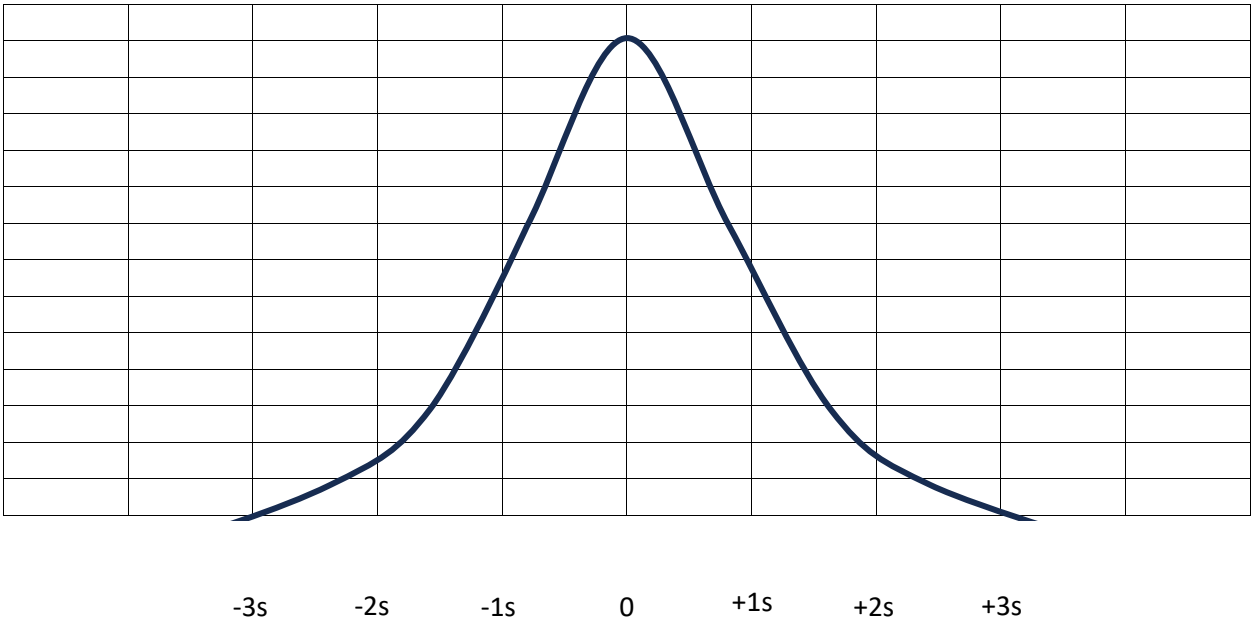
Sampling: How large of a sample is needed for a valid use of the output depends very much on the variance of the relationships. Generally, one wants a sample of thirty or more observations to make statistically valid conclusions. The ability to use a Z or T table allow one to judge statistical significance

or probabilities, and Chi Square tests allow one to judge if two series are statistically representative of each other or not.

Variance: The variance is the standard deviation squared.

Distributions and Skewness: When the variance is evenly distributed about the mean, then the mean, mode and median will be nearly the same or the same value. Such a bell shaped curved is called a Gaussian distribution, after Johann Carl Friedrich Gauss, a German mathematician from his research in the early 1800s. When distributions are not normal (Gaussian) then we need to be careful about using a mean result as typical. It may be better, when unsure to use a median, or the most typical value, the mode, in some cases.

A normal Gaussian curve is shown below along with the percentage of observations that fall within one, two or three standard deviations. It is symmetric on both sides. When using a normal curve, we expect 68% of the observations to be within plus or minus one standard deviation, **s**, of the mean estimate, 95% of the observations to be within two standard deviations and 99.7% to be within three standard deviations. For eighty percent confidence that our estimate is true, we would need to go to 1.282 standard deviations in each direction from the mean estimate, known as a confidence interval.



