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# STATISTICAL MASS APPRAISAL MODELS FOR LARGE COMMERCIAL BUILDINGS

## Presenter

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# PATRICK M. O'CONNOR, ASA

## President & Owner, O'Connor Consulting Inc.

- Leader in computer assisted appraisal for over 30 years
- Originator and co-developer of Location Value Response Surface as a modern method to analyze location influences in real estate
- Former Chief Assessor for New York City, supervised staff of 580 to reappraise over 900,000 properties
- Published (41 articles)
- Co-author of Property Appraisal and Assessment Administration (IAAO, 1990)
- Co-author of Visual Valuation (Appraisal Institute, 2010)
- Contributor to The Appraisal of Real Property (Appraisal Institute, 2013)



# ORIGINAL IDEA & PREMISE

- Commercial property tax appeals use dark store theory, potential major losses to commercial assessment roll
- Prepare and defend tax appeals with too few commercial sales within assessment jurisdiction
- Expand geographic area of data and market analysis to provide statistical support of estimates of market values
- Provide market analysis for commercial and industrial properties that has sufficient sales transactions



# PERSONAL NOTES

- I have great respect for real estate mass appraisal profession
- Report is about Florida data, but experience indicates that problems exist in most of USA
- Over 40 years of progress should not be overshadowed by problems expressed in this report
- Mass appraisal is much more technically advanced in real estate valuation than single property appraisal



This report is just an indication of problems and one potential solution, guide to future

# AVM & CAMA MARKET MODELS WITH STATISTICAL SUPPORT

- Several statistically-oriented techniques are used in Automated Valuation Models (AVM) and Computer-Assisted Mass Appraisal (CAMA)
- Three regression techniques are commonly used as statistical models in CAMA systems:
  - Linear (Additive)
  - Multiplicative [log-linear] (based on linear regression program)

- Non-linear Regression



# CONCEPTS TESTED

Expansion from assessment jurisdiction to statewide model

Tested US Census data in statewide model

Tested various types of neighborhoods against (sales points) including GIS response surfaces,

Tested one model and cluster of property types (4 models)

Tested linear and non-linear regression



# DATA SOURCES (Metadata)

Florida Property Appraisers are well respected professionals with modern tools in CAMA and GIS

Assessment jurisdictions' (County) data to Florida Department of Revenue to Florida Property Tax Data Portal

Data standardized by Florida Department of Revenue

Florida Department of Revenue to CourthouseUSA

Courthouse USA added X, Y coordinates, helped to consolidate to Statewide files residential and commercial



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CourthouseUSA to O'Connor Consulting Inc.





# VALUATION PROCESS TOWARDS MARKET VALUE

- Data gathering (third Party)
- Data analysis
- Market analysis
- Model specification
- Model calibration
- Statistical quality review
- Model formula application to population of properties
- Comparable sales grid based on regression model & coefficients



# STATISTICAL MODELS SHOULD BE RATIONAL AND EXPLAINABLE

- Data transformations
- GIS location adjustments combined with county boundaries (neighborhoods)
- Some variables will be statistically significant and enter regression models
- Some additional variables important to more traditional appraisers may be tested/added as contained variables **as long as it does not disrupt the regression model.**



# FLORIDA COMMERCIAL MODEL, PART 1

FLORIDA DOR UC	Use Group	Common Name
3	Apartment	Multi-family - 10 units or more
27	Industrial	Auto Sales repair related
29	Industrial	Wholesale Outlets
41	Industrial	Light Manufacturing
42	Industrial	Heavy Industrial
44	Industrial	Packing Plants
45	Industrial	Canneries
46	Industrial	Other Food Processing Factories

# FLORIDA COMMERCIAL MODEL, PART 2

FLORIDA DOR UC	Use Group	Common Name
17	Office	Office Buildings, One Story
18	Office	Office Buildings, Multi-story
19	Office	Professional Service Buildings
21	Office	Restaurants, Cafeterias
23	Office	Financial Institutions
11	Retail	Stores, One Story
12	Retail	Stories, Mixed Use
13	Retail	Department Stores
14	Retail	Supermarkets
15	Retail	Regional Shopping Centers
16	Retail	Community Shopping Centers

