Chapter 601

Comparables Appraisal

Introduction

Without the sale of the property itself, it is widely considered that the best estimate of market value of a property is the recent sale price of highly similar properties in close proximity to the subject property. This procedure is used to estimate the market value of a subject property from comparable properties based on the sales comparison approach.

The Comparables Appraisal procedure in **NCSS** contains tools and reports for all steps of the sales comparison approach. First, it allows you to select an appropriate subset of your sales database, such as properties in the same area of similar age, size, and sale date. Then the comparability (or distance) of each of the candidate subset properties to the subject property is measured based on specified attributes. The investigator may then select specific properties as comparables or use those that are most similar to the subject property. Next, the comparable property sales prices are adjusted to the subject property based on specified amounts or percentages, for each unit of difference from the subject property. Finally, an average or weighted average of the adjusted sale prices of the comparable properties can be used to estimate the subject property market value.

Comparables Appraisal Details

The sales comparison approach to property value estimation has five steps:

1. Select a pool of candidate properties from a database of recent sales.
2. Rank these properties according to similarity to the subject property.
3. Select the desired comparable properties.
4. Adjust the comparable property values according to differences in attributes from the subject property.
5. Estimate the subject market value based on the average of the adjusted values of the comparables.

Step I – Subset of Candidate Properties

The first step is to select a group of candidate comparable properties from the sales database. Usually, this step involves selecting properties of similar age, size, and location. Selecting a proper subset of properties for consideration greatly reduces the need for making significant (sometimes controversial) adjustments to the sale prices.

Step 2 – Rank the Properties

A distance measure is used to quantify the similarity of each candidate property to the subject property. Three measures of distance are available for consideration in this procedure. Once the distance is calculated for each candidate property, they are sorted from lowest to highest. The properties with the smallest distances (or largest comparability) are closest to the subject property.

Suppose there are K attributes measured for each property to be used to determine distance from the subject property. The value of the ith attribute on the jth property is represented by X_{ij}.

Euclidean Distance

The Euclidean distance between the jth candidate property and the subject property, based on K similarity attributes, may be calculated using the formula:

$$D_j = \sqrt{\sum_{i=1}^{K} \frac{w_i}{\sum w_i} \left(\frac{X_{ij} - X_{iS}}{s_i} \right)^2}$$

where s_i is the standard deviation of all the candidate properties for the ith attribute, and w_i is an attribute importance weight. If s_i is 0, it is replaced with 1. Technically, D_j is the weighted standardized Euclidean distance. In theory, the Euclidean distance formula puts all attributes on the same scale by dividing the difference by the attribute standard deviation. For example, a difference of 2 bedrooms and a difference of 980 square feet may be put on the same scale by dividing each difference by the standard deviation of the respective attribute. The differences are squared to put negative and positive differences on equal basis.

Note that if all attributes of the subject property and candidate property match exactly, the distance will be zero. Typical distance values will be between zero and three.

This measure of distance relies on having a large enough number of candidate properties to reliably estimate the standard deviation of each attribute.

The Euclidean distance may be roughly interpreted as the average number of standard deviations of the candidate property from the subject property.

Minkowski Distance

The Minkowski distance between the jth candidate property and the subject property, based on K similarity attributes, may be calculated using the formula:

$$D_j = 100 \times \sum_{i=1}^{K} \frac{w_i}{\sum w_i} \left| \frac{X_{ij} - X_{iS}}{X_{iS}} \right|$$

where w_i is an attribute importance weight. Technically, D_j is the weighted Minkowski distance. If X_{iS} is 0, it is replaced with 1. Like the Euclidean distance, the Minkowski distance formula puts all attributes on the same scale but does so by using percent difference rather than by dividing the difference by the attribute standard deviation. The absolute value of differences is taken to put negative and positive differences on equal basis.

As with the Euclidean distance, if all attributes of the subject property and candidate property match exactly, the distance will be zero.

The Minkowski distance may be interpreted as the average percent difference of the candidate property from the subject property.

Comparability (Euclidean)

The Euclidean distance may be converted to a 100-point Comparability scale using

$$Comparability_j = 100 \times \frac{Base\ Value - D_j}{D_j}$$

where D_j is the Euclidean distance and the *Base Value* is a pre-specified number, usually 3 or greater. The Comparability is simply a re-characterization of the Euclidean distance to a 100-point scale. Euclidean distances close to zero give Comparability values that are close to 100. Large Euclidean distances produce Comparability values at or near 0. If all attributes of the subject property and candidate property match exactly, the Comparability will be 100.

