ALMY, GLOUDEMANS, JACOBS & DENNE
Property Taxation and Assessment Consultants

7630 NORTH 10TH AVENUE • PHOENIX, ARIZONA 85021 • U.S.A.
1-602-870-9368 • FAX: 1-602-861-2114 • http://www.agjd.com

Summary of Wind Turbine Analysis
Robert J. Gloudemans
December 4, 2013

At the request of the Municipal Property Assessment Corporation (MPAC), the author conducted an analysis of residential sales within 5 kilometers of wind turbines. The objective of the project was to determine the impact of location near a wind turbine on residential property values.

The analysis used improved residential sales in nine regions and eight market areas that occurred during calendar 2009-2013. Initially 4,332 sales met these criteria. Four sales with assessments and/or sales prices below $30,000 and 10 sales having extreme assessment-to-sales ratio of less than 0.55 or greater than 1.70 were removed from consideration, leaving 4,318 sales.

The dependent variable in the analysis was assessment-to-sales ratios in which 2012 values were divided by time-adjusted sales prices. The models that produced 2012 values did not contain variables related to proximity near wind turbines. Thus, the relevant question is to what extent ratios on these properties are too high because of the absence of such adjustments. Independent variables included the following:

- Distance from the nearest wind turbine, including binary variables for being within one kilometer, being within two kilometers, and being within 5 kilometers
- A binary variable for abutting a property with a wind turbine
- View of the nearest wind turbine: full, partial, or none

Preliminary analyses found no meaningful differences in assessment levels among regions or market areas.

Figure 1 shows a graph of assessment ratios with distance to the nearest wind turbine. A trend line has been drawn to the data, along with a horizontal reference line at 1.00. As can be seen, there is no meaningful relationship with the possible exception of properties within approximately 1 km.

Figure 2 contains a box plot of being within 1, 2, or 5 km of a wind turbine. Again, ratios for properties within 1 km appear slightly high, while there is no difference between properties within 2 or 5 km.

Similarly, figure 3 is a box plot for abutting a wind turbine and figure 4 is a box plot of view of the nearest wind turbine (full, partial, or none). Properties with a full view of the nearest wind turbine may have slightly higher ratios. Of course, these will also tend to be those properties closest to a wind turbine. Regression analysis will determine the relevant variables.

Figure 5 shows the initial regression model. The Adjusted R-Square is .006 (meaning that the model explains only 0.6% of the variation in assessment ratios). The only significant variable, with a coefficient of 0.045, is being within 1 km of a wind turbine. The variable is significant at the 99% confidence level.

Since the graphs and initial model revealed little systematic difference in ratios by any of the candidate variables, the ratios were further trimmed at 0.70 and 1.40 and the model rerun to discern relationships more clearly (3.0% of ratios exceeded the trim points). Figure 6 shows the revised results. Distance within 1 km is still the only significant predictor with a coefficient of .037 and relatively strong t-value of 4.7 (again significant at the 99% confidence level).

Finally, sales within 1 kilometer were divided into those with a full view (183 sales), those with a partial view (32 sales), and those with no view of a wind turbine (54 sales). Figure 7 shows the resulting model with the three variables. Ironically, no view enters while partial view does not.

We conclude that presence of a wind turbine (or turbines) has a statistically significant but minor impact on property values in the study area. The most relevant variable is close proximity. Based on the available data, distance within 1 km of a wind turbine tends to lower values approximately 4%.

