

# Expressway Proximity Damages to Residential Property

by Roland D. Nelson, SR/WA  
Laurence G. Allen

*Laurence G. Allen is a fee appraiser with Dean Appraisal Company in Detroit, Michigan. He received his B.A. from Linfield College and is currently completing his M.B.A. at the University of Michigan. He is a member of the American Institute of Real Estate Appraisers (M.A.I.) and a senior member of the American Society of Appraisers (A.S.A.).*

*Roland D. Nelson, SR/WA, is a fee appraiser with Dean Appraisal Company in Detroit, Michigan. He has a B.S. degree from Michigan State University. He is a past president of the Michigan Chapter of the American Institute of Real Estate Appraisers, as well as a current member (M.A.I.). Nelson is also a senior member of the American Society of Appraisers (A.S.A.), a designated member of the Institute of Real Estate Management (C.P.M.) and a member of the Society of Real Estate Counselors (C.R.E.).*

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The appraisal of real estate has often been termed an "art" because a great deal of experience and judgment are required by the appraiser. The appraiser is required to analyze the various factors that contribute to value and arrive at a specific conclusion as to the market value of a particular property. However, appraising is more than an art. Many appraisal problems do lend themselves to vigorous scientific analysis using the statistical appraisal process.

## **The Statistical Appraisal Process**

The estimated market values are the results of a statistical appraisal process which combines experienced judgment, econometrics and modern data processing. The great advantage of the statistical approach over traditional appraisal methods is that it is scientific. Although the computational details of statistical appraising can be formidable, the basic steps and logic may still be understood by a layman with no special knowledge of appraising, econometrics, or computers.

Four general steps are involved in the statistical appraisal process.

### **Step 1: Sample Selection**

The first step is to assemble a sample of sales of properties that are similar to the Subject. In practice, it is not necessary that the sample properties be identical to the Subject. Usually, it is sufficient if the sample sales occur in the same neighborhood or subdivision as the Subject, or in some other subdivision with generally comparable houses and lots. As a rule, the larger the sample, the better the estimates that will emerge from the appraisal process.

For purposes of illustration let us suppose that 10 arms-length sales of houses have occurred in the Subject's subdivision since 1970. This sample is represented in Figure A (on the following page). Each asterisk corresponds to a single sale. Actual selling prices are shown on the vertical axis; the date of sale beginning at 1970 is shown horizontally. As we might expect the data suggests that the selling prices of houses have steadily increased between 1970 and 1979.

### **Step 2: Linear Regression**

The second step is to identify and

fit to the data an equation relating the selling price of the sample properties to the characteristics of the houses and lots, such as size, design, rooms, location, age and date of sale, which explain market value. This step almost always involves a certain amount of statistical experimentation with alternative equation forms and variable definitions. Usually, these experiments are conducted using a computer. The objective of Step 2 is to find an equation which possesses good statistical properties yet also conforms to economic theory and appraisal experience.

In our simplified example, the only characteristic that explains market value is the date of sale. So, we would probably choose to fit to the sample data a linear equation of the general form:

$$y = a + bx$$

In this equation  $y$  refers to selling price and  $x$  is the date of sale measured in years from 1970. The coefficients  $a$  and  $b$  are unknown and must be estimated statistically using

the sample.

The method that is universally preferred by econometricians for fitting linear equations of the form given above is least squares. The equation which results when least squares is applied to our sample of 10 sales is:

$$y = 23000 + 3000x$$

This equation has been drawn as a line superimposed on the sample in Figure B (below).

The equation's vertical intercept,  $a = 23000$ , is an estimate of selling price at the start of 1970. The estimated slope,  $b = 3000$ , indicates that the selling prices of properties within the subdivision have increased at the general rate of about \$3,000 per year.

Notice that the estimated line does not fit the data perfectly. There is usually a vertical distance between a point representing a sale and the line drawn in Figure B. This distance is a residual or error. It is the part of an actual selling price that is not explained by the date of sale through the estimated equation.

### Step 3: Estimation of Market Values

The next step in the appraisal process is to derive a hypothetical selling price for the Subject property on the date of appraisal. This is done by evaluating the estimated equation using the information that describes the Subject.