One drawback of the Comparability metric is that it depends upon the arbitrary choice of the *Base Value*. The ranking of the properties using this metric is identical to the ranking given by the Euclidean distance, regardless of the choice of *Base Value*.

Step 3 – Select Comparables

Once the candidate subset of properties has been ranked, the comparable properties to be used in subject property market value estimation should be chosen. Typically, the 4 or 5 candidate properties with the lowest distances are used. Otherwise, justification should be provided for choosing other comparables with larger distances.

Step 4 – Comparable Property Value Adjustment

To bring the sale price values of the comparable properties into conformity with the subject property, value adjustments (hopefully small) are made to the comparable properties according to the differences in the comparable and subject properties.

Sale date adjustment

If overall changes in property values across the market have occurred over time (since the comparable sale date), an initial date-based sale price adjustment may be advisable. This adjustment is based on the amount of time between the sale date of the comparable property and the desired basis date of the subject property valuation. A monthly price adjustment factor (A) is used to produce sale prices adjusted to the basis date as follows

$$S_{j,adj} = (1 + A \times M)S_j$$

where $S_{i,adj}$ is the adjusted sale price, S_i is the original sale price, A is the adjustment factor, and M is the difference in months from the basis date. Positive *A* values indicate increasing sale prices, while negative *A*

values indicate decreasing sale prices. Dates previous to the basis date result in positive M values, while dates after the basis date result in negative M values.

For example, suppose the basis date is January 1. Further suppose that a property is sold 4 months before the basis date for $100,000. Also suppose that properties values in general increased about 6% during the year previous to the basis date. Increasing 6% per year, or 0.06, is comparable to 0.005 per month (if not compounding). The value for A in this example would be 0.005. The adjusted sale price of the comparable property would be

$$S_{j,adj} = (1 + 0.005 \times 4)\$100,000 = \$102,000$$

This is the estimated sale price for the property if the property had been sold 4 months later on January 1.

Dollar and percentage adjustments based on attribute differences

The sale price of each comparable property is then adjusted for differences in other attributes. The adjustments are either dollar (lump sum) or percentage adjustments. Dollar adjustments are made by multiplying the specified dollar adjustment amount by the difference in units for the particular attribute. Then this amount is added to (or subtracted from) the running adjusted sale price. Similarly for percentage adjustments, the specified percentage adjustment is multiplied by the difference in units for the attribute. The percentage of the current adjusted sale price is taken, and the amount is added to (or subtracted from) the running adjusted sale price. The adjustments are made in the same order that they are specified. If there are only dollar adjustments, the order doesn't matter, but if there are percentage adjustments the order does matter, since the percentage adjustment is made on the adjusted price to that point.

As an example of a dollar adjustment, suppose that a comparable property has 2,500 square feet while the subject property has 3,000 square feet. In this case, the value of the comparable property should be adjusted up by 500 square feet to make it 'equivalent' to the subject property. Suppose the appraiser determines an appropriate dollar amount of adjustment for each unit difference to be $50 per square foot. Since the difference in size is 500 square feet, $25,000 ($50 × 500) is added to the sale price of the comparable property.

As an example of a percentage adjustment, suppose that a comparable property has a quality rating of '1' while the subject property has a quality rating of '3'. The value of the comparable property should be adjusted up, as if it had a quality rating of '3' also. If the appraiser sets a percentage adjustment of 2% for each unit difference in rating, the current adjusted sale price is multiplied by 1 + 2 × 2% = 1 + 2 × 0.02 = 1.04. For a $200,000 property, this would be equivalent to adding $8,000 to the comparable property running value.

Step 5 – Subject Property Value Estimation

After each comparable property has been adjusted to bring its value in conformity with the attributes of the subject property, an estimate of the value of the subject property may be calculated. Four different estimates are available in NCSS:

1. **Closest**. The adjusted sale price of the closest comparable (using the chosen distance metric) is used as the estimate of the subject property market value.

2. **Least Absolute Dollar Change**. The adjusted sale price of the property that had the least amount of adjustment in absolute dollar amounts (of all candidate properties) is used as the estimate of the subject property market value.

3. **Simple Average**. The average adjusted sale price of the specified comparable properties is used to estimate the subject property market value.