# VARIABLES IN APARTMENT, INDUSTRIAL, OFFICE AND RETAIL MODELS

Total building area (started at 10,000 Square Feet)

Building square footage, group 10 percentiles percentages

Age percentage

Improvement quality percentage

Construction class percentage

Time percentage (by month or quarter)

Individual property location percentage

Florida DOR Use Code percentage (except apartments)



# VARIABLES IN 2 OR FEWER MODELS

## Two model variable

Number of buildings on property percentage

## One model only

Building-to-land ratio percentage



# APARTMENT & INDUSTRIAL MODELS

## Apartment

$(TOT\_LVG\_AREA * 67.313) * Age\ PRCT * Improvement\ Quality\ PRCT * Construct\ Class\ PRCT * Building\text{-}to\text{-}Land\ Ratio\ PRCT * Time\ Month\ PRCT * Location\ PRCT$

## Industrial

$(TOT\_LVG\_AREA * 36.667) * Age\ PRCT * Improvement\ Quality\ PRCT * Construct\ Class\ PRCT * Total\ Square\ Foot\ Group\ 10\ PRCT * DOR\ UC\ PRCT * Time\ Quarter\ PRCT * Location\ PRCT$



\*PRCT means percentage

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# OFFICE & RETAIL MODELS

## Office

$(TOT\_LVG\_AREA * 40.857) * \text{Building Number PRCT} * \text{Age PRCT} * \text{Improvement Quality PRCT} * \text{Construction Class PRCT} * \text{Total Square Foot Group 10 PRCT} * \text{DOR UC PRCT} * \text{Time Quarter PRCT} * \text{Location PRCT}$

## Retail

$(TOT\_LVG\_AREA * 91.26) * \text{Age PRCT} * \text{DOR UC PRCT} * \text{Building Number PRCT} * \text{Imp Quality PRCT} * \text{Construction Class PRCT} * \text{Total Square Foot Group 10 PRCT} * \text{Time Month PRCT} * \text{Location PRCT}$





# LOCATION ADJUSTMENT PERCENTAGES

Combination of

Individual cluster of property types, location value response surfaces

Countywide residential median values divided by statewide residential median value

Countywide commercial adjustments for each model



# PERCENTAGES ADJUSTMENTS

Percentages variables assigned before and during model calibration

Some are existing categories, used reciprocal of sales ratio from prior model (**categorical**)

Some are created by dividing **continuous variables** by its median

Some are clustered into **groups of 10 percentiles**, used reciprocal of sales ratio from prior model