Figure 1 – Graph of Ratios with Distance to the Nearest Wind Turbine

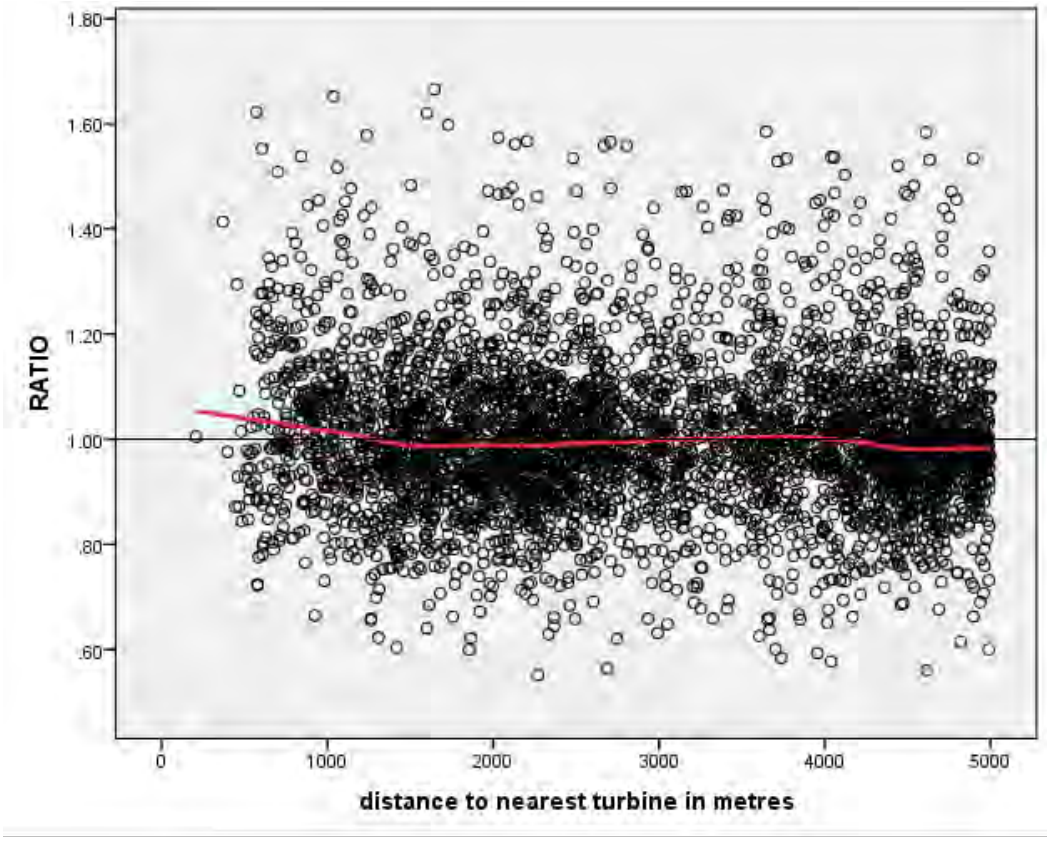

Figure 2 – Graph of Ratios with Kilometers (1, 2, or 5) to the Nearest Wind Turbine