4. **Weighted Average**. A weighted average of the adjusted sale prices of the specified comparable properties is used to estimate the subject property market value. The weights are based on the distances between the subject property and comparable property and the user-specified *Base Value*. Weights are calculated using the formula:

$$W_j = 100 \times \frac{Base\ Value - D_j}{D_j}$$

where D_j is the Euclidean or Minkowski distance. Negative weights are reset to zero. The subject property value is estimated by

$$\sum_{j=1}^{C} \frac{W_j}{\sum W_j} S_{j,adj}$$

where C is the number of comparable properties and $S_{j,adj}$ is the adjusted sale price of the jth comparable property.

Data Structure

Each column of the spreadsheet (database) represents a property attribute and each row represents a property. A sale price column is required. The sale price column gives the sale prices for all properties except the subject property. Several other attribute columns will likely be needed, but not required, to run the Comparables procedure. These include

-   Sale Date column – used to determine differences in sale date from the specified basis date

-   Selection column(s) – used to identify a subset of all properties to be considered for comparison, may be text or numeric

-   Similarity column(s) – used to determine the distance between the subject and candidate properties

-   Adjustment column(s) – used to determine differences between subject and comparable properties in order to determine comparable property price adjustment; at least one adjustment column is needed in order to make adjustment to comparable properties

-   ID column – used to identify properties used in the analysis

-   Report column(s) – these are not necessarily used in calculations, but included in the adjustment report

-   Subject Indicator column – may be used to identify the subject property, although other means are available

-   Comparable Indicator column – may be used to identify the comparable properties, although other means are available

Comparables Appraisal

The following dataset of residential property sales gives an example of what a (simpler) comparables appraisal dataset may look like. In this particular dataset, the last row represents the subject property.

Property Sales Dataset (Subset)

Prop_ID	Sale_Date	Sale_Price	BS_SF_Fin	Main_SF	Qual	Gar_Cnt	Style	Bath_Cnt	Lot_SF
389-1525-487	8/8/2013	245000	800	2415	64	3	Single	3.5	9827
389-1525-584	12/29/2011	173000	0	2348	98	2	Single	2.5	9347
389-1528-570	12/26/2013	221000	0	2404	71	2	Single	2.5	9587
389-1528-618	9/9/2012	183597	0	2908	92	2	Single	2.5	12421
389-1529-518	11/23/2012	212000	736	2280	77	2	Single	3.5	14324
389-1530-434	10/21/2011	257500	621	2572	65	2	Single	2.5	10553
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
389-1547-562	8/19/2009	212000	0	2546	75	2	Single	2.5	11211
389-1547-650	9/30/2014	262500	1300	2526	81	2	Single	2.5	12369
389-1549-608	12/19/2009	189477	0	2530	67	2	Single	2.5	16713
389-1551-554	4/9/2014	202000	796	2606	80	2	Single	2.5	11249
389-1551-637	2/3/2011	200200	0	3344	87	2	Single	3.5	11235
389-1553-553	3/12/2013	174913	0	2522	82	2	Apt	2.5	9587
389-1539-521			580	2764	83	2	Single	2.5	11061

Property Sales dataset column definitions

Prop_ID: Property identification number

Sale_Date: Date of property sale

Sale_Price: Purchase price

BS_SF_Fin: Finished basement square feet

Main_SF: Non-basement square feet

Qual: Property and structure quality score

Gar_Cnt: Number of garage spaces

Style: Type of home (Single is single-family home)

Bath_Cnt: Number of (finished) bathrooms

Lot_SF: Size of lot in square feet

Example 1 – Comparables Appraisal Study

This section presents an example of selecting 5 comparable properties from the dataset and using the adjusted prices of the 5 comparables to estimate the market value of the subject property. Although a single run will be used, this example will follow the 5 steps outlined earlier. The example uses the Property Sales dataset, which contains 101 properties.

The appraiser limits the analysis to single-family dwelling properties that are sold after January 1, 2010. The Euclidean distance metric is to be used for measuring distances between the candidate properties and the subject property. The subject property is the last row of the dataset, with ID number 389-1539-521. Unit adjustment amounts are determined based on previous experience (in particular, with hybrid appraisal model results for properties in the same area). A monthly price adjustment of 0.2% per month will be applied. The specified appraisal date will be January 1, 2016.

Setup

To run this example, complete the following steps:

1   Open the Property Sales example dataset
- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Property Sales** and click **OK**.