Linear and non-linear: A linear relationship is one where a change in the dependent variable is expected to be directly proportional either positively or negatively, to the change in the independent variable. In some cases, the marginal impact declines after a single change, and is that case additional units of the independent variable have less and less impact on the dependent variable. For example, for a single-family home the impact of a single car garage on price may be similar to the impact of the next car space in a two-car garage. But in some areas, the third garage space is less valuable and the fourth even less so. This means that when adjusting a comp price for such a feature as a garage it would be advisable to use a lower adjustment with each garage unit beyond two spaces. This would be true whether one was using a sales comparison approach to value or a regression method. However, the capture the non-

linearity, one would need to use a set of dummy variables and separate out the one and two car garages from those with more. A dummy variable is a zero or one, one if the feature exists and zero otherwise. Instead of a single variable for garage spaces, we now have a variable for one garage, two garage spaces, three garage spaces and four or more. This means four variables and each one will have a different coefficient of impact on price.

Mean reversion: An analyst must look for trends and cycles, both seasonal or economic in nature. Once a cycle or pattern is spotted, then one can suggest a general trend towards which the variable will meander towards. The idea is that there is some underlying long-term trend about which some variable, such as price, oscillates as the market tries to find an equilibrium (the point when there is no pressure or observable trend). We can think of vacancy rates and rents as both having long term trends that represent long term equilibrium values, and short-term trends from the uncertainty inherent in the market.

Noise: An analyst may try and tease out patterns that are systematic in nature (repeat) like seasons, but there will always be unexplained movement in a variable that we describe as noise.

Data visualization and mapping: It is extremely important to be able to graph table into meaningful tables for analysis. As such it is useful to have spreadsheet skills such as Excel and the ability to calculate statistical functions and aggregate up using histograms or pivot tables. Mapping applications like Tableau or Maptitude, ArcGIS and many others are also useful to show market trends and patterns.

Valuation Bias

Statistical tests like the t tests mentioned above or the Chi Square tests, not discussed in depth here, can be used to judge if valuation conclusions are systematically biased in some way. In particular it is illegal to be biased based on race, gender, age, or religion, at least in the US. Bias in appraisal can be unconscious or conscious. By comparing the pattern of over or undervaluation for a protected minority group versus a non-protected group like middle income whites, one can look for systematic bias. Most appraisers are not intentionally biased. However, there are anecdotal stories about black families receiving very low appraisals when family photos are on the wall, versus the same home with a white family photo on the wall being re-appraised. We can expect more scrutiny of such claims of bias in the future and work hard at trying to be sure that the method of valuation, sampling methods and adjustments to values are consistently applied across all minority groups.

Another sort of bias in appraisal, which remains pervasive, is found when appraisal is required for mortgage loan approvals and origination. Most residential loans are sold to Fannie and Freddie (government sponsored secondary mortgage market buyers and sellers). Lenders generate most of their income by fees charged for processing loans or loan-premiums earned upon sale. Therefore, there is an incentive to get loans approved, and appraisers that do not “hit the mark” necessary to support a particular loan are not hired as frequently as those that help lenders move product. Appraisers are always told the contract purchase price, which they know they must hit for a loan to be approved without modifications in the contract terms or loan request. In the case of refinancing, it is suspected that appraisers are often told by loan officers the value figure needed to make the loan request feasible. This system wide bias of hitting the mark, has resulted in very few appraisals under the contract price. Unfortunately, the result of such a justification system of appraisal is that neither buyers nor lenders are protected from over paying on a property. Data analyzed for the past five decades suggests that

appraisals hit the mark (purchase price) 90% or more of the time, resulting in very few appraisals affecting the loan approval decision. When an appraisal comes in under the purchase price, it often benefits buyers who can then renegotiate the price. In some cases, buyers are asked to put more equity down or it ends up killing the deal altogether. What one would expect, is not to kill the deal 50 % of the time, but rather result in appraisals equally above and below the purchase price, and more lender tolerance for some variance between the appraisal and the purchase price.

An ideal system would allow an appraiser to provide not just a single value estimate, but also a range for which they are highly confident, say 80% or better, and this would provide useful information to the lender about value uncertainty and risk. We are not close to implementing such a system and so the current system bias of hitting the mark will continue to plague the residential industry.

