Advanced Statistical Modeling
In Real Estate Appraisal

John A. Kilpatrick, Ph.D., MAI
August 2, 2012

www.greenfieldadvisors.com

Suite 240 – 2101 4th Ave
Seattle, WA, USA 98121
+01-206-623-2935

Suite 1000 - 1870 The Exchange
Atlanta, GA, USA 30339
+01-770-951-7030
An Exploratory Review of the Effects of Toxic Mold on Real Estate Values

by Robert A. Siracusa, PhD, and Ross Throppe, PhD

Despite widespread recent interest in toxic mold, real estate literature has provided limited guidance on valuation issues for properties affected by it.
CONSTRUCTION DEFECTS AND STIGMA
Published in
Mealey's Construction Defects
July, 2003
John A. Kilpatrick, Ph.D., Managing Partner
Mundy Associates LLC
Seattle, Washington 98109

Abstract
Properties suffering from construction defects exhibit a diminution in value resulting from both the actual cost to cure as well as the residual stigma losses. In the unremediated state, the sum of these should equal the diminution in market value, while post-remediation there is significant

An Exploratory Review of the Effects of Toxic Mold on Real Estate Values

by Robert A. Sirvans, PhD, and Ross Torpate, PhD

abstract
This article reports outcomes of ten litigated toxic mold cases; a contingent valuation (CV) analysis of toxic mold in South Carolina; and model case studies of an apartment complex near Seattle.

Despite widespread recent interest in toxic mold, real estate literature has provided limited guidance on valuation issues for properties affected by it.
CONSTRUCTION DEFECTS AND STIGMA

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An Exploratory Review of
the Effects of Toxic Mold
Real Estate Values

John A. Kiparick, Douglas C. Brown, MAI, and Ronald C. Rogers, PhD

The Performance of Exterior Insulation Finish Systems
and Property Value

Exterior insulation finish systems, or synthetic stucco, is a siding material used on a quarter of a million residences and several thousand commercial buildings in the United States, Canada, and Europe. EIFS use has been linked with moisture problems and structural rot in many buildings, necessitating value impact estimates by appraisers. The value estimates, which may require outside expertise in accordance with Advisory Opinion 9 of the Uniform Standards of Professional Appraisal Practice, include cost to cure and stigma. For residential appraisals, stigma may be estimated with matched pairs. For a commercial appraisal, stigma takes the form of an increased capitalization rate.
CONSTRUCTION DEFECTS AND STIGMA

Published in
Mealey's Construction Defects
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John A. Kilpatrick, Ph.D., Managing Partner
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Abstract
Properties suffering from construction defects exhibit a diminution in value resulting from these defects. The decrease in property value is a reflection of the added depreciation from the repair and replacement costs of the defect. We refer to this diminution in value as "construction defect loss." We explore the repair and replacement costs associated with construction defects. Additionally, we examined the diminution in property value resulting from construction defects. This diminution in value is a direct result of the costs associated with the defect.

Chinese Drywall

A Greenfield Advisors White Paper
John A. Kilpatrick, Ph.D., MRICS and Christopher A. Miller, MAI
June 5, 2009

The Chinese Drywall issue is rapidly unfolding, and Greenfield Advisors has been tracking the issues since they first came to light. The following is based on the best information available to date, which is believed to be reliable.

In 2005, a spike in housing construction appeared in the southeastern United States as a result of major hurricanes in the previous year. As homes from 2006 began to age a bit, those built with the Chinese drywall began to manifest problems, notably rotten egg (sulfur) smells and corroding copper plumbing, copper heat exchanger coils, and exposed copper wiring. Scores of lawsuits have cropped up as people noticed the pattern and came to the conclusion that the Chinese drywall was contaminated and defective.
CONSTRUCTION DEFECTS AND STIGMA
Published in
Meeker’s Construction Defects
July, 2003
John A. Kippatrick, Ph.D, Managing Partner
Mundy Associates LLC
Seattle, Washington 98109

Abstract
Properties suffering from construction defects exhibit a diminution in value resulting from the presence and repair requirements of the defects. Overall, the repair costs associated with construction defects are significant. The property is more likely to be damaged in the future by the defects or due to the presence of the defects in the property market. The presence of construction defects may also lead to a loss of value due to reduced demand for the property.

Chinese Drywall
A Greenfield Advisors White Paper
John A. Kippatrick, Ph.D., MRICS and Christopher A. Miner, MAI
June 5, 2009

The Chinese Drywall issue is rapidly unfolding, and Greenfield Advisors has been tracking the issues since they first came to light. The following is based on the best information available to date, which is believed to be reliable.

In 2005, a spike in housing construction appeared in the southeastern United States as a result of major hurricanes in the previous year. As homes from 2006 began to be built with the Chinese drywall, manifest problems, notably not only the smell and corroding copper plumbing, but overheating from heat exchanger coils, and even the shorting of wiring. Scores of lawsuits have been filed by homeowners and people affected by the issue, and the conclusion that the Chinese drywall was contaminated and defective.

The Performance of Exterior Insulation Finish Systems and Property Value

Insulation finishes systems, or synthetic stuccos, is a siding material used on a million residences and several thousand commercial buildings in the United States, Canada, and Europe. EIFS use has been linked with mold, real estate literature, and a loss of value for properties affected by it.

The Impact of Hazardous Materials on Property Value

Public opposition to the handling, storage, or disposal of hazardous materials in proximity to human or wildlife populations is high. How to safely deal with such hazardous materials is thus becoming a significant national issue. The impact of hazardous materials on property value is difficult to measure, however. While some models of real and perceived risk exist, to integrate them with actual market behavior is problematic. A theory of how contamination influences value that incorporates the impact of hazardous materials on property value over time and distance is considered.