2   Specify the Comparables Appraisal procedure options
- Find and open the **Comparables Appraisal** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Price, Date, Subject Tab

Sale Price Column ....**Sale_Price**
Sale Date Column..**Sale_Date**
Basis Date **1/1/2016**
Subject Specification ....**Specify Subject(s) from an ID Column**
ID Column...**Prop_ID**
Subject ID Specification.................................**Enter Subject IDs Directly**
Subject ID(s)...**389-1539-521**
Estimation Method ....**Weighted Average**
Base Value **3**
Report Columns...**Style**
Label (ID) Column...**Prop_ID**

Candidates Subset Tab

Selection Column 1...**Style**
Selection Range ....**Single**
Exclude if Date is before.................................**Checked**
Date **1/1/2010**

Similarity Tab

Distance Metric...**Euclidean**
Similarity Column 1..**Main_SF**
Distance Weight...**4**
Similarity Column 2..**Lot_SF**
Distance Weight...**2**
Similarity Column 3..**Gar_Cnt**
Distance Weight...**1**

Select Comparables Tab

Comparable Specification...............................**Most Similar Based On Distance**
Number Shown...**5**
Number Used in Averages...............................**5**

Adjustment Tab

Adjust Prices to Basis Date ....**Checked**
Monthly Price Adjustment Factor.....................**0.002**
Adjustment Column 1 ....**Main_SF**
Amount ($ or %)...**$40**
Adjustment Column 2 ....**Qual**
Amount ($ or %)...**1%**
Adjustment Column 3 ....**Lot_SF**
Amount ($ or %)...**$4**
Adjustment Column 4 ....**Gar_Cnt**
Amount ($ or %)...**$5100**
Adjustment Column 5 ....**BS_SF_Fin**
Amount ($ or %)...**$20**
Adjustment Column 6 ....**Bath_Cnt**
Amount ($ or %)...**$4200**

Reports Tab

Candidate Subset Report ....**Checked**
Similarity Settings Report ....**Checked**
Distance Report...**Checked**
Number of Properties Reported.......................**10**
Adjustment Settings Report ....**Checked**
Comparables Report..**Checked**
Number Across Page..**3**
Show Definitions..**Checked**
Show Dollar Signs ....**Unchecked**
Show Commas in Dollars ....**Unchecked**
Show Column Separator = |............................**Checked**
Show Horizontal Separator (---------)...............**Checked**

Report Options (*in the Toolbar*)

Variable Labels..**Column Labels**

3   Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Settings Report

Subject Property   389-1539-521

Candidate Subset Report

Selection Column	Selection Criterion
Style	Single

Properties with dates before 1/1/10 were excluded from the candidate subset of properties.

Properties Summary

Total Number of Properties:	101
Number of Subject Properties:	1
Number Excluded by Selection:	28
Number of Candidate Properties:	72

Similarity Settings Report

Similarity Columns	Weight	Mean	Standard Deviation	COV	Subject Property
Main SF	4	2645.0	294.7	11.1	2764
Lot Size	2	11766.7	2456.0	20.9	11061
Garages	1	2.1	0.4	18.1	2

This report summarizes the entries of the Candidate Subset tab, as well as the number of candidate properties.

Similarity Settings Report

Similarity Settings Report

Similarity Columns	Weight	Mean	Standard Deviation	COV	Subject Property
Main SF	4	2645.0	294.7	11.1	2764
Lot Size	2	11766.7	2456.0	20.9	11061
Garages	1	2.1	0.4	18.1	2

This report displays a summary of the entries of the Similarity tab. Notice that the column names have been replaced by the column labels. Additionally, this report gives the mean, standard deviation, and coefficient of variation of all the candidate subset properties for each similarity column. The subject property value for each of the similarity columns is given also.

Distance Report

Distance Report

Property ID	Euclidean Distance	(Unadjusted) Sale Price	Main SF	Lot Size	Garages
389-1539-521			2764	11061	2
389-1537-588	0.16	210500	2807	10552	2
389-1534-554	0.17	165803	2813	10553	2
389-1533-469	0.19	182500	2691	10969	2
389-1539-655	0.24	217000	2848	10547	2
389-1531-572	0.28	181000	2679	11836	2
389-1534-421	0.32	173000	2876	11672	2
389-1541-539	0.32	213000	2765	9593	2
389-1539-559	0.32	293500	2742	9593	2
389-1532-545	0.37	176500	2626	10547	2
389-1551-554	0.41	202000	2606	11249	2

The first row corresponds to the subject property. The next ten rows show the most similar properties to the subject property, based on Euclidean distance (for the three attributes specified). The first five candidate properties become the comparable properties for the Comparable Adjustment and Appraisal Report, since the Comparable Specification was set to Most Similar Based on Distance.