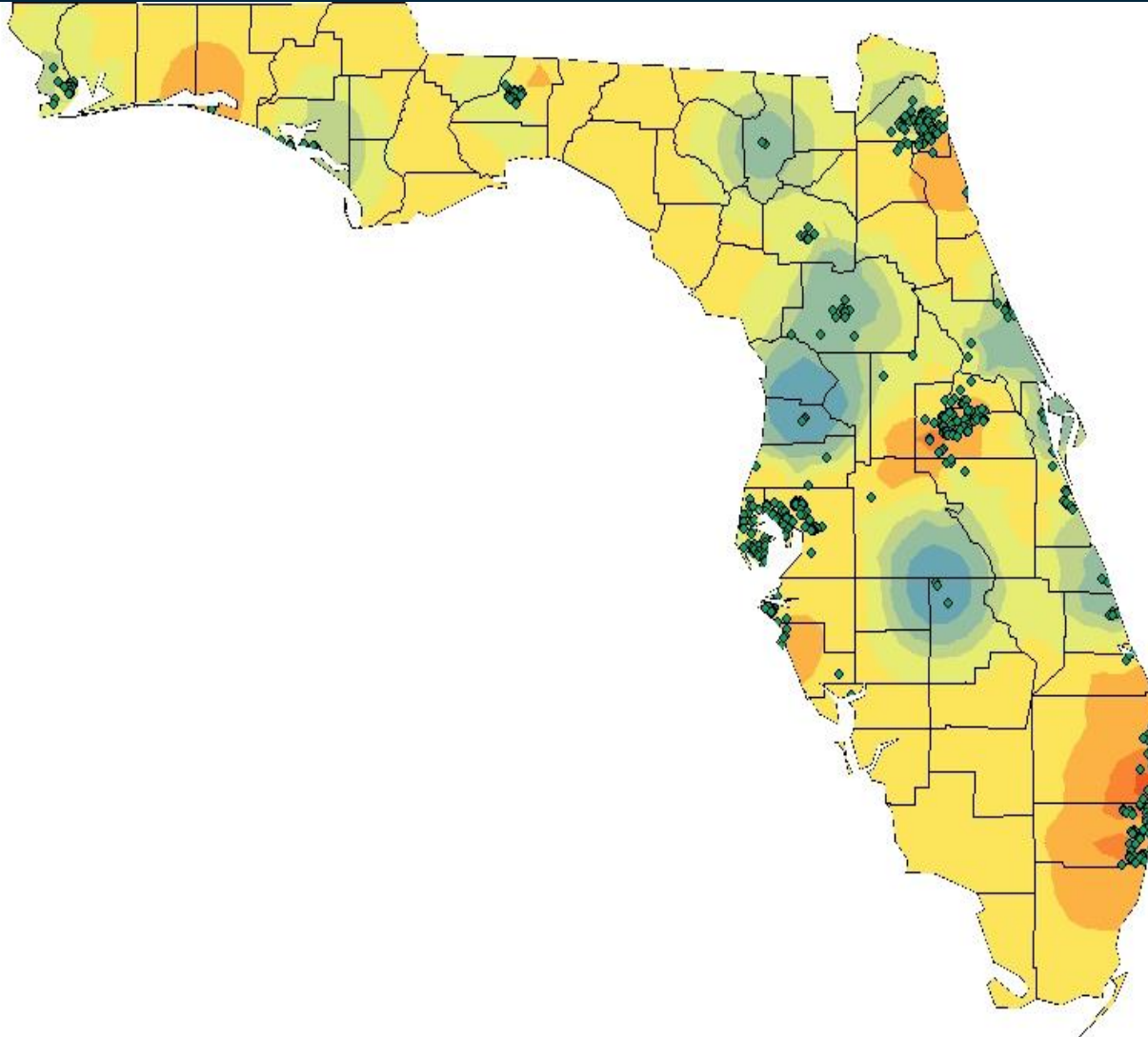
Most final coefficient values are percentages

(**exception, square footage = \$ amount**)