The issue of the safe handling, storage, and disposal of hazardous materials is extremely costly, even to a large extent.
An Exploratory Review of the Effects of Toxic Mold and Property Values

John A. Kilpatrick, Douglas C. Brown, MAI, and Ronald C. Rogers, PhD

The Performance of Exterior Insulation Finish Systems and Property Value

Bill Mundy, MAI, PhD

The Impact of Hazardous Materials on Property Value

JOURNAL OF HOUSING RESEARCH VOLUME 15 ISSUE 2

Application of Repeat Sales Analysis to Determine the Impact of a Contamination Event

John A. Kilpatrick
**CONSTRUCTION DEFECTS AND STIGMA**

Published in
*Meeker's Construction Defects*

July, 2003

John A. Kilpatrick, Ph.D., Managing Partner
Mundy Associates LLC
Seattle, Washington 98110

Abstract
Properties suffering from construction defects exhibit a diminution in value resulting from the economic and physical consequences of the defect. This diminution is often manifest as a loss of market value and is commonly referred to as a "stigma". This paper presents an overview of the current research on the effects of construction defects on property value, with a focus on the economic implications of these defects on real estate transactions.

**Chinese Drywall**

*A Greenfield Advisors White Paper*

John A. Kilpatrick, Ph.D., MRICS and Christopher A. Miner, MAI
June 5, 2009

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In 2005, a spike in housing construction appeared in the southeastern United States as a result of the housing boom. As homes from 2006 began to be built with the Chinese drywall, manifest problems, notably rust stains and corroding copper pipes, were discovered. Scores of lawsuits have been filed by consumers who believe that the Chinese drywall was defective or contaminated and ineffective.

**The Performance of Exterior Insulation Finish Systems and Property Value**

John A. Kilpatrick, Douglas C. Brown, MAI, and Ronald C. Rogers, PhD

The performance of exterior insulation finish systems, or synthetic stucco, has been a point of contention for many years. This paper presents research on the economic impact of exterior insulation finish systems on property value, with a focus on the use of synthetic stucco in the construction industry.

**The Impact of Hazardous Materials on Property Value**

Bill Mundy, MAI, PhD

This paper explores the relationship between the presence of hazardous materials on a property and its overall value. The authors provide an overview of the current research on the topic, as well as recommendations for real estate professionals on how to assess and mitigate the effects of hazardous materials on property value.

**THE FUTURE OF REAL ESTATE INFORMATION**

*E*VOLUTION OF REAL ESTATE STANDARDS

"I don't see information technology as a stand-alone system. I see it as a great facilitator. And maybe more important, it is a reason to keep asking yourself the question – why, why, why?" - Paul O'Neill, former Chairman and CEO of Alcoa, now U.S. Treasury Secretary
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The Performance of Insulation Finish Systems and Property Values
John A. Kilpatrick, Douglas C. Brown, MAI, and Ronald C. Rogers, PhD

SUMMATION OF EVIDENTIARY RULES FOR REAL ESTATE EXPERTS MANDATED BY DAUBERT V. MERRELL DOW PHARMACEUTICALS, INC.
by David G. McLean, John F. Kilpatrick, & Bill Mundy, CRE

An Exploratory Review of the Effects of Toxic Mold

Factors Influencing CBD Land Prices
Bill Mundy, MAI, PhD

The Future of Real Estate Information
By John A. Kilpatrick

The Impact of Transit Corridors on Residential Property Values
John A. Kilpatrick, Ronald L. Thrope, John L. Caruthers, and Andrew Krause

The Impact of Hazmat Materials on Property Values

JOURNAL OF HOUSING RESEARCH
VOLUME 15 ISSUE 2
Application of Repeat Sales Analysis to Determine the Impact of a Contamination Event
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Advanced Statistical Methods
Advanced Statistical Methods

Hedonic Modeling
Advanced Statistical Methods

Hedonic Modeling

Survey Research
Advanced Statistical Methods

Hedonic Modeling

Survey Research

Meta Analysis
Advanced Statistical Methods

Hedonic Modeling

Survey Research

Meta Analysis

Expert Systems
Goals for this course:
Goals for this course:

Basic familiarity with the fundamentals
Goals for this course:

Basic familiarity with the fundamentals

How does this comport with USPAP and CPE?
Goals for this course:

Basic familiarity with the fundamentals

How does this comport with USPAP and CPE?

How does this fit in the appraisal body of knowledge?
Goals for this course:

Basic familiarity with the fundamentals

How does this comport with USPAP and CPE?

How does this fit in the appraisal body of knowledge?

When will you find this useful?
An Introduction to Statistics for Appraisers

by Marvin L. Wolverton, PhD, MAI
Part 3. Introduction: Why Should Real Estate Appraisers Care about Statistics?

Preview Part 3 ........................................................................................................................................... 39
Course Introduction ...................................................................................................................................... 41
Online Session: Multiple Regression Model ............................................................................................... 41
Developing an Opinion of Value ..................................................................................................................... 46
How Could the Information We Developed in the Online Session Augment the Valuation Process? ..................................................................................................................................... 49
How and Why Might Clients Value Statistical Analysis by Appraisers? ..................................................... 49
Why Should Real Estate Appraisers Care about Statistics? ........................................................................ 51
Review Part 3 ............................................................................................................................................... 53
What this class is NOT --

NOT focused on litigation
NOT introducing new topics
-- everything in this course is well established in the valuation literature
NOT trying to teach the AI’s Quant Analysis Course
NOT trying to debate USPAP or CPE
-- these methods are all well established in USPAP and in the Code of Professional Conduct
Reference Manual on Scientific Evidence

Third Edition


Committee on Science, Technology, and Law Policy and Global Affairs

FEDERAL JUDICIAL CENTER

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu
Why Is Knowledge of Regression Useful to the Appraiser?

Learning about regression is increasingly important. As computing technology advances and data becomes more available, the regression model and other statistical techniques become more accessible and usable. And not surprisingly, over the past decade the number of appraisers using regression has increased dramatically. Thus even if you do not use regression, there is likely to be a time in the future when you will be looking at the work of someone else who has used the regression model. One group that uses regression extensively is tax assessors, who are charged with estimating the values of large numbers of properties. They have found that the use of models such as regression make the task reasonable in terms of time and cost.

Almost everyone in the appraisal and mortgage lending industries has heard of automated valuation models. Some people may not realize that regression is often at the core of these models. Recent estimates are that 20% - 30% of residential valuations are now being done using regression models, most in response to the preferences of mortgage lenders. That being the case, one can argue that regression has now become mainstream and is a recognized method or technique. Note that the Competency Rule and USPAP Standard 1 have particular relevance, because they require that appraisers be aware of, understand, and correctly employ recognized methods and also have the necessary knowledge and experience to complete assignments correctly. In addition, Standard 6 restates Rule 1 with reference to mass appraisal.
MODULE 4

Why Is Knowledge of Regression Useful to the Appraiser?