The Euclidean distance is defined toward the beginning of this chapter of the documentation.

Adjustment Settings Report

Adjustment Settings Report

Sale Date Column:	Sale Date
Basis Date:	1/1/16 (Prices are adjusted to be as if they were sold on this date.)
Monthly Price Adjustment Factor:	0.002 (0.2% per month)
Price Adjustment Formula:	Adjusted Price = (1 + 0.002 * M) * Sale Price
	M is the number of months from the Basis Date to the sale date. Dates previous to the Basis Date result in a positive M value, while dates after the Basis Date result in a negative M value.

Adjustment Columns	Adjustment Value	Mean	Standard Deviation	COV	Subject Property
Main SF	$40	2645.0	294.7	11.1	2764
Quality	1%	78.4	10.7	13.7	83
Lot Size	$4	11766.7	2456.0	20.9	11061
Garages	$5100	2.1	0.4	18.1	2
Base SF	$20	364.2	535.5	147.0	580
Bathrooms	$4200	2.7	0.4	14.7	2.5

This report describes the process of adjustment for each comparable property. Notice that the column names have been replaced by the column labels. First, the adjustment for the difference in sale date from the basis date is applied. This is followed by the adjustment for each of the Adjustment Columns, in the listed order. Additionally, this report gives the mean, standard deviation, and coefficient of variation of all the candidate subset properties for each adjustment column. The subject property value for each of the adjustment columns is given also.

Comparable Adjustment and Appraisal Report

Comparable Adjustment and Appraisal Report

Section 1

Property ID:	Unit Adj.	Subject 389-1539-521 Value	Comparable 1 389-1537-588 Value	$Adj	Comparable 2 389-1534-554 Value	$Adj	Comparable 3 389-1533-469 Value	$Adj
Euclid. Distance			0.16		0.17		0.19	
Sale Price			210500		165803		182500	
Style		Single	Single		Single		Single	
Sale Date Adj.	0.2%/mo	1/1/16	8/29/15	1729	4/15/12	14773	12/1/12	13503
Main SF	$40	2764	2807	-1720	2813	-1960	2691	2920
Quality	1%	83	61	46312	63	35723	95	-23871
Lot Size	$4	11061	10552	2036	10553	2032	10969	368
Garages	$5100	2	2	0	2	0	2	0
Base SF	$20	580	0	11600	0	11600	700	-2400
Bathrooms	$4200	2.5	3.5	-4200	2.5	0	2.5	0
Net (%Adj $Adj)			26.5%	55757	37.5%	62168	-5.2%	-9480
Gross (%Adj $Adj)			32.1%	67597	39.9%	66088	23.6%	43061
Adj. Sale Price		**220815**		266257		227971		173020

Section 2

Property ID:	Unit Adj.	Subject 389-1539-521 Value	Comparable 4 389-1539-655 Value	$Adj	Comparable 5 389-1531-572 Value	$Adj
Euclid. Distance			0.24		0.28	
Sale Price			217000		181000	
Style		Single	Single		Single	
Sale Date Adj.	0.2%/mo	1/1/16	1/25/15	4862	12/20/11	17519
Main SF	$40	2764	2848	-3360	2679	3400
Quality	1%	83	94	-24035	68	30288
Lot Size	$4	11061	10547	2056	11836	-3100
Garages	$5100	2	2	0	2	0
Base SF	$20	580	0	11600	417	3260
Bathrooms	$4200	2.5	3.5	-4200	2.5	0
Net (%Adj $Adj)			-6.0%	-13077	28.4%	51367
Gross (%Adj $Adj)			23.1%	50113	31.8%	57567
Adj. Sale Price		**220815**		203923		232367

Note: The subject property appraised value (220815) is the weighted average of the adjusted sale prices of the 5 nearest comparable properties based on the Euclidean Distance metric. The weights are based on the Euclidean Distance with base value 3. That is, Weight = (3 - Dist) / 3.