In Figure C we begin by erecting a vertical line on the date of appraisal, January, 1977. The point where this vertical line crosses the line fitted in

Step 2 represents a hypothetical sale of the Subject property on January, 1977. By running a horizontal line to the vertical axis, we find that the estimated equation implies a selling price of \$44,250.

The selling price can also be computed arithmetically by substituting  $x = 7.0833$  years (from the start of 1970 to January, 1977) in

the estimated equation,  $y = 23,000 + 3,000(7.0833) = \$44,250$ . A selling price computed in this way is the best unbiased statistical estimate that can be made of market value on the date of appraisal given the sample from Step 1 and the assumed linear relationship,  $y = a + bx$ , from Step 2.

Figure A

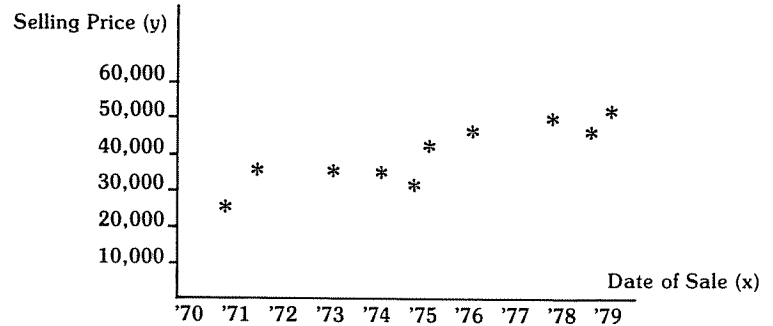


Figure B

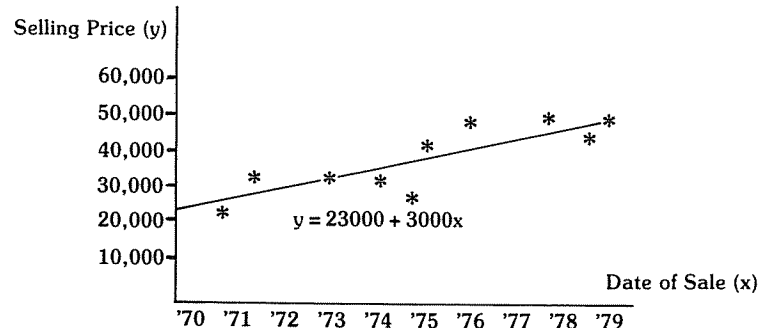
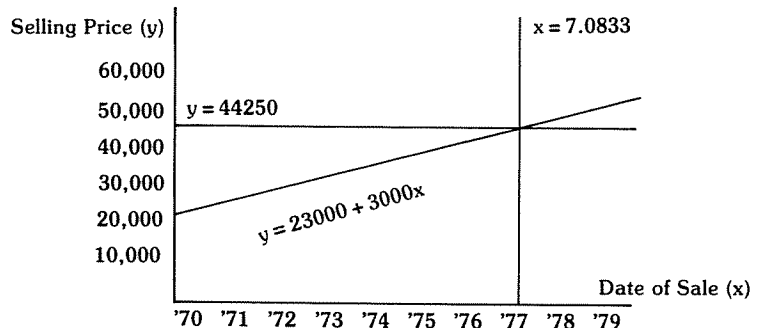


Figure C



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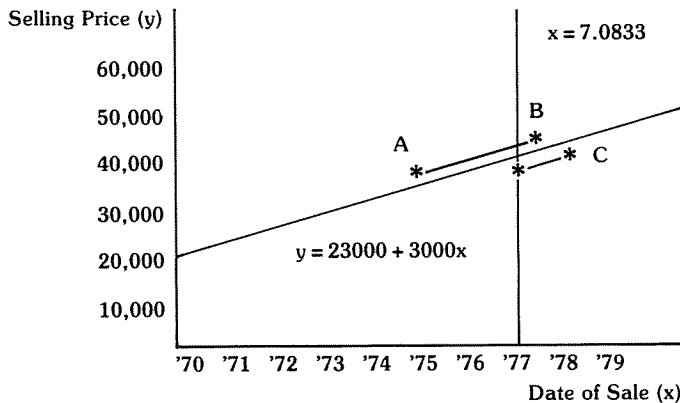
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**Table 1**