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The Hedonic Regression Model

Sometimes called a “hedonic pricing model”

- Uses comparable prices in the same way as a sales adjustment grid
- Called “hedonic” because it measures the marginal prices of individual components that people enjoy
USPAP? – more at the end

Comment to Standards Rule 3-1(a)

Changes and developments in economics, finance, law, and society can have a substantial impact on the appraisal profession. To keep abreast of these changes and developments, the appraisal profession is constantly reviewing and revising appraisal methods and techniques and devising new methods and techniques to meet new circumstances. Each appraiser must continuously improve his or her skills to remain proficient in appraisal review.
USPAP? – more at the end

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The Hedonic Regression Model

Advantages:

– Statistically grounded
– Easy to test which variables are statistically and economically meaningful
– “Matched Pairs” to achieve marginal prices are embedded in the process
– Easy to test accuracy
The Hedonic Regression Model

Disadvantages:
- Requires a large set of comparable data
- Mathematically more difficult
- Less appraiser judgment
- (is this an advantage or disadvantage?)
- Can be difficult to explain
The Hedonic Regression Model

What do we mean by “marginal prices”

- Economic term
- The regression equivalent of the output of a matched pair
- In a linear regression, it’s the coefficient
The Hedonic Regression Model

What do we mean by “marginal prices”

Example:
Land value = $10,000 per acre
V = 10000X

Thus, the marginal price of an acre of land is $10,000
The Hedonic Regression Model

What do we mean by “marginal prices”

Example:
House Value = $150/SF
  + $1,000 for every bathroom > 2
  -- $1,000 for every bathroom < 2
  + $2,000 if it has a garage
  + $2,000 if it has a fireplace
The Hedonic Regression Model

What do we mean by “marginal prices”

Example:
\[ V = \text{Intercept} + 150X + 1000 (B-2) + 2000G + 2000F \]

What is the marginal price of a fireplace?
The Hedonic Regression Model

Consider this equation again:

$V = \text{Intercept} + 150X + 1000 (B-2) + 2000G + 2000F$
The Hedonic Regression Model

Consider this equation again:

\[ V = \text{Intercept} + 150X + 1000 (B-2) + 2000G + 2000F \]

What’s missing?
The Hedonic Regression Model

Consider this equation again:

\[ V = \text{Intercept} + 150X + 1000 (B-2) + 2000G + 2000F \]

What’s missing?

Unexplained Variance
The Hedonic Regression Model

Consider this equation again:

\[ V = \text{Intercept} + 150X + 1000(B-2) + 2000G + 2000F + \varepsilon \]
The Hedonic Regression Model

Some rules about epsilon (unexplained variance):
- Normally distributed
- Mean of zero (indicates unbiasedness)
- Standard deviation of 1 (consistency)
The Hedonic Regression Model

Some rules about epsilon (unexplained variance):
– Normally distributed
– Mean of zero (indicates unbiasedness)
– Standard deviation of 1 (consistency)

We’ll return to these rules again in a minute:
– Problems
– Solutions
The Hedonic Regression Model

Consider this equation again:

\[ V = \text{Intercept} + 150X + 1000 (B-2) + 2000G + 2000F + \varepsilon \]
The Hedonic Regression Model

The Regression Intercept

- A constant
- The value of the equation if all other factors were set to zero
The Regression Intercept

- A constant
- The value of the equation if all other factors were set to zero

- In a hedonic pricing model, can be thought of as the value of a lot in the subject neighborhood
The Regression Intercept

– A constant
– The value of the equation if all other factors were set to zero

– In a hedonic pricing model, can be thought of as the value of a lot in the subject neighborhood
– (not exactly statistically accurate)
The Hedonic Regression Model

Assume the following appraisal problem:

<table>
<thead>
<tr>
<th>Comp #</th>
<th>Price</th>
<th>SF</th>
<th># of baths</th>
<th>Garage?</th>
<th>Fireplace?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$185,000</td>
<td>1250</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>2</td>
<td>$190,000</td>
<td>1300</td>
<td>2</td>
<td>Yes</td>
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<tr>
<td>3</td>
<td>$195,000</td>
<td>1400</td>
<td>3</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>$205,000</td>
<td>1450</td>
<td>3</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>$220,000</td>
<td>1500</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Subject</td>
<td>?</td>
<td>1400</td>
<td>2</td>
<td>Yes</td>
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<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
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<td>----</td>
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</tr>
<tr>
<td>1</td>
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<td>sf</td>
<td>bath</td>
<td>gar</td>
<td>fp</td>
</tr>
<tr>
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<td>1250</td>
<td>2</td>
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<tr>
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<td>190000</td>
<td>1300</td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>195000</td>
<td>1400</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>205000</td>
<td>1450</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>220000</td>
<td>1500</td>
<td>2</td>
<td>1</td>
<td>1</td>
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</table>

**SUMMARY OUTPUT**

<table>
<thead>
<tr>
<th>10</th>
<th>Regression Statistics</th>
</tr>
</thead>
</table>
| 11 | Multiple R             | 0.99533329  
| 12 | R Square               | 0.99188312  
| 13 | Adjusted R Sq          | -0.0324675  
| 14 | Standard Error         | 2500        
| 15 | Observations           | 5           |

**ANOVA**

<table>
<thead>
<tr>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression: 4</td>
<td>763750000</td>
<td>190337500</td>
<td>40.73333333</td>
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</tr>
<tr>
<td>Residual: 1</td>
<td>62500000</td>
<td>6250000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total: 5</td>
<td>770000000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Coefficients**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-Value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>-0.2079376</td>
<td>0.86346136</td>
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<td>3</td>
<td>0.20483276</td>
<td>785.310237</td>
<td>785.310237</td>
</tr>
<tr>
<td>bath</td>
<td>0</td>
<td>0</td>
<td>65535</td>
<td>#NUM!</td>
<td>0</td>
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<tr>
<td>gar</td>
<td>8750</td>
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<td>0.32172249</td>
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<td>70263.6492</td>
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<tr>
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<td>-1250</td>
<td>-0.1072113</td>
<td>0.93200691</td>
<td>146894.485</td>
<td>146894.485</td>
</tr>
</tbody>
</table>
The Hedonic Regression Model

Consider this equation again:

\[ V = -12,500 + 150X + 0B + 8750G - 1250F \]

\[ V = -12,500 + 150(1400) + 0(2) + 8750(1) - 1250(1) \]

\[ V = $205,000 \]
The Hedonic Regression Model

Consider this equation again:

\[ V = -12,500 + 150X + 0B + \]

\[ V = -12,500 + 150(1400) + \]

\[ V = $205,000 \]

How much confidence do we have in this answer?
Notice the difference between $R^2$ and adjusted $R^2$. 