This report displays the adjustments that are made to each comparable property to arrive at the adjusted sale price. The first column gives the user-specified per unit difference adjustment values. The second column shows the attributes of the subject property. The remaining columns pertain to the comparable properties.

The Sale Date Adj. row and the six adjustment attribute rows give the subject property value, the comparable property value, and corresponding dollar adjustment that is made due to the difference from the subject value.

Net (%Adj $Adj)

On the left is the percent change from the sale price to the adjusted sale price. On the right is dollar amount change from the sale price to the adjusted sale price.

Gross (%Adj $Adj)

On the left is sum of the absolute values of all adjustments (dollar and percent) in percent form. On the right is sum of the absolute values of all adjustments (dollar and percent) in dollar form.

Adj. Sale Price*

For the comparables, this is the sale price after all adjustment have been made to bring the property into conformity with the subject property.

For the subject column, this is the estimated market value of the subject property based on the weighted average of the five comparable properties. This estimate is in bold.

Comparable Adjustment Profile Plot

Comparable Adjustment Profile Plots
_____
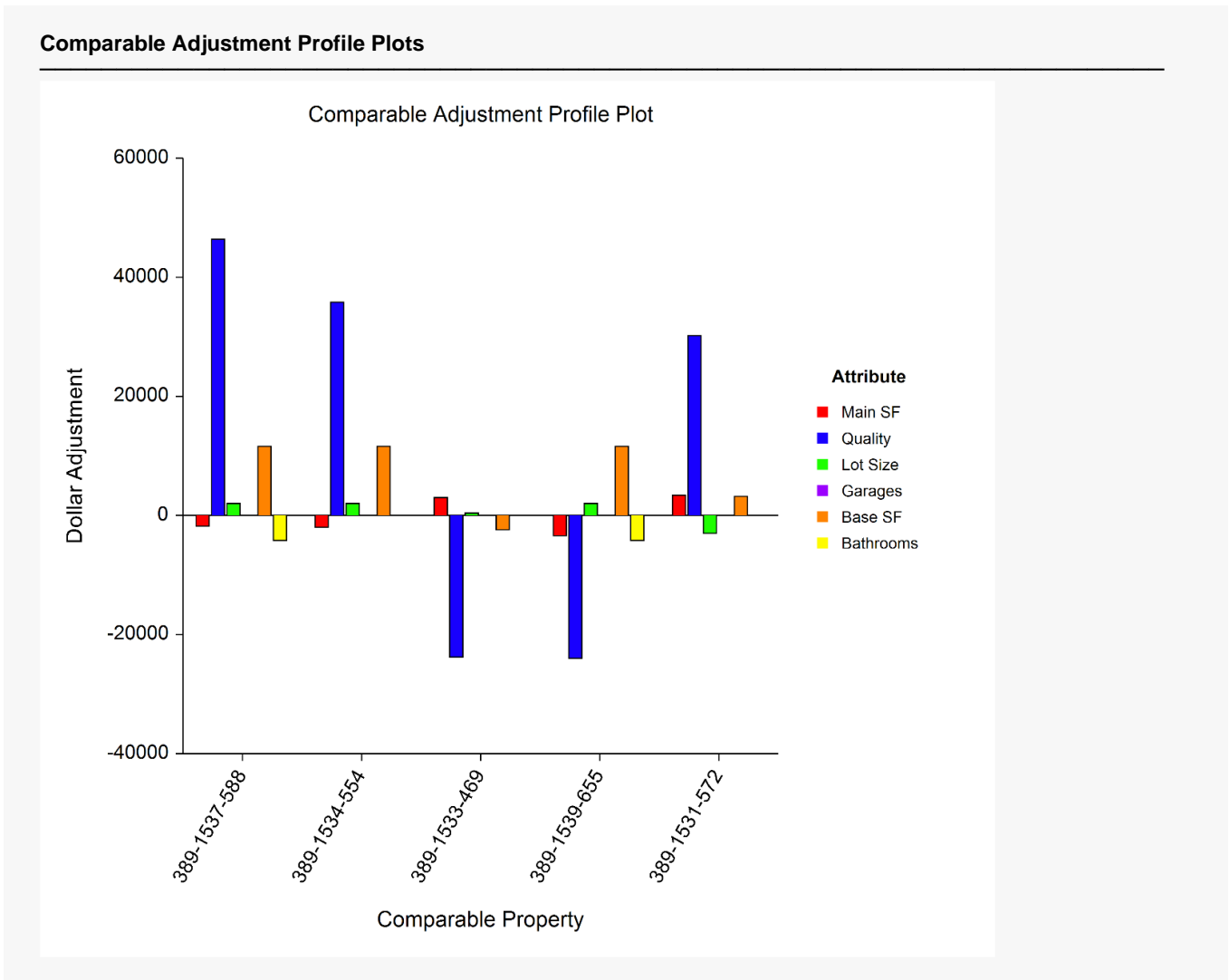
This plot displays the adjustments that are made to each comparable property. It might be noted that the two attributes with the largest adjustments are Quality and Basement Finished Square Feet. Likely this is due to these two attributes not being included in the similarity assessment (they don't contribute to the distance measure).