Within the commercial market, there is also some pressure to hit the mark, but since many lenders keep such loans there is less pressure to hit the mark, and often the appraiser is not given the purchase price. As a result, we observe less bias in the appraisal of commercial properties.

Other sorts of bias are sought out by clients. For example, with property tax appeals, a client wants a conservatively low valuation. They may exert pressure on an appraiser to be conservative, or they may seek out an appraisal firm with a reputation for doom and gloom forecasts and assumptions in all their appraisals. Matching up with the pre-existing biases of appraisers is called the clientele effect in finance. We seek out appraisers who have the biases we want, and then clients need not exert any pressure for a given result.

Remaining professional and unbiased in a world that seeks out such biases is truly a challenge facing the appraisal industry, now and in the foreseeable future.

Conclusions

There are at least five primary methods of appraisal commonly in use by the valuation industry as of 2024. These include the sales comparison approach, cost approach, income approach, regression models, and time adjusted value estimate.

With the sales approach to value for estimating market value, the value is based on what buyers will pay for similar property, with adjustments to sales prices where the comparable property is better or worse in some way. Omitted variables will plague both manual appraisals and automated valuation models based on regression models, and the assumption is all cases is that the error from omitted variables balances out with a mean residual error of zero. Fair market value would require that we learn the circumstances behind all buyers and sellers in all transactions used in a sales comparison approach, and since information on duress, financial circumstances, and information access is rarely known we can never really solve for fair market value. Market value is simply and statistically most probable price, and should be based on at least three comparable properties, and several if available.

While cost rarely equals value, it is a default approach applicable when a property is fairly new and at what is likely the highest and best use of the property or at least the most probable use, and no income data or sales data is readily available. If a sale of the subject property has occurred withing the last ten years or so, and no significant capital improvements have been made to the property, then the time adjusted value method is likely preferrable, assuming one has enough data to construct an index of price changes. Within the cost approach, replacement cost is usually appropriate, but reproduction cost may

be appropriate for very unique buildings, often historically significant icons. The cost approach also might represent an upper limit to value, if alternative sites are available and if the entitlement process is fairly quick such that new construction can start within a reasonable period of time. The best cost estimates will require including general contracting experts in the process.

There are several income approaches to value. All involve discounting of future income back to present value, with several variations on the formulas used for discounting and the net operating income estimates which might be based on stabilized level estimates or year by year in the case of discounted cash flow analysis. Which methods are applied depends on the details available on income and expenses. One should always use as much information and detail as possible, and as reasonably available. The theory is that the value lies in the mind of the typical investor of such property. Research on financing rates and required rates of return for similar risk and growth prospects result in better value estimates.

Regression and more advanced statistical techniques to estimate value are able to utilize larger samples than the traditional methods above, and in fact, depend on larger samples. Such methods require experience and statistical expertise, and in the world of residential appraisal are becoming widely accepted by lenders. Hybrid methods where a computer search system helps select suggested comps and helps run values using regression models or via appraisal emulation are becoming common. Appraisal emulation is actually a sales comparison approach, but based on regression coefficients to help adjust sales comp prices.

Time adjusted valuation is one of the newer techniques to become popular. It depends on a long time series of sales trends at a granular level that matches the market conditions within which the subject property exists. It assumes that the prior sale price of the subject property was equilibrium and not a duress sale, and brings the past price to the date of the appraisal by constructing an appropriate index of sales price trends per unit of comparison, such as price per square feet. It can be fairly accurate if the subject property has not made significant modifications to the structure and is typical of the market for which the index is constructed.

Bias in appraisal remains a concern of the industry, lenders, and regulators. Two types of common biases are: 1) Justification appraisals that merely parrot back the sales price as the value and do not seek to objectively judge if the buyer paid too much. Such appraisals are worthless to buyers and lenders and cost the buyer needless fees. 2) Bias against protected minority groups, race, age, gender is also a concern and one that can be tested over time by comparisons with the majority groups.