Item	Comp. A	Comp. B	Comp. C
Selling price on date of sale	\$39,000	\$47,500	\$47,500
Date of Sale	12/74	9/77	5/78
X value for comparable	5.0000	7.7500	8.4167
7.0833 - x value for comp.	2.0833	-.6667	-1.3333
Coefficient (b) of x	3000	3000	3000
Adjustment	\$6,250	-\$2,000	-\$4,000
Selling price adjusted to 1/77	\$45,250	\$45,500	\$43,500

**Figure D****Step 4: Adjustment of Comparable Sales**

The last step in the appraisal process is to adjust and compare the selling prices of three comparable properties with the estimated market value of the Subject. This step is not strictly necessary to the appraisal process. Nevertheless, Step 4 is included because it shows how the statistical approach improves upon the traditional appraisal method.

The comparable sales are chosen from the sample from Step 1 on the basis of similarity to the Subject and small residuals. In Figure D the three selected sales have been labeled A, B and C. All three sales occurred within 2 years of January, 1977 and lie close to the fitted line. A comparable is adjusted for the discrepancy between its date of sale and the date of appraisal by moving it along a line parallel to the fitted equation until it hits the vertical line erected at January, 1977. From Figure D it can be seen that the adjusted selling prices all fall close to the market value of \$44,250 estimated in Step 3.

The arithmetic required to adjust the selling prices of the comparables is summarized in Table 1.

Although the selection and adjustment of comparable sales represents standard appraisal practice, the procedure outlined above incorporates an important improvement. The traditional practice is to make subjective adjustments based upon experience and judgment. On the other hand, the adjustments computed above are scientific because they are based entirely on the statistical estimate of the coefficient b obtained in Step 2. The statistical approach is particularly advantageous when comparable sales must be adjusted for many subject properties. Then, the equation coefficients estimated in Step 2 provide a single consistent basis for computing all the adjustments.

We have recently been involved in various appraisals that required a



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determination of the effects of expressway proximity on the value of single family homes in various developed urban locations. The problem requires an analysis of a large amount of sales data, as well as interviews of property owners, brokers, lenders and assessors. We determined that the problem was suitable to computer and statistical analysis. We secured the services of Dr. Edward Pearsall as an economic consultant who developed the software necessary as well as advice and guidance as to the best approach and processes for solving the appraisal problem scientifically.

It is seldom that an appraiser gets the opportunity to examine one factor affecting value as in depth as was necessary in these studies. The proximity factor was found to have an important influence on the selling price of residential property. It is important for appraisers to understand this influence as it is a consideration in the cost, market and income approaches to value. In a cost approach it becomes economic obsolescence due to location. With an income or market approach it becomes an adjustment factor that would apply to rents or sale prices. It should be an important factor in valuation for mortgage purposes, property taxation, condemnation or any other purpose that requires a market value estimate.

Estimates of the damages incurred by homeowners due to their proximity to a highway can be estimated by adding a second explanatory variable to the equation that is estimated in Step 2. The equation that is fit by least squares becomes:

$$y = a + bx + cz$$

where  $z$  is some suitably defined measure of the property's proximity to the highway. Fitting an equation with 2, 3, 10 or even 50 explanatory variables is not a difficult task for a modern digital computer. The estimate of the coefficient  $c$  relates selling price to highway proximity in a way that is analogous to the relationship between selling price and date of sale measured by  $b$ . In Step 3 of the appraisal process different values of  $z$  can be inserted to estimate market values of a Subject pro-

Figure 1: OWNER INTERVIEWS

Date: May 1980

Address of Property: 26827 Warner

Person Interviewed: Mrs. Hartman

Did Person Interviewed -

Know name of subdivision? Yes

Know lot number in subdivision? Yes

Have knowledge of Deed Restriction? No

Comments:

Bad points about freeway:

*Did not like the noise & vibration*

Good points about freeway:

*Nothing to report*

Other Comments:

*Lived here since highway was started. Would not let me through the house and interview took place at front door. Mrs. Hartman lives by herself. Highway Dept. offered to sell the strip of excess land north of her, but she could not afford to buy. Complained that people use it as a dump.*

erty both before and after construction of the highway. In Step 4 adjustments can be made to the selling prices of comparable properties to reflect differences in proximity to the highway,  $z$ , as well as date of sale,  $x$ .