One visual adjustment has been made to these plots for the comparable property labels to keep them from overlapping. The default label is horizontal. These labels are adjusted by clicking on the Plot Format button (on the Plots tab), selecting the Group Axis sub-tab, and clicking the Layout button to the right of Lower Axis Labels. The Alignment is changed to Right, the Rotation Angle is changed to 60, and the Margin Above the Text is changed to 10.

Net and Gross Adjustment Plot

Net and Gross Adjustment Plots
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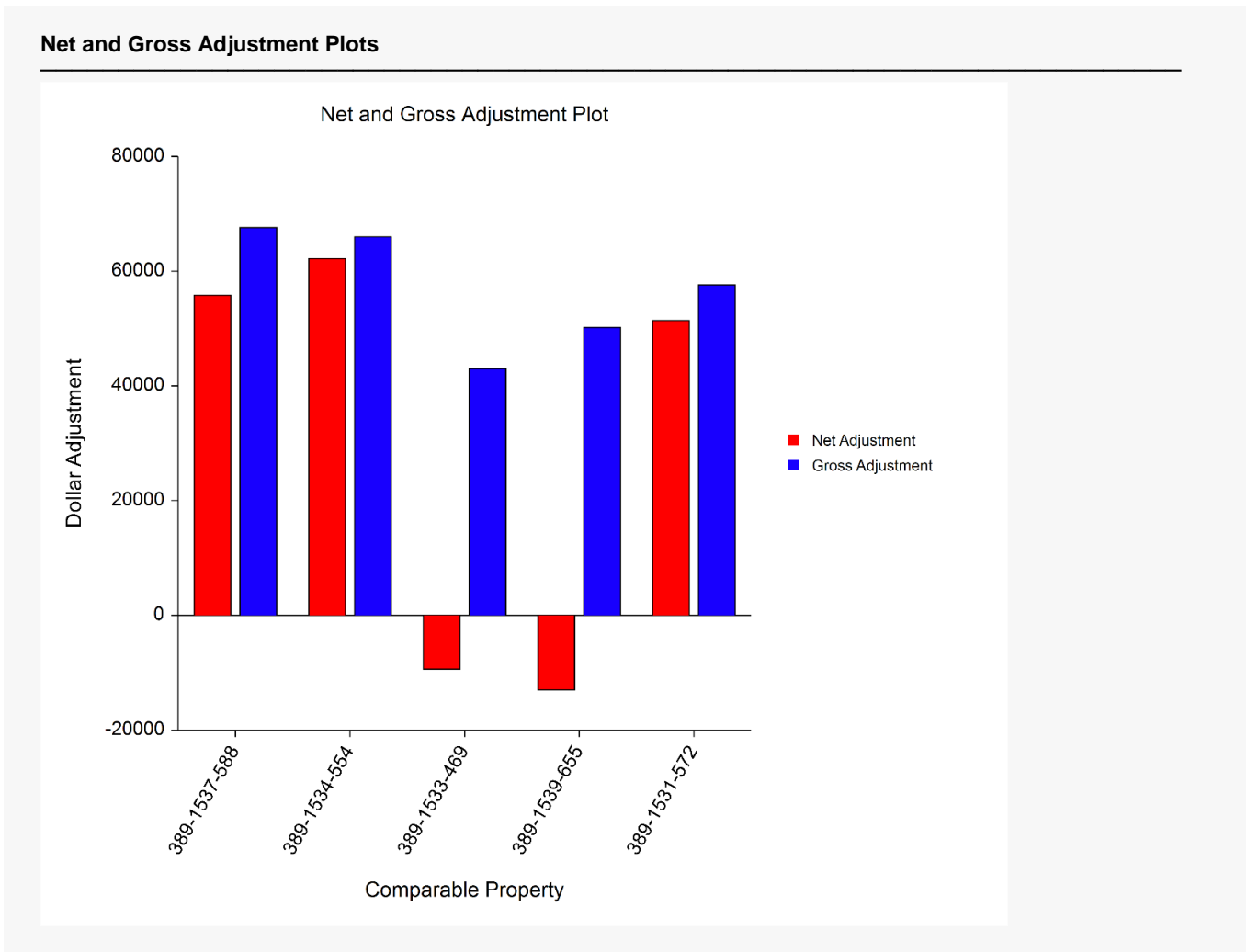
This plot displays the net and gross adjustments that are made to each comparable property. The net adjustment is the sum of all adjustments, including adjustment to the basis date, if applicable. The net adjustment is also the difference between the original sale price and the adjusted sale price. The gross adjustment is the sum of the absolute values of all adjustments, including adjustment to the basis date, if applicable.