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Lower 99%</th>
<th>Upper 99%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-12500</td>
<td>60104.0764</td>
<td>-0.2079726</td>
<td>-776194.7</td>
<td>751194.7</td>
<td>-776194.7</td>
<td>751194.7</td>
</tr>
<tr>
<td>sf</td>
<td>150</td>
<td>50</td>
<td>3</td>
<td>-485.31024</td>
<td>785.310237</td>
<td>-485.31024</td>
<td>785.310237</td>
</tr>
<tr>
<td>bath</td>
<td>0</td>
<td>0</td>
<td>65553</td>
<td>#NUM!</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>gar</td>
<td>8750</td>
<td>4841.22918</td>
<td>1.80739223</td>
<td>-52763.649</td>
<td>70263.6492</td>
<td>-52763.649</td>
<td>70263.6492</td>
</tr>
<tr>
<td>fp</td>
<td>-1250</td>
<td>11659.2238</td>
<td>-0.1072113</td>
<td>-149394.48</td>
<td>146894.485</td>
<td>-149394.48</td>
<td>146894.485</td>
</tr>
</tbody>
</table>
Notice the meaningless t- and p-statistics
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Price</td>
<td>sf</td>
<td>bath</td>
<td>gar</td>
<td>fp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>185000</td>
<td>1250</td>
<td>2</td>
<td>1</td>
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<tr>
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<td>1300</td>
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<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>195000</td>
<td>1400</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>205000</td>
<td>1450</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>220000</td>
<td>1500</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SUMMARY OUTPUT**

<table>
<thead>
<tr>
<th>Regression Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R: 0.99533329</td>
</tr>
<tr>
<td>R Square: 0.99188312</td>
</tr>
<tr>
<td>Adjusted R Square: -0.0324675</td>
</tr>
<tr>
<td>Standard Error: 2500</td>
</tr>
<tr>
<td>Observations: 5</td>
</tr>
</tbody>
</table>

**ANOVA**

<table>
<thead>
<tr>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>763750000</td>
<td>190937500</td>
<td>40.733333</td>
<td>#NUM!</td>
</tr>
<tr>
<td>1</td>
<td>6250000</td>
<td>6250000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>770000000</td>
<td>154000000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Coefficients**

<table>
<thead>
<tr>
<th></th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-Value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Lower 95.0%</th>
<th>Upper 95.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1250</td>
<td>-0.20793726</td>
<td>0.86946163</td>
<td>-776194.7</td>
<td>751194.7</td>
<td>-776194.7</td>
<td>751194.7</td>
</tr>
<tr>
<td>sf</td>
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<td>3</td>
<td>0.20483276</td>
<td>-485.31024</td>
<td>785.310237</td>
<td>-485.31024</td>
<td>785.310237</td>
</tr>
<tr>
<td>bath</td>
<td>0</td>
<td>0</td>
<td>65535</td>
<td>#NUM!</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>gar</td>
<td>8750</td>
<td>1.80739223</td>
<td>0.32172249</td>
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<td>70263.6492</td>
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<td>70263.6492</td>
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<td>-0.1072113</td>
<td>0.93200691</td>
<td>-149394.48</td>
<td>146894.485</td>
<td>-149394.48</td>
<td>146894.485</td>
</tr>
</tbody>
</table>
Even though we get “unbiased” answers, the results are meaningless and lack validity, largely as the result of a small data set.
This data set goes on for 100 comp sales
### SUMMARY OUTPUT

<table>
<thead>
<tr>
<th>Regression Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.926102954</td>
</tr>
<tr>
<td>R Square</td>
<td>0.857666682</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.8516737</td>
</tr>
<tr>
<td>Standard Error</td>
<td>3876.550144</td>
</tr>
<tr>
<td>Observations</td>
<td>100</td>
</tr>
</tbody>
</table>

### ANOVA

<table>
<thead>
<tr>
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<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
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</thead>
<tbody>
<tr>
<td>Regression</td>
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<td>8602533703</td>
<td>2.2E+09</td>
<td>143.112</td>
<td>2.527E-39</td>
</tr>
<tr>
<td>Residual</td>
<td>95</td>
<td>1427625897</td>
<td>1.5E+07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>10030159600</td>
<td></td>
<td></td>
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</tbody>
</table>

### Coefficients

<table>
<thead>
<tr>
<th></th>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
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<th>Upper 95%</th>
<th>Lower 95.0%</th>
<th>Upper 95.0%</th>
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<tbody>
<tr>
<td>Intercept</td>
<td>-3996.20597</td>
<td>9535.782453</td>
<td>-0.41907</td>
<td>0.67611</td>
<td>-22927.1272</td>
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<td>22.7022</td>
<td>3.7E-40</td>
<td>141.6178293</td>
<td>168.7595234</td>
<td>141.6178293</td>
<td>168.759523</td>
</tr>
<tr>
<td>bath</td>
<td>483.8462186</td>
<td>784.148651</td>
<td>0.61703</td>
<td>0.53869</td>
<td>-1072.88564</td>
<td>2040.578077</td>
<td>-1072.88564</td>
<td>2040.57808</td>
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<tr>
<td>gar</td>
<td>2105.047687</td>
<td>797.2185058</td>
<td>2.64049</td>
<td>0.00968</td>
<td>522.3688867</td>
<td>3687.726487</td>
<td>522.3688867</td>
<td>3687.72649</td>
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<tr>
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<td>1225.677281</td>
<td>788.087123</td>
<td>1.55526</td>
<td>0.12321</td>
<td>-338.8734327</td>
<td>2790.227996</td>
<td>-338.8734327</td>
<td>2790.228</td>
</tr>
</tbody>
</table>
Note the negative sign for the intercept – we’ll deal with that in a minute!