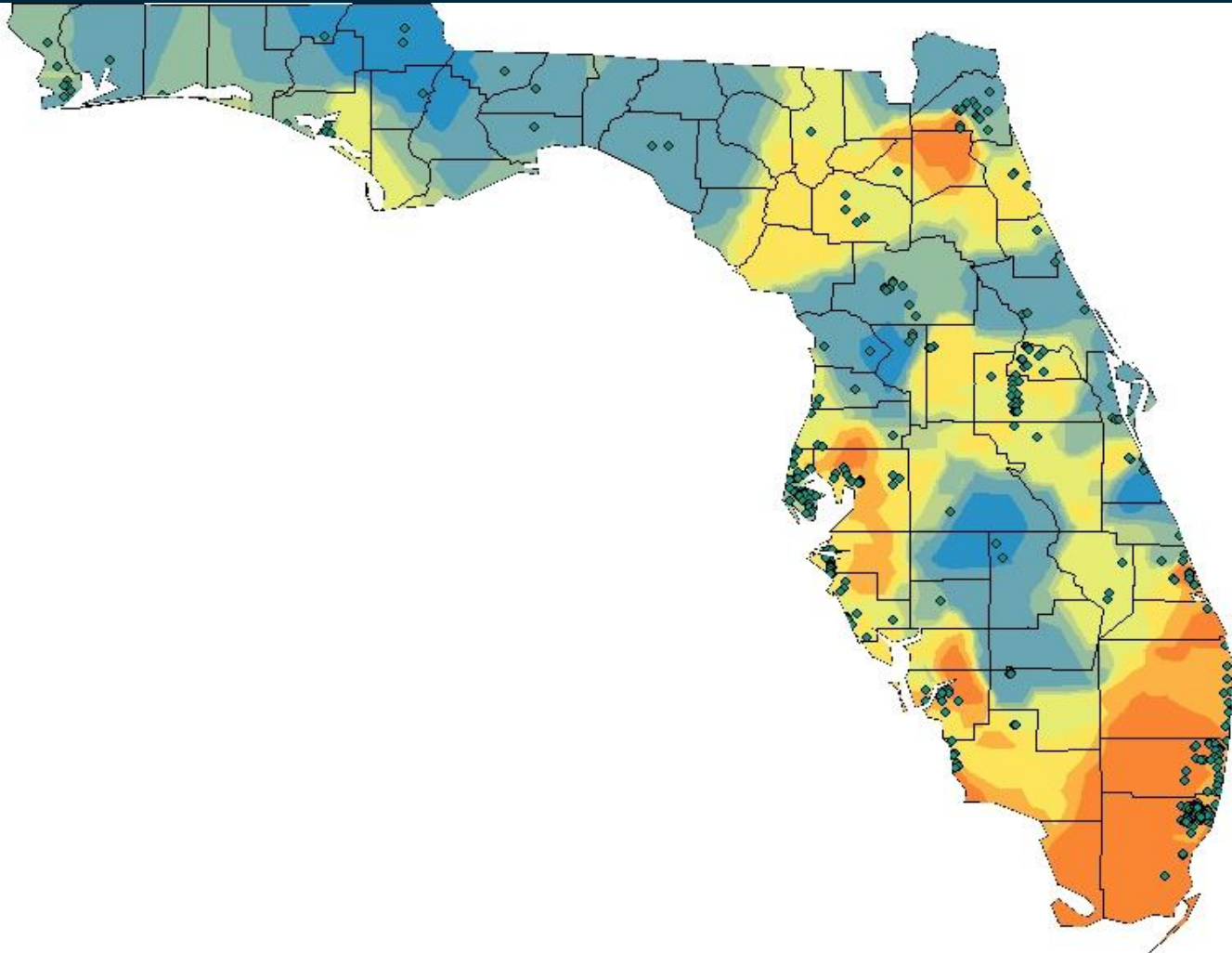
# FLORIDA APARTMENT LOCATION

Red is higher values, Blue is lower values



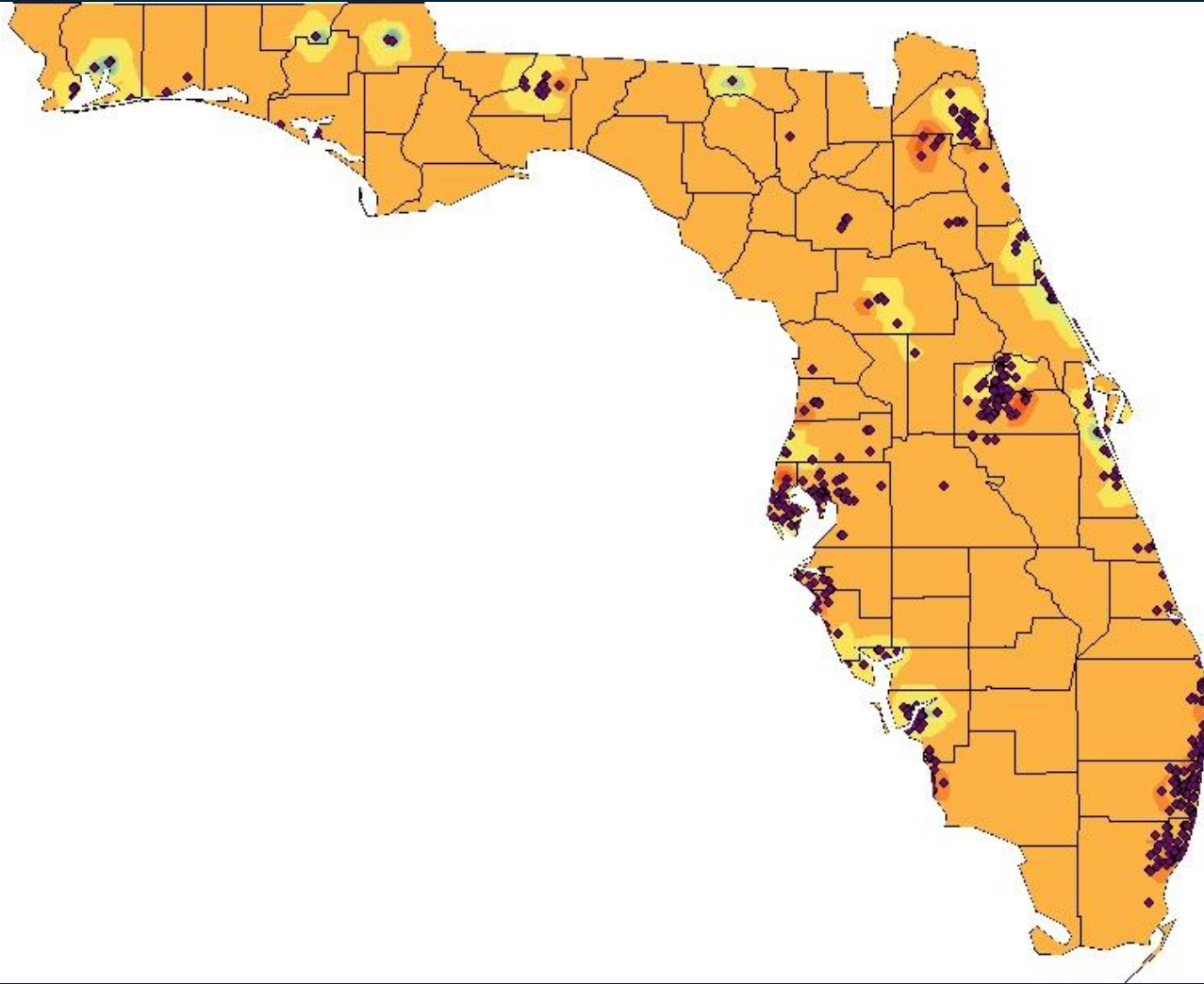
# FLORIDA INDUSTRIAL LOCATION

Red is higher values, Blue is lower values



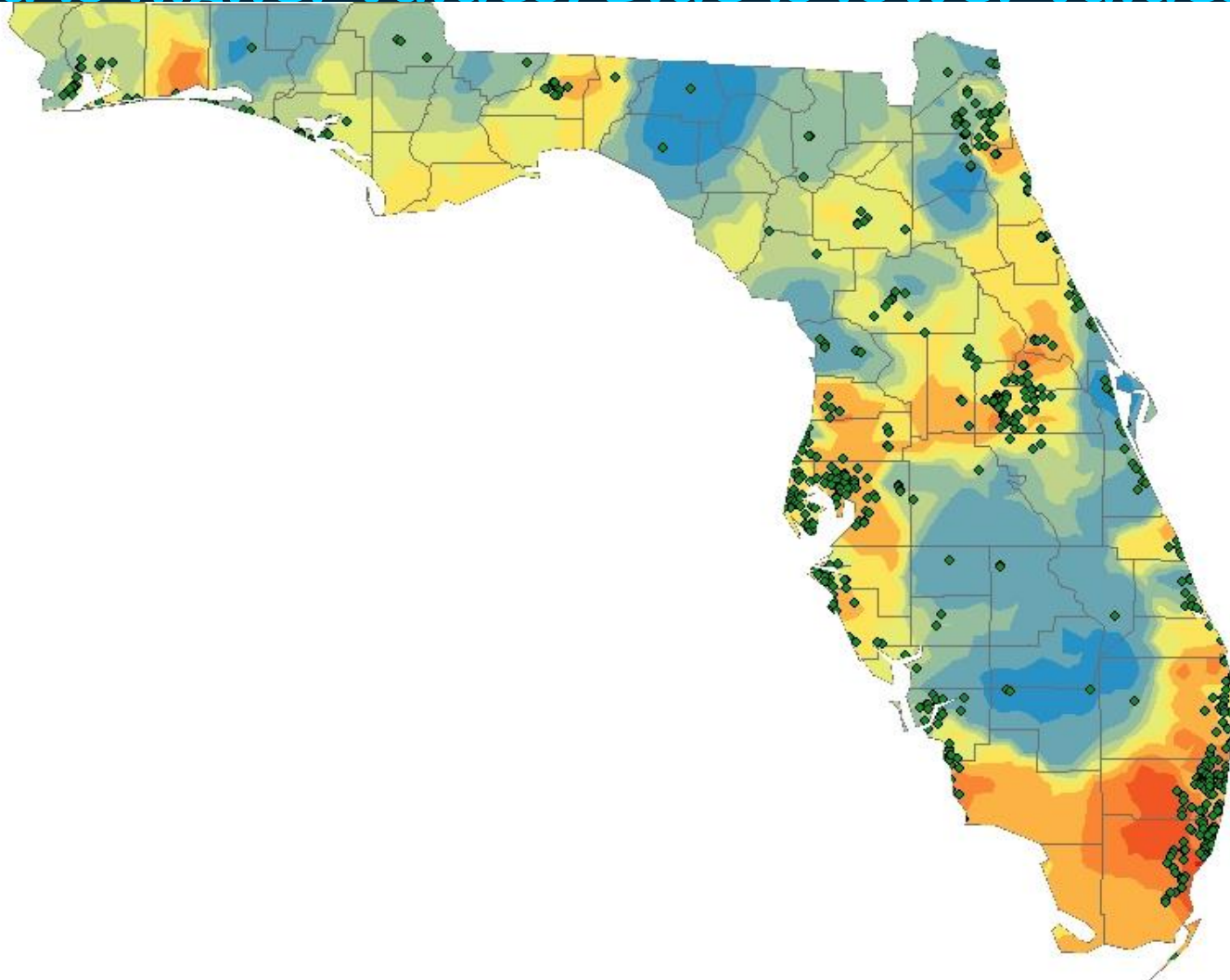
# FLORIDA OFFICE LOCATION

Red is higher values, Blue is lower values



# FLORIDA RETAIL LOCATION

Red is higher values, Blue is lower values



# QUALITY FINAL PERCENTAGES

IMPROVEMENT QUALITY	APARTMENT	INDUSTRIAL	OFFICE	RETAIL
Minimum/Low Cost	0.60	1.26	0.77	0.80
Below Average	0.96	0.94	1.00	1.05
Average	0.98	1.00	1.00	0.97
Above Average	1.04	0.93	1.13	1.25
Excellent	1.02	0.92	1.25	1.40
Superior	1.13	1.00	2.04	1.50

# MODEL TERMS

Total Living Area (total building size), \$ adjustment

All other model terms are multipliers, percentages

Some terms are constrained to sub-level percentages

Several terms are combined into one term such as location adjustments:

- Location value response surface (one or more);
- Countywide residential median sale price divided by the statewide residential median sale price; and
- Countywide median reciprocal of sales ratio





# TYPICAL RESIDENTIAL NON-LINEAR TERMS THAT DID NOT WORK IN THIS RESEARCH

Total buildings size adjustment curve

Age adjustment curve

Land square footage and land size adjustments curve

Single model concept



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# IAAO RECOMMENDED QUALITY STATISTICS