Market Value Estimation Plot

Market Value Estimation Plots
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Market Value Estimation Plot
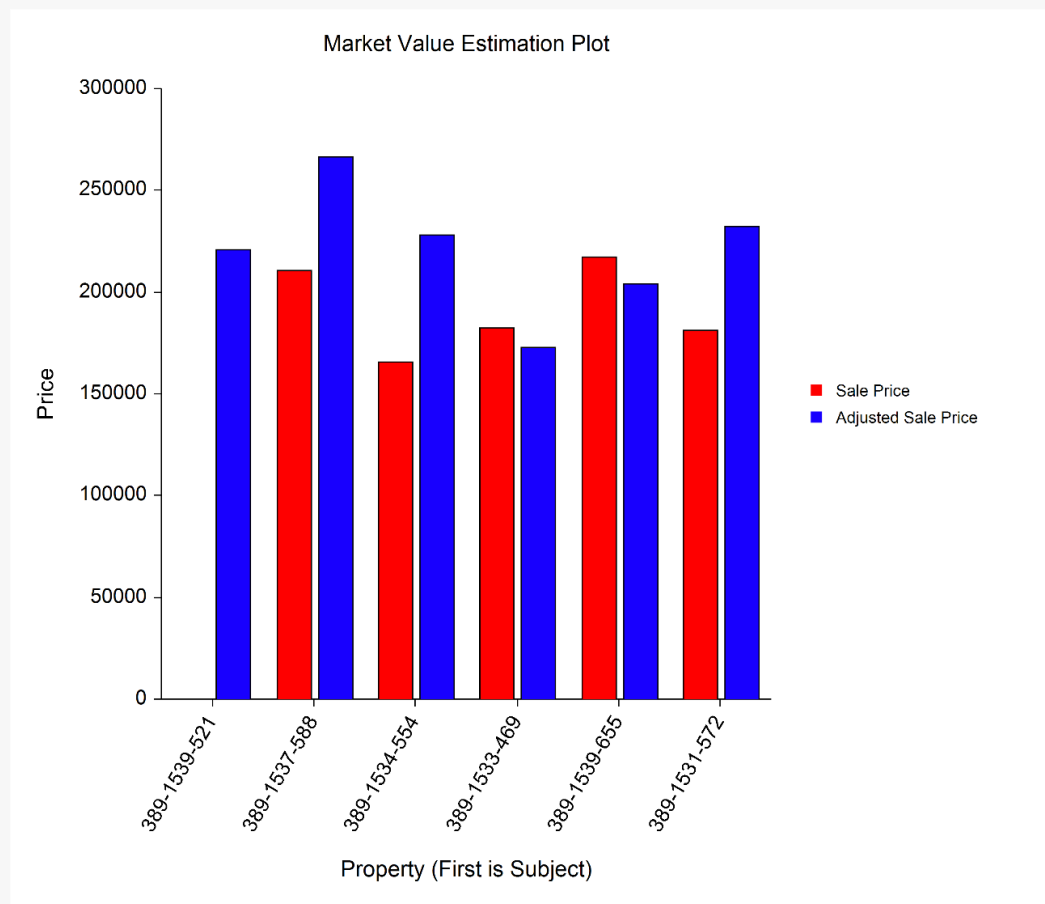
This plot displays the estimated market value of the subject property (on the left), followed by the original sale price and the adjusted sale price for each of the comparable properties.