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<table>
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<td>MS</td>
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<td>2.2E+09</td>
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<td>1.5E+07</td>
</tr>
<tr>
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</tr>
<tr>
<td>F</td>
<td></td>
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<td>Residual</td>
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<tr>
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<td>-0.41907</td>
<td>-22927.1272</td>
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<td>0.12321</td>
<td>-338.8734327</td>
<td>2790.227996</td>
<td>-338.8734327</td>
</tr>
</tbody>
</table>
Note the more meaningful range of adjusted R²
F-test shows that the regression is valid.
Not all t-stats and p-values are in line, but the results are meaningful and have expected signs
We can “bootstrap” the process by eliminating the variables that don’t have meaningful results.
Now, adjusted $R^2$ is improved and the intercept has the expected sign.
Now, what does our equation look like?

\[ V = 2846 + 148(SF) + 2132(G) \]

\[ V = 2846 + 148(1400) + 2132(1) = $212,178 \]

(earlier answer was $205,000)
The Hedonic Regression Model

One more improvement:

\[ \ln(V) = \text{Intercept} + \text{Coefficients} \times \ln(\text{factors}) \]

Why?
The Hedonic Regression Model

Using logarithms is called a log- or semi-log transformation

Sometimes called a Box-Cox transformation

Remember that error terms are supposed to be ~N(0,1)?

Real estate prices are always > 0, so this rule may be violated

Log transformation corrects for this
The Hedonic Regression Model

Without transform, residuals are biased
The Hedonic Regression Model

sf Residual Plot
Without Transform

sf Residual Plot
With Transform

With transform, residuals are unbiased
The Hedonic Regression Model

Transformed solution

\[ V = \exp(\text{Intercept} + \text{Coefficients} \times \text{Factors}) \]

= $210,686
(earlier answer was $212,178)
The Hedonic Regression Model

Transformed solution

\[ V = \exp(\text{Intercept} + \text{Coefficients} \times \text{Factors}) \]

= $210,686

This is the anti-log function
The Hedonic Regression Model

Appraisal Standards?
Generally thought of under USPAP 6 (Mass appraisal, AVMs)
Hedonic modeling is fully consistent with USPAP 1
When conducting a mass appraisal, IAAO supplemental standards provide good guidance
Integrated with GIS, etc.
Need to cite either/or USPAP 1 and 6
The Hedonic Regression Model

Colwell, et al., TAJ 2009

Cites Rubenfeld, Reference Manual on Scientific Evidence
Cites In Re: Guardian Pipeline (Judge Frank Easterbrook)

Testifying expert should have training in both appraisal and statistical methods
Hedonic Regression: “must read”

Colwell, et al., TAJ 2009
Kauko & d’Amato, Mass Appraisal Methods (RICS, 2008)
Gloudemans, Mass Appraisal of Real Property (IAAO, 1999)
Wolverton, An Introduction to Statistics for Appraisers (A.I., 2009)
Survey Research

Informal surveys
– Market Research
– Rent/Cap Rate Surveys, etc.

Formal surveys
– Contingent Valuation
– Conjoint Measurement
– Perceived Diminution
Survey Research

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– Market Research
– Rent/Cap Rate Surveys, etc.

Formal surveys
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Survey Research

Common Uses:

When transactional data is insufficient or unreliable
– Lack of transactions
– Transactions don’t meet definition of value
– Market is at disequilibrium
Survey Research

Common Uses:

When transactional data is insufficient or unreliable
– Lack of transactions
– Transactions don’t meet definition of value
– Market is at disequilibrium

To supplement or support transactional data
Survey Research

Two recent examples:
Survey Research

Two recent examples:

Allison v. Exxon – survey research told a compelling story to the jury when transactional data was muddled in a drinking water contamination case.
Survey Research

Two recent examples:

Allison v. Exxon – survey research told a compelling story to the jury when transactional data was muddled in a drinking water contamination case

Rogers v. U.S. – explained and supported a transactions-based adjustment in a rails-to-trails taking
Survey Research

“stated preference” versus “revealed preference”
Survey Research

“stated preference” versus “revealed preference”

Transactional-based models (e.g. – sales comparison approach): the market participants reveal their preferences via the choices they make.
**Survey Research**

“stated preference” versus “revealed preference”

Transactional-based models (e.g. – sales comparison approach): the market participants **reveal** their preferences via the choices they make

Survey research: market participants **state** their preferences directly
Survey Research

“stated preference” versus “revealed preference”

Note that both are market perspectives and rely on market data.
Facts of the situation + = 
Facts of the situation + Market Survey Responses = [Result]
Facts of the situation + Market Survey Responses = Results: (value, adjustm’t, etc.)
Often referred to as a fact card, but may be photographs, a video, or other presentation.
Often referred to as a fact card, but may be photographs, a video, or other presentation.

In Rogers v. U.S., the “fact card” was actually a set of videos, much like a typical Realtor™ sales video. Alternate presentations of the video showed the yard with a trail and without a trail.
Facts of the situation

Important issues include large sample size, response rate, and unbiased format of the questions.

Follows well-accepted sampling methods, derived from market research and statistics.

Market Survey Responses

Results: (value, adjustm’t, etc.)
Important issues include large sample size, response rate, and unbiased format of the questions.

Increasing use of online surveys allows for very large samples, albeit with lower response rates, but improves selection bias.

Follows well-accepted sampling methods, derived from market research and statistics.
Survey Research - Advantages

One of the only ways to measure “non-use” values

- Environmental impairment
- Both Goods (willingness to pay) and Bads (willingness to accept)
- Private impacts of public goods (airports, rails-to-trails, etc.)
One of the only ways to measure “non-use” values

– Environmental impairment

– Both Goods (willingness to pay) and Bads (willingness to accept)

– Private impacts of public goods (airports, rails-to-trails, etc.)