**Coefficient of Dispersion (COD) 5 to 25**

**Median Ratio 90% to 110%**

**Price-Related Bias (PRB) -0.05 to 0.05 acceptable**

**Outside this range is unacceptable -0.10 to 0.10**

**Between these two ranges is acceptable, but not good quality**

**Price-Related Differential (PRD) 0.98 to 1.03**



**Weighted Mean 90% to 110%**

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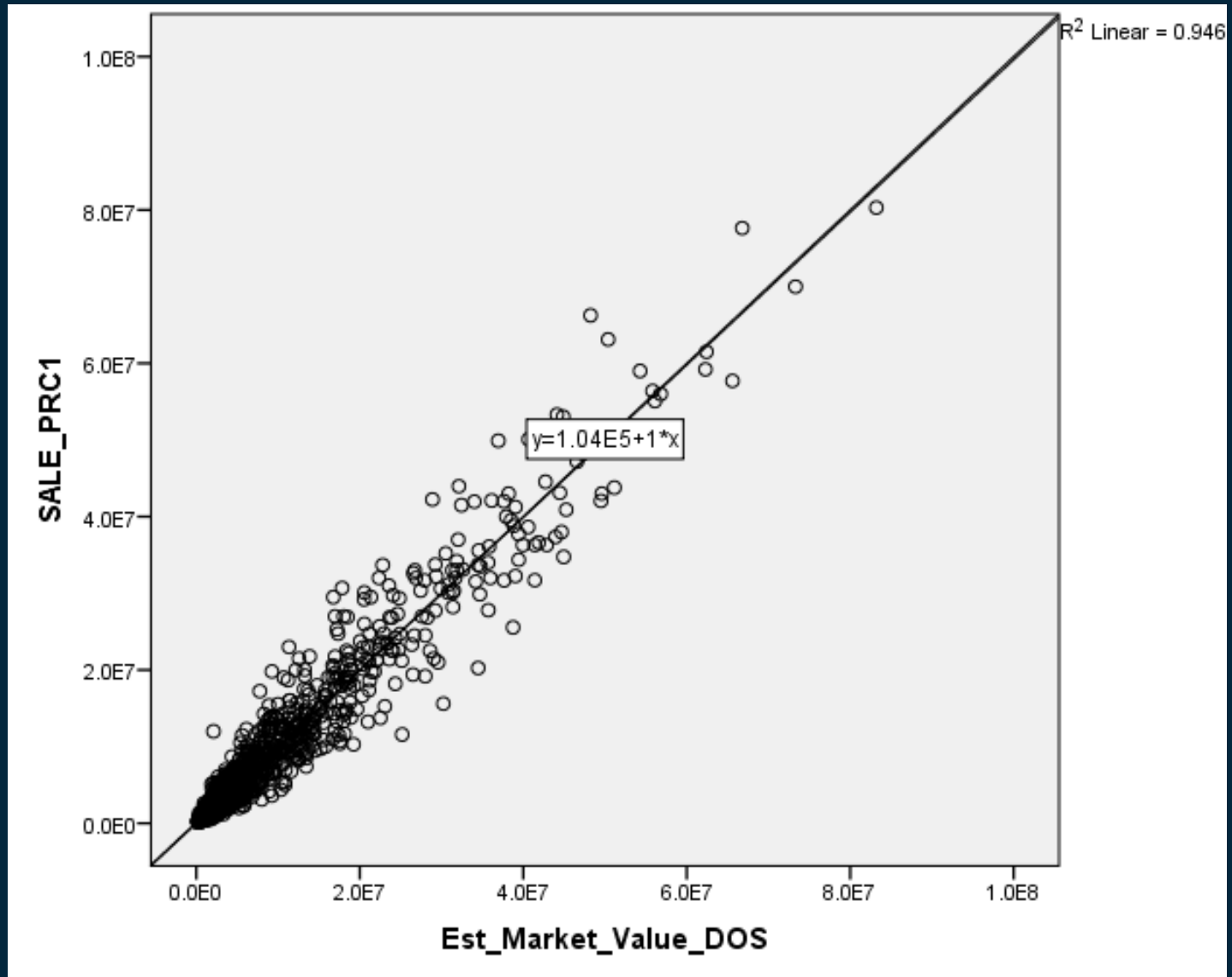
# SALES RATIO QUALITY STATISTICS

	Sales	Median	Weighted Mean	Price-Related Differential	Coefficient of Dispersion	Price-Related Bias
Apartments	503	1.010	1.002	1.054	.191	-0.012
Industrial	427	1.012	.976	1.094	.235	-0.03
Office	491	.973	.941	1.089	.257	-0.032
Retail	609	1.052	.989	1.166	.314	-0.098
Sales Total	2030	1.01	0.987	1.095	0.256	-0.044

# SALE PRICE AND EST. MARKET VALUE RANGES

	<b>COUNT</b>	<b>MINIMUM</b>	<b>MEDIAN</b>	<b>MAXIMUM</b>
<b>Sale Price</b>	<b>2,030</b>	<b>115,000</b>	<b>1,995,050</b>	<b>80,300,000</b>
<b>Est. Market Value</b>	<b>2,030</b>	<b>147,245</b>	<b>1,986,227</b>	<b>83,196,708</b>