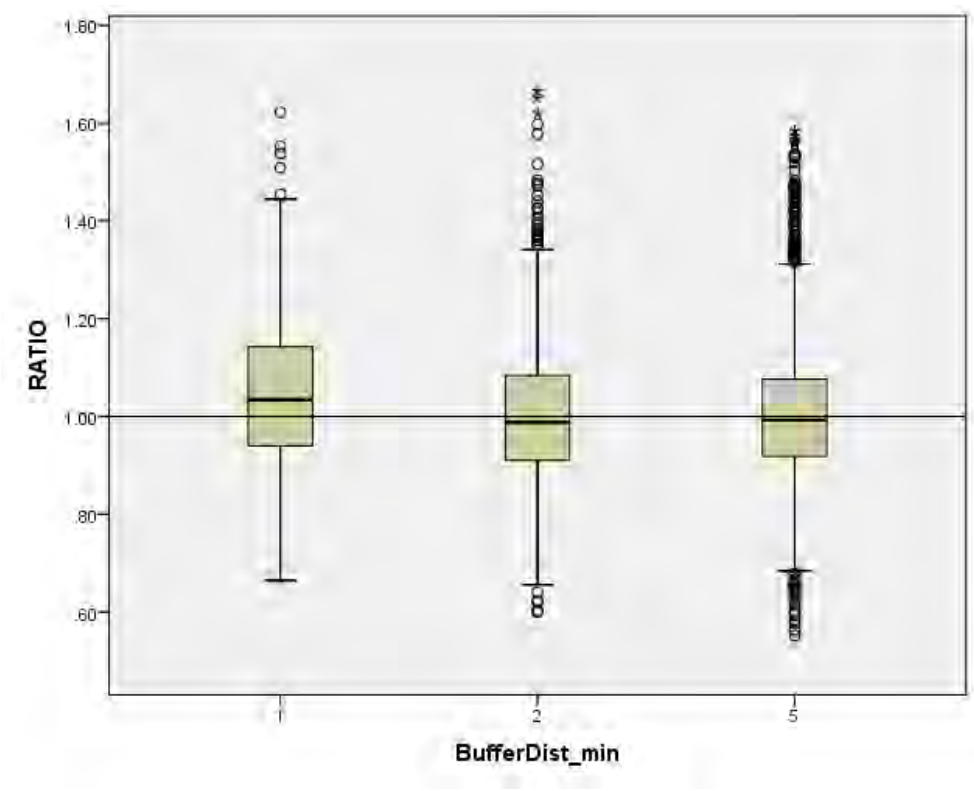

Figure 3 – Graph of Ratios with Abutting a Property with a Wind Turbine (0 = No, 1 = Yes)