Often referred to as “passive use” values
Survey Research - Advantages

Enormously flexible
Widely used both in appraisal and other areas – well developed body of knowledge
Methodology outlined in the Reference Manual on Scientific Evidence published by the U.S. Justice Department
Results easy to analyze and describe – understandable and compelling to a Court
Survey Research - Challenges

1993 NOAA Panel – questions which have been answered

Confusing WTP with WTA

(Note: WTP has an implicit income constraint)

Confusing cross-sectional and longitudinal studies
Survey Research – “Must Read”


Mundy and McLean, “Addition of CV to the Required Body of Knowledge”, in J. Real Estate Practice and Education (ARES, 1998)

Meta Analysis

Question – how do we statistically compile the collected wisdom of scholars in the field?
Meta Analysis

Contrasting and combining results from different studies,
Identifying patterns among study results
Identifying sources of disagreement
Identifying other interesting relationships
Meta Analysis

One recent use -- to assess diminution in value resulting from environmental disamenities
Meta Analysis

Assume we have three published studies about groundwater contamination:

<table>
<thead>
<tr>
<th>Study</th>
<th># obs</th>
<th>% dim</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>25%</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>40%</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>45%</td>
</tr>
</tbody>
</table>
What if we took a weighted average of these studies?

<table>
<thead>
<tr>
<th>Study</th>
<th># obs</th>
<th>% dim</th>
<th>Weighted</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>30</td>
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<td>11%</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>40%</td>
<td>9%</td>
</tr>
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<td>25</td>
<td>45%</td>
<td>16%</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>45%</td>
<td>35%</td>
</tr>
</tbody>
</table>

average of 3 studies
Meta Analysis

In reality, meta analyses look at dozens of studies, and control for such factors as type of contaminant (groundwater, air, etc.), geographic region, neighborhood type (rural, suburban, etc.), time factors, and underlying unimpaired property value.
Meta Analysis

In reality, meta analyses look at dozens of studies, and control for such factors as type of contaminant (groundwater, air, etc.), geographic region, neighborhood type (rural, suburban, etc.), time factors, and underlying unimpaired property value. The exact control variables are less important than arriving at a good explanatory “fit”
The “file drawer problem” with meta analyses -- a cautionary tale
The “file drawer problem” with meta analyses -- a cautionary tale

Imagine we’re conducting a meta analysis, and these are the 20 studies we find published
The “file drawer problem” with meta analyses -- a cautionary tale

What if there were actually 30 studies, but 10 didn’t get published?
Fortunately, this is rarely a problem in real estate studies – negative or zero findings are usually just as interesting and publishable as positive ones!

The “file drawer problem” with meta analyses -- a cautionary tale

What if there were actually 30 studies, but 10 didn’t get published?
Meta Analysis

Usefulness?
- Contaminated Property Litigation
- Housing Characteristics
- Real Estate Brokerage Effectiveness
- REIT & RE Portfolio Valuation
- Appraisal Accuracy
- Environmental Amenities
- Transportation Infrastructure & Airport Noise
- Historic Preservation
Meta Analysis – “must read”

Lipscomb, Mooney, & Kilpatrick, *J. Real Estate Literature*, forthcoming, 2013
Sirmans, MacDonald, Macpherson, & Zietz, National Center for R.E. Research, 2005
Debrezion, Pels, & Rietveld, *J. Real Estate Finance & Economics*, 2007
Expert Systems

What happens “in between” the hedonic model and the sales adjustment grid?

Is there a way to bring the power of statistical analysis to smaller data sets or “dirty” data?

How can we incorporate the appraiser’s “judgment” into statistical processes?
Expert Systems

Ties together several streams of research:

– Statistics
– Appraisal Theory and Practice
– Set Theory
– Equilibrium Theory
Expert Systems

But first a word about WLS – weighted least squares

OLS (ordinary least squares) only works if the error terms (the “residuals”) are normally distributed with a mean of zero and a standard deviation of 1

What if the error terms are badly behaved?
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What could cause badly behaved errors?

Spatial colinearity
Temporal colinearity
Non-negative variables (i.e. – truncated prices)
Expert Systems

What could cause badly behaved errors?

Spatial colinearity
Temporal colinearity
Non-negative variables (i.e. – truncated prices)

These are all common in real estate data
In a pure regression model, we accommodate this with what’s called “weighted least squares.”

Some uniform weighting is applied.

Example – using a logarithmic adjustment in hedonic pricing models.
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Hence, when we apply regression or other statistical modeling to the appraisal process, one challenge is to incorporate appraiser judgment to adjust for “non-normality” in the data.

Recall Colwell, et al. *TAJ* 2009 – both appraisal and statistics training are necessary in modeling
Expert Systems: 
The Bayesian Estimator

\[
\Pr(H \mid E) = \frac{\Pr(E \mid H) \Pr(H)}{\Pr(E)}
\]
Expert Systems:
The Maximum Likelihood Estimator (MLE)

Given what we know about this data, what probability model fits best?
Expert Systems:
The Maximum Likelihood Estimator (MLE)

Consistency: The MLE converges asymptotically to the value being estimated. From an appraisal perspective, this means that there is a benefit to experience and professionally developed judgment.
Expert Systems:
The Maximum Likelihood Estimator (MLE)

What do we mean by “asymptotic”?

As “N” gets larger and larger, the equation becomes more and more normal.