### Problem

In Michigan condemnation, if the taking does not touch a subject property, then there is no taking.

Several class action suits were initiated on behalf of property owners alleging that particular residential subdivisions which were deed restricted to single family use had their deed restrictions broken as a result of an expressway taking. The breaking of the deed restrictions was determined to be a technical touching of the property. One of the sticks in the bundle of rights was taken. This opened the door to possible damages due to the proximity of the expressway to the remaining houses in the subdivisions.

### Interviewing Procedures

The dates of taking were established by negotiations between the highway department and the home owners' attorney. Our assignment was to go back to the date of taking to estimate any damages to the subdivision properties due to the expressway taking.

Appointments were made with the property owners and individual, personal on-site, inspections and owner/

occupant interviews were undertaken. The owner/occupants were not advised before these interviews as to the purpose of the interviews. (See Figure 1).

The general interviews started out by verifying the occupant as an owner or tenant and the respective term of occupancy and verification of any applicable sales history.

The owners were asked if they knew the name of their subdivision, the lot number and what was their deed restriction. Seldom did an owner know the name of their subdivision. Even less seldom did they know their lot number and we did not observe any owner that knew their deed restrictions.

We then asked the owner/occupant what were the good and the bad points about their respective location in relation to the expressway.

The good points were the quick access to the expressway via service drives and ramps and place of employment, shopping, etc. Some owner/occupants even preferred the traffic to looking out at other houses and some were pleased that the service drives were snow plowed before the subdivision streets.

The bad aspects were much more pronounced. They included, but were not limited to: noise, dirt, faster and more traffic, vibrations from expressway traffic, vibrations from expressway traffic causing basement and window cracks,

safety, vision problems, etc.

It should be kept in mind that our subject houses either fronted on a service drive (where on-street parking was prohibited), backed up to the expressway, or sided up to the expressway, on streets which ran off from the service drives.

In almost every instance at the end of our interviews we asked the owner/occupants if they had to do it over again, would they locate in the same place, or would they prefer to be several houses away from the expressway, for the same amount of money. In almost every instance the owner/occupants would prefer for the same money to be more removed from their present location.

These owner/occupant interviews were expanded by interviewing others. These included, but were not limited to additional owner/occupants in our comparative properties, both with close proximity to the expressway and removed from the expressway. We interviewed local real estate salespersons and brokers. We discussed the valuation problems of proximity with the local tax assessing personnel. We discussed the proximity problem with investors, mortgage companies and FHA and fee appraisers. We even discussed the deed restrictions with the title companies who insured the titles on house transfers where the deed restrictions had been broken by the condemnation for the expressway.

In general it was our findings that assessors, FHA appraisers, mortgage lenders, brokers and property owners did recognize a decrease in value due to expressway proximity.

## Procedures

We then went on to a statistical analysis of the sales in the area. The technique utilized was a multiple regression process with proximity as one of the variables.

In all of the studies we have gathered large amounts of sales data. Generally, we used anywhere from 300 to 900 sales. An attempt was made to obtain approximately 100 of these sales in close proximity to the expressway. The remaining

sales were selected from the subject subdivision, other subdivisions that contained proximity sales and control subdivisions without any proximity to the expressway. A control subdivision was a similar subdivision of houses that had no deed restrictions at the time of taking.

The data was gathered from the tract index, assessor's records, broker's records, inspections and the verifications and the data generally included the following:

Sale Price & Terms  
Date of Sale  
Conditions of the Sale  
Proximity to Freeway  
Year of Construction  
Lot Size  
Building Area  
Levels  
Garage Area  
House Type  
Number of Bedrooms  
Bathrooms  
Subdivision  
Fencing  
Basement  
Air Conditioning  
Siding  
Pool  
Landscaping  
Storms & Screens  
Physical Condition  
Recreation Rooms, etc.  
Heating System  
Fireplace  
Lot Frontage

The data was then transformed into factors that were meaningful both from an appraisal and a statistical standpoint. For example it was found most useful to transform the sale prices into a unit rate which was the sales price per square foot of ground floor building area. A separate variable was set up to express the changes in Price/SF as the house size changes. This was found to be a highly significant adjustment factor.