# SALE PRICE TO EST. MARKET VALUE



# FLORIDA CRITERIA 1 AND 8

- Florida Statutes permit 15 % reductions in sales prices without documentation
- After the 15%, Property Appraisers must provide documentation
- I believe it is for cost of sales
- So practical target level of assessment is 85%
- The IAAO Standard of Sales Ratios recommends 10% range above and below the statutory level of assessment (this could also be considered fractional level of assessment)
- Florida's acceptable range is 77% to 94%



# COMPARISON OF ESTIMATES OF MARKET VALUES-TO-SALES PRICES

Use Group	Sales	SR Est MV / SP	SR AV / Est MV
Apartment	503	1.01	0.76
Industrial	427	1.01	0.83
Office	491	0.97	0.88
Retail	609	1.05	0.72
Total	2,030	1.01	0.80

# RETAIL MARKET VALUE-TO-SALES PRICES

DOR UC, Common Name	Sales	SR Est MV / SP	SR AV / Est MV
11 - Stores, One Story	277	1.04	0.72
12 - Stories, Mixed Use	62	1.05	0.79
13 - Department Stores	12	1.08	0.56
14 - Supermarkets	26	1.01	0.69
15 - Regional Shopping Centers	6	1.00	0.65
16 - Community Shopping Centers	226	1.07	0.73
Total	609	1.05	0.72



# VALUE PER SQUARE FOOTAGE

FL_Use_Code _Group	Sales Count	Price SF Median	Est MV SF Median	Assessed Value SF Median
Apartment	503	\$60.59	\$61.94	\$46.56
Industrial	427	\$40.82	\$43.22	\$35.03
Office	491	\$80.98	\$80.49	\$73.83
Retail	609	\$89.52	\$94.87	\$68.14
Total	2,030	\$65.61	\$69.01	\$54.05



# HIGHLIGHT OF PROJECT

- 67 Florida counties
- 56 Florida counties with commercial sales in final models
- Up to 34 counties are within the Florida Standard range of 77% to 94%
- 41 counties had 5 or more sales in final model
- Within the 41 counties with 5 or more sales, up to 32 counties have assessed to sales price ratios within IAAO standard



# EDITORIAL COMMENTS

- Tax Attorneys -advocates (bias) for clients
- Information provided to lenders vs. assessment office (purpose of appraisal)
- Optimistic-to-pessimistic
- Appraised values considerably below market even when recent sales prices are known
- Government officials tend to cater to voter
- Commercial appraisers
- Unintentional tax burden shifting from high-valued commercial properties to residential properties (voters)



# SOME USES FOR COMMERCIAL STATISTICAL MARKET MODELS

- Prepare market values, cost tables, use coefficients for comparable sales adjustments
- Direct market valuation
- Check adjustments for income approach
- Identify potential problems, field appraisers, double check final assessment roll
- **Support in defense of commercial assessment roll**



• Quality assurance

• Private sector AVMs, lender's portfolio review, etc.

# POTENTIAL VARIABLES RELATED TO COMMERCIAL SALES PRICES

**Good potential for 39 States with sales disclosure, may  
provided value applications for 11 non-disclosure  
States**

**Possible use of benchmark economic values (sales  
prices, costs, income approach)**

**Reviewed appraisal acceptable data from free US  
Census downloadable data**

**US Census variables related to Florida sales prices**

**Block\_owner\_occ, Pop\_Area\_houseunits,  
Pop\_Area\_pop\_class, Pop\_Area\_sqmi**



# CONCLUSIONS, PART 1

Questions about market values of retail (big box) properties evolved into attempt to generate estimates of market value for many commercial and industrial properties

In this case, single model did not match quality of four models (cluster of building groups)

**Assumptions must be proven in every model**

Assessors' values are considerably below market value even when the sale price should be known

**Statistical support is available to provide accurate commercial market values and defend tax appeals**



# CONCLUSIONS, PART 2

**Market analysis requires sufficient economic information (sales prices)**

**Logical geographic expansion (statewide) is possible**

**Location adjustments may be developed from a combination of several geographic area**

**Following real estate appraisal principles are important to all real estate statistical modeling**



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