The Central Limit Theorem is an example of an asymptotic distribution
Asymptotically stable systems
Expert Systems:
The Maximum Likelihood Estimator (MLE)

Asymptotic normality: As sample size increases, the MLE distribution tends toward a normal distribution.
Expert Systems:
The Maximum Likelihood Estimator (MLE)

Asymptotic normality: As sample size increases, the MLE distribution tends toward a normal distribution.

\[ f(x) \sim N(\text{as } n \to \infty) \]
Expert Systems:
The Maximum Likelihood Estimator (MLE)

Efficiency: There is no asymptotically unbiased estimator that has lower asymptotic mean square error.
Expert Systems: The Maximum Likelihood Estimator (MLE)

So why don’t we use MLE more often?
Expert Systems:
The Maximum Likelihood Estimator (MLE)

So why don’t we use MLE more often?

\[
\ln L(\Phi \mid x_1\ldots x_n) = f(x_1\ldots x_n \mid \Phi) = \sum_{i=1}^{n} \ln f(x_i \mid \Phi)
\]
Expert Systems

Ties together several streams of research –

Appraisal Theory and Practice
Shiller and Weiss (1999) – Type II errors
Mass Appraisal
Daubert & Kumho Tire
**Expert Systems**

<table>
<thead>
<tr>
<th></th>
<th>Null hypothesis ((H_0)) is true</th>
<th>Null hypothesis ((H_0)) is false</th>
</tr>
</thead>
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<tr>
<td>Reject null hypothesis</td>
<td>Type I error</td>
<td>Correct outcome</td>
</tr>
<tr>
<td></td>
<td>False positive</td>
<td>True positive</td>
</tr>
<tr>
<td>Fail to reject null hypothesis</td>
<td>Correct outcome</td>
<td>Type II error</td>
</tr>
<tr>
<td></td>
<td>True negative</td>
<td>False negative</td>
</tr>
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**Expert Systems**

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Shiller & Weiss – Type II errors cause appraisal models to underestimate risk
Expert Systems

A brief sojourn into Daubert

Does the method center upon a testable hypothesis?
Is there a known or potentially knowable error rate associated with the method?
Has the method been subject to peer review?
Is the method generally accepted in the relevant scientific community?
Expert Systems

A brief sojourn into Daubert

Do(es) the method(s) center upon a testable hypothesis? Is there a known or potentially knowable error rate associated with the method(s)? Has the method been subject to peer review? Is the method generally accepted in the relevant scientific community?
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Tie together several streams of research –

Set Theory
  Fuzzy Logic

(as distinct from neural networks)
Expert Systems

Tie together several streams of research –

“…a ‘fuzzy set’…extends the concept of membership in a set to situations in which there are many, possibly a continuum, of grades of membership.”

-- Zadeh (1964)
Expert Systems

Tie together several streams of research –

“…a ‘fuzzy set’…extends the concept of membership in a set to situations in which there are many, possibly a continuum, of grades of membership.”

From a statistician’s perspective, this sounds a whole lot like the way we determine “comparables”

-- Zadeh (1964)
Expert Systems

Tie together several streams of research –

Equilibrium Theory
What is the nature of the real estate market?

Nash (1951)
Expert Systems

Tie together several streams of research –

Equilibrium Theory
  What is the nature of the real estate market?

Nash (1951)
  Why does this matter?
Expert Systems

Tie together several streams of research –

Equilibrium Theory
What is the nature of the real estate market?

Nash (1951)
Why does this matter?

(hint: modeling heterogeneity)
Expert Systems

The real estate transactional market constitutes a Nash equilibrium, in which all participants take into account the strategies of other participants in the goal of optimizing their utility.
Expert Systems

The real estate transactional market constitutes a Nash equilibrium, in which all participants take into account the strategies of other participants in the goal of optimizing their utility.

Thus, spatial and temporal autocorrelation are part of the process, rather than aberrations to the model.
Expert Systems

The appraiser, faced with a set of data and a set of prior observations about the underlying market, uses fuzzy logic to formulate a maximum likelihood estimator to determine the true value of the property.
Expert Systems

The appraiser, faced with a set of data and a set of prior observations about the underlying market, uses fuzzy logic to formulate a maximum likelihood estimator to determine the true value of the property.

S/he is able to do this with a limited data set based on the Bayesian priors already known about the probable behavior of the market.
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Adapted from McClusky & Anaud’s Figure 4
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Two Case Studies:

- Plaquemines Parish, LA
- Lomax, IL
Expert Systems

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- Plaquemines Parish, LA
- Lomax, IL

\[
COD = \frac{\sum \text{abs}(\text{Price} - \text{Value})}{n}
\]

\[
COD = \frac{\sum \text{abs}(\text{Price} - \text{Value})}{n}
\]

\[
COD = \frac{\sum \text{abs}(\text{Price} - \text{Value})}{\text{median value}}
\]
Expert Systems

\[
COD = \frac{\sum \text{abs}(\text{Price} - \text{Value})}{n/\text{median value}}
\]

COD: Coefficient of Dispersion
From the IAAO Supplemental Standards
Expert Systems

COD: Coefficient of Dispersion
From the IAAO Supplemental Standards

\[ COD = \frac{\sum \text{abs}(\text{Price} - \text{Value})}{n} \]

A measurement of the accuracy of the statistic

From the IAAO Supplemental Standards

COD: Coefficient of Dispersion
**Expert Systems**

Parametric Statistics – used when we expect that the underlying data is well distributed (i.e. – normal)

Non-Parametric Statistics – used when the data is not expected to be well defined or well distributed
Expert Systems

Parametric Statistics – used when we expect that the underlying data is well distributed (i.e. – normal)

Example – Mean, Standard Deviation

Non-Parametric Statistics – used when the data is not expected to be well defined or well distributed

Example – Median, Coefficient of Dispersion
Expert Systems

Two Case Studies:

• Plaquemines Parish, LA

• Lomax, IL

\[ COD = \frac{\sum abs(\text{Price} - \text{Value})}{n} / \text{median value} \]
Shortly after Katrina
Proposed Plaquemines Parish Class Action Area
Proposed Plaquemines Parish Class Action Area

Note Sample Area
### Table 1

**Case Study No. 1 Valuation Example**

<table>
<thead>
<tr>
<th>Property Type</th>
<th>Base Value</th>
<th>Qual/Cond</th>
<th>Brick</th>
<th>Acres</th>
<th>SF</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficients</td>
<td>$20,000</td>
<td>$5,000</td>
<td>$3,000</td>
<td>$25</td>
<td>$25</td>
<td>-$500</td>
</tr>
<tr>
<td>Property type “J” base values</td>
<td>$48,000</td>
<td>2</td>
<td>0</td>
<td>0.5</td>
<td>1200</td>
<td>17</td>
</tr>
<tr>
<td>Property type “I” characteristics</td>
<td>2</td>
<td>1</td>
<td>0.3</td>
<td>1350</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

Val_i = $48,000 + ((2-2)*$20,000) + ((1-0)*$5,000) + ((0.3-0.5)*$3,000) + ((1350-1200)*25) + ((21-17)*-500)