The sale prices were also adjusted to the date of valuation through the use of the area Consumer Price Index. Another variable was then set up to measure the relationship of price changes to the CPI changes. This also was found to be highly significant. (See Table 2).

**Table 2**  
**Detroit CPI**  
**(July 71=100)**

1964	74.4
1965	76.3
1966	79.5
1967	82.1
1968	85.9
1969	91.2
1970	96.7
1971	100.0
1972	104.0
1973	109.8
1974	122.9
1975	132.1
1976	138.9
1977	149.8
1978	159.8
1979	180.1

The other variables found to be significant were the distance from the expressway, lot size in relation to house size and type.

The factor that we were most interested in was the expressway proximity factor. This factor was significant at the 95% level and in fact the null hypothesis that a proximity has no effect on the sale prices could be rejected at the 99% confidence level.

The first definition of the proximity variable was based loosely on elementary physics. First, the source of the noise, sights, fumes, hazards, etc. that are disagreeable to homeowners is to be found some distance into a highway from the edge of the right of way. Consequently, 30 feet was added to the measured distances from structure centers to the highway. Second, the physics of wave propagation in three dimensions suggests that noise energy dissipates at a rate that is inversely proportional to the square of the distance from a point source. Vision also depends on a three dimensional wave, so, if homeowners regard the highway as an eyesore or as an intrusion on their privacy, this effect should also be proportional to the inverse of distance squared. On the other hand, volume filling effects such as fumes and soot attenuate at a rate that is inversely proportional

to the distance cubed, while the risks that a highway presents to wandering pets and small children is probably proportional to the inverse of just distance. Noise is the most frequently cited irritant to homeowners and the definition of proximity was chosen to reflect this fact.

Experimental regressions were computed using a variety of measures of proximity to the highway for this study and in previous studies. These experiments tend to show that our damage estimates for houses close to the expressway (100 feet or less) are largely invariant to the particular choice of a damage measure. On the other hand, damage estimates to properties at some distance from the expressway (more than 100 feet) are quite sensitive to the specification of the proximity variable. Any reasonable definition of the variable will support a regression with statistical properties that are almost identical to the estimates we have utilized.

An example illustrating the dollar effects on sale prices resulting from our formulation are summarized below.

In other studies various fits of the proximity relationship were attempted. In every case our formulation was found to be superior or else there was no measurable difference. The only exception was when data was available on the decible level in the subdivisions along the expressway. This was found to be a superior measure than proximity as measured by distance.

### Conclusions

In this case, statistics provided a valuable assistance in solving the appraisal problem. In the case of

proximity damages it is very difficult for an appraiser to estimate the effect of variables such as proximity that are small but are significant factors affecting value through conventional appraisal processes. An appraiser can obtain three comparables on the expressway and three off and try to measure the differences, but the myriad of factors that go into creating a sale price will generally cloud the results. The results will vary substantially depending on which comparables the appraiser chooses to use.

A statistical process is much superior in this respect. The average

effect of an individual variable can be established based upon a large number of sales. This provides a more reliable answer and indicates a confidence interval. This type of study also requires a close look at other variables that effect the prices of residential housing. The relevance and strength of these other factors can be determined and used as valuation benchmarks.

The limitation of this approach is that the results represent the average relationship of specific variables. It cannot handle unique or unusual factors that do not occur frequently enough to provide a sufficient base of measurement.

The advantages of this approach in isolating the effects of an individual valuation factor, however, far outweigh the limitations. Scientific appraising provides practical supplement to an appraiser's judgment and experience.

For more information contact the authors at Dean Appraisal Company, 800 City National Bank, Detroit, Michigan 48226.

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	<u>1,000 SF</u>	<u>1,250 SF</u>	<u>1,500 SF</u>
Over 300 feet	\$ 0	\$ 0	\$ 0
300 feet	161	202	242
250 feet	224	280	336
200 feet	332	415	498
150 feet	542	677	813
100 feet	1,039	1,299	1,559
50 feet	2,744	3,430	4,115
30 feet	4,878	6,097	7,316