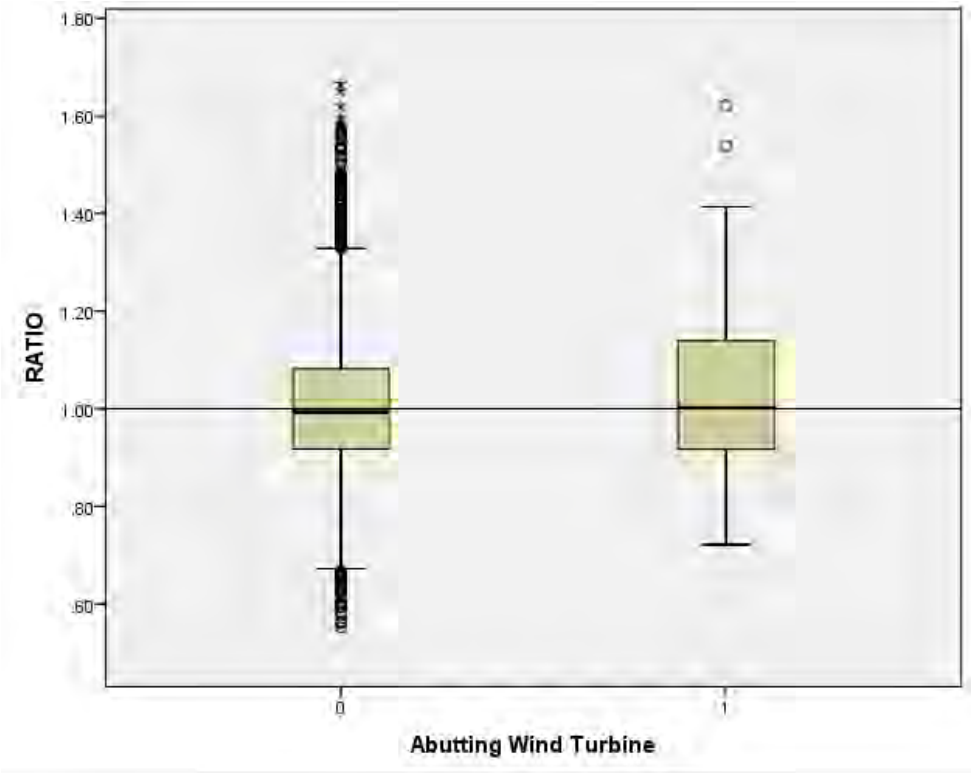

Figure 4 – Graph of Ratios with View of Nearest Wind Turbine

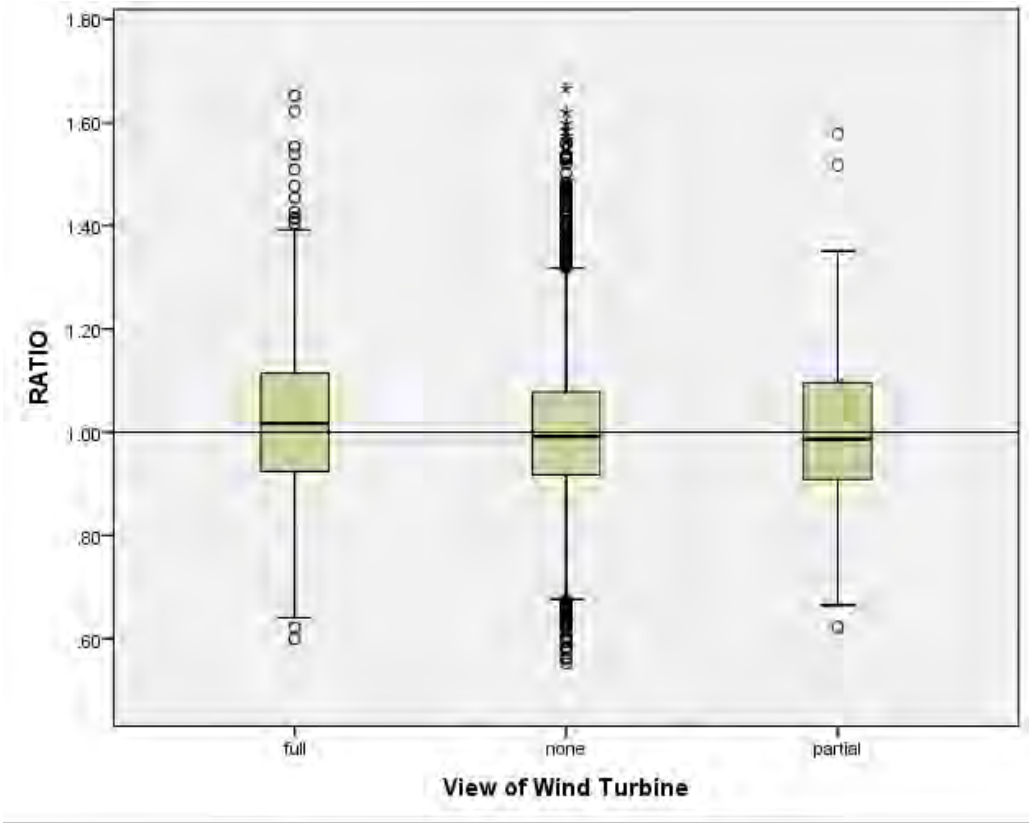

Figure 5 – Initial Regression Model

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.076	.006	.006	.14514

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.003	.002		439.333	.000
	Within 1 km	.045	.009	.076	5.024	.000

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics: Tolerance
1	Abutting Wind Turbine	.003	.167	.867	.003	.899
	VIEW_FULL	.021	1.208	.227	.018	.739
	VIEW_PARTIAL	-.017	-1.121	.262	-.017	.983
	Within 2 km	-.006	-.399	.690	-.006	.980
	Distance to nearest turbine	-.010	-.579	.563	-.009	.811

Figure 6 – Revised Model With Outlier Ratios Removed

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.072	.005	.005	.12595

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.000	.002		496.937	.000
	Within 1 km	.037	.008	.072	4.681	.000

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics: Tolerance
1	Abutting Wind Turbine	-.024	-1.501	.134	-.023	.906
	VIEW_FULL	.017	.935	.350	.014	.738
	VIEW_PARTIAL	-.016	-1.010	.312	-.016	.983
	Within 2 km	-.008	-.497	.619	-.008	.980
	Distance to nearest turbine	-.006	-.379	.705	-.006	.812

Figure 7 – Model With Sales within 1 Km Categorized by View (Full, Partial, or None)

Model Summary

2

R	R Square	Adjusted R Square	Std. Error of the Estimate
.075	.006	.005	.12594

Coefficients

2

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.000	.002		499.070	.000
Full View	.034	.010	.056	3.609	.000
No View	.057	.017	.051	3.331	.001

Excluded Variables

2

	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
					Tolerance
Partial View	.012	.796	.426	.012	1.000

Robert J. Gloudemans

Robert J. Gloudemans is a partner in Almy, Gloudemans, Jacobs & Denne. Bob previously worked for IAAO and the Arizona Department of Revenue. He provides consulting services in mass appraisal modeling, computer-assisted appraisal systems, and ratio studies and has served over 100 clients in the U.S., Canada, and internationally. He has served three appointments on the IAAO Standards Committee and has contributed extensively to the mass appraisal literature. He is the author of *Mass Appraisal of Real Property* (IAAO, 1999) and with his partner, Richard Almy, co-author of the new IAAO textbook, *Fundamentals of Mass Appraisal* (IAAO, 2011).