Val_i = $48,000 + $0 + $5,000 - $600 + $3,750 - $2,000

Val_i = $54,150

**C.O.D. = 9.06%**
Table 4

Lomax Coefficients of Dispersion

<table>
<thead>
<tr>
<th>Property Type</th>
<th>C.O.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double-Wide</td>
<td>8.05%</td>
</tr>
<tr>
<td>Mobile Home</td>
<td>35.21%</td>
</tr>
<tr>
<td>Old Style 1</td>
<td>21.81%</td>
</tr>
<tr>
<td>Old Style 2</td>
<td>13.40%</td>
</tr>
<tr>
<td>Ranch</td>
<td>7.67%</td>
</tr>
</tbody>
</table>
Lessons Learned & Avenues for Future Research

The use of MLEs in an expert system

The use of non-parametric models to evaluate statistical properties ("known" error rates)

How is this applicable in a single-property appraisal model?
Kendall’s tau (for collinearity & dependence)
   -- also Spearman’s ρ

Kolmogorov-Smirnov (for normality)

Mann-Whitney (to test if the difference in medians between two populations equals zero)
   -- also $X^2$

Kruskal-Wallis statistic (variance)
Expert Systems – “must read”


Lentz and Wang, J. Real Estate Research, 1998 – tells us that the sales adjustment grid is just a special case of the weighted least squares regression hedonic model.
USPAP?

Scope of Work Rule – current wording:

“The scope of work is acceptable when it meets or exceeds:

• The expectations of parties who are regularly intended users for similar assignments; and
• What an appraiser’s peers’ actions would be in performing the same or a similar assignment”
USPAP?

Scope of Work Rule – Proposed 2014 update:

“The scope of work is acceptable when it meets or exceeds:

• Both the expectations of parties who are regularly intended users for similar assignments and what an appraiser’s peers’ actions would be in performing the same or a similar assignment; or
USPAP?

Scope of Work Rule – Proposed 2014 update:

- Recognized methods and techniques prescribed by the Appraisal Practices Board of the Appraisal Foundation, or in other peer-reviewed, published appraisal or valuation books and articles, and published appraisal or valuation coursework taught by a college, university, professional appraisal or valuation organization, or state and federal government agencies.”
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USPAP?

Standards Rule 1-1 (a)

“In developing a real property appraisal, an appraiser must… be aware of, understand, and correctly employ those recognized methods and techniques that are necessary to produce a credible appraisal.”
USPAP?

Standards Rule 2-2(a)(b)(c) (viii)

“(Describe) (Summarize) (State) the information analyzed, the appraisal methods and techniques employed, and the reasoning that supports the analyses, opinions, and conclusions….”
USPAP?

Advisory Opinion 18

“An AVM’s output is not, by itself, an appraisal, and communication of an AVM’s output is not, in itself, an appraisal report.”
USPAP?

Advisory Opinion 18

“An AVM’s output is not, by itself, an appraisal, and communication of an AVM’s output is not, in itself, an appraisal report.”

➔ Both USPAP 1 and 6 may apply
USPAP?

Standards Rule 6-4(b) comment:

“Mass appraisers must develop mathematical models that, with reasonable accuracy, represent the relationship between property value and supply and demand factors, such as presented by quantitative and qualitative property characteristics.”
USPAP?

Standards Rule 6-4(c) comment:

“Models must be calibrated using recognized techniques, including, but not limited to, multiple linear regression, nonlinear regression, and adaptive estimation.”
USPAP?

Comment to Standards Rule 3-1(a)

Changes and developments in economics, finance, law, and society can have a substantial impact on the appraisal profession. To keep abreast of these changes and developments, the appraisal profession is constantly reviewing and revising appraisal methods and techniques and devising new methods and techniques to meet new circumstances. Each appraiser must continuously improve his or her skills to remain proficient in appraisal review.
**USPAP?**

*Comment to Standards Rule 3-1(a)*

The reviewer must have the knowledge and experience needed to identify and perform the scope of work necessary to produce credible appraisal assignment results. Aspects of competency for an appraisal review, depending on the review assignment’s scope of work, may include, without limitation, familiarly with the specific type of property or asset, market, geographic area, *analytical methods*, and applicable laws, regulations, and guidelines.
Code of Professional Ethics of the Appraisal Institute
CPE?

E.R. 1-4

It is unethical in the performance of a service to knowingly fail to:

(a) Identify the appropriate Standards to be applied
(b) Disclose in any report the Standards applied
(c) Take all steps necessary or appropriate to understand the Standards applied
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Dr. John Kilpatrick, MAI, is an appraiser and financial economist and is the CEO of Greenfield Advisors, specializing in economic market and valuation analysis, principally in real estate matters, with offices in Seattle and Atlanta. He also serves as a Visiting Scholar in Real Estate Finance at Baruch College, City University of New York, and is a nationally certified USPAP instructor.

His Ph.D. is in Finance from the University of South Carolina, where he also taught Real Estate and Corporate Finance in the Moore School of Business. He also previously served as the founding Administrator of the South Carolina Supercomputer Network and as the Secretary/Treasurer of the Academic Coalition for Intelligent Manufacturing Systems, based in Washington, DC.

Dr. Kilpatrick is the author of four books, contributing author to three others, and has written over one hundred journal articles, book chapters, monographs, and other publications. He is a frequent speaker before national groups, such as the U.S. Senate Subcommittee on Science, Technology, and Space, the National Trust for Historic Preservation, the Asian Real Estate Society, and Institutional Investor magazine’s Integrated Wealth Management Forum. His work in real estate finance has been the subject of recent articles in the New York Times, the Boston Globe, the Wall Street Journal, and the British magazine Modus. He is a contributing author to Brownfield Law and Practice as well as the American Bar Association’s Brownfields 3rd Edition.

His recent consulting clients include the U.S. General Services Administration, the Hearst Family, the Japan Real Estate Institute, and numerous private investors, corporations, university endowments, trusts, and law firms. Among his other honors, Dr. Kilpatrick is a Fellow of the Faculty of Valuation of the British Royal Institution of Chartered Surveyors, a Fellow of the American Real Estate Society, and is featured in Who’s Who in America.