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Regression Analysis of Property Productivity Index and Value

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Research Report

**Introduction**:

For this research report a literature is reviewed, which is titled “Regression Analysis of Property Productivity Index and Value” [1] and authored by A. Ason Okoruwa, PhD, MAI, AI-GRS. In the chosen literature, a case study is shown based on a real estate dataset to determine how regression analysis can be useful to infer casual relationships between different features of the dataset, and also how it can help real life market value proposition by predicting and forecasting the future outcomes with simple mathematical equations. In this paper, Regression Analysis is applied to the property productivity indexes of properties (particularly price-productivity index regression), in the valuation of a light industrial property on a real estate dataset. The paper showed that regression analysis is a useful technique with small sample size. Because in everyday practice, appraisers typically do not have a large set of samples of comparable and competitive properties to replicate the price-establishing behavior of the relevant buyer groups as well as the buyers, who also have to evaluate the productive attributes of different properties in deciding which property to buy. The paper proposed that Regression Analysis can be applied in small dataset to research and analyze a market’s behavior in order to understand the relationships between the important features as well as to help the decision making process.

In this research report, the content of the chosen literature is analyzed critically to evaluate the data science methodology proposed based on business and real life aspects, the dataset chosen to prove its novelty by the author. Finally, a set of recommendations is presented in the later section by measuring the work’s usefulness and contributions in the field of data science.

**Body:**

Statement of the Problem: The paper focused on the problem that every market faces where analyzing the market data and behavior becomes very important for both appraisers and prospect buyers. An appraiser should develop an opinion of the market value of an interest in the property being appraised. Also a prospect buyer should evaluate the productive attributes of different properties in deciding which property to buy. But the first problem is how to research and analyze the data. For a common solution, sales comparison approach [2] is typically employed, which is advocated by various quantitative techniques such as data analysis (paired, grouped, secondary data analysis techniques), statistical analysis (graphic, scenario analysis), cost related adjustments, Capitalization of income differences etc. However, these techniques have certain drawbacks and one is they need large set of sample size. In everyday appraisal practice, the analyst faces problems with a limited sample size available for analysis. So, the initial problem to solve is to find an efficient data analysis technique that performs well in a small sample set.

Proposed Method: The paper proposes that regression analysis, which can be a reliable data analysis technique even with small sample size. Rank transformation regression [3] and price-quality regression are the most effective regression techniques. The paper has applied the price-quality regression technique on a small dataset and shown that it has been advocated in the real estate literature as a way to solve the limited sample size problem.

Research Design and Implementation: The price-quality regression applied in this work, is based economic theory in the empirical real estate literature for the selecting the significant property productivity features of a property class and assigning the weights by applying Solver program, a Microsoft Excel add-in. Rating the property productivity features reflects the price establishing characteristics of the similar buyer group in decision making. This resolves a common problem for price-quality regression because it is often criticized that property productivity features of a property, the ranking or rating of productivity features, and the weights assigned to the productivity features are subjectively determined by the analyst so it has biased values. But in this case, the rating is backed up by the economic theory in the empirical real estate literature. Finally, a regression analysis is performed, using selling price as the dependent variable and the weighted productivity index or score as the independent variable.

Data Collection: The dataset was collected from light industrial property in the Omaha-Council Bluffs Metropolitan Statistical Area (MSA) which contains sales data of single-tenant real estates from different counties in United States. The MSA combines several counties in the United States, such as five counties southeastern Nebraska and three counties in southwestern Iowa.

Data Analysis: To understand the data, a regression analysis of the property productivity index and value model is developed where the dependent variable is selling price and the independent variable is the weighted property productivity index of the property productivity features, as found in the empirical real estate literature. The productivity features have been selected based on reports in the appraisal literature as to factors influencing value (see the data collection discussion). The ratings are determined by appraisal and economic principles and logic. Graphic analysis is performed on the selected property productivity features such as Market Conditions (Date Sold), Building Size, Office Area, Building Age, Ceiling Height, Docks plus Drive-In Doors, Site Area to illustrate the relationship between the features and selling price. In the graphic analysis, the trend lines indicated the relationships between the features and selling price whether they are proportional or inversely proportional to the changes. This indicates the importance of the features and the rating was done based on that. According to the rating, Market Condition (Date sold) is the most important feature and Site Area is the least important feature from the dataset. This rating criteria was one of the key findings of the work as in price-quality regression, this rating has to be determined randomly but in this case, it was done with a proper graphic analysis, backed up by real estate data.

After doing the exploratory data analysis, optimization was done. The Solver program is used for optimization problems. In this instance, the optimization problem is reducing the variance of the weighted property productivity indexes of the features. The lower this variance, the optimal and better the model would be for predicting the selling price. Three algorithms are available in the Solver program which are the Simplex method, the Generalized Reduced Gradient (GRD) Method, and the Evolutionary algorithm. In this analysis, the Evolutionary algorithm is implemented for estimating the weights for the property features. The weights are selected to reduce the variance of the weighted index. The criterion of reducing variance of the property productivity index is analogous to selecting comparable properties that are very close in their measured attributes.

Experiments: Finally some experiments are shown where the results are outstanding and useful based on the proposal of report. The r-square for the estimated model is 66.00% (Appendix A), and this indicates the percent variation in the selling price that is explained by the weighted property productivity indexes for the comparable properties. A statistical analysis (Appendix B) was done to show the performance of the proposed model. The confidence level of the model is over 95% which is a very good indicator that the model can predict correctly most of the time.

Recommendations: A limitation in this work is that some significant property productivity characteristics may have been omitted from the model. More robust property productivity can be used to show the model’s flexibility in wide range of features in the dataset. The experiments are also required to be done in large datasets to see how it performs with more features. If it performs well in large datasets, we can determine that this model is robust and flexible. Otherwise the model would be limited to small and less complex dataset, which also can be a problem in real life.

Also another limitation is that the analyst will still rate the productivity features for the subject property and the set of comparable properties selected for analysis though it is done by relying on empirical literature. The analysis should be done without any inputs of the analyst.

**Conclusion**:

The paper mainly focused on two major problems, such as, efficient data analysis technique on a small sample sized data which can be resolved by applying price-quality regression technique; property productivity features of a property, the ranking/rating of productivity features, and the weights assigned to the productivity features may have biased value because it is assigned by the analysts which also can be resolved by relying on the empirical literature for the selection of significant property productivity features of a property class and assigning them weights by applying Solver program. Rating the property productivity features reflects the price establishing characteristics of the similar buyer group in decision making. One of the limitations is some important property productivity characteristics may have been ignored from the model. The model should be robust and flexible to many diverse features. The experiments should also be done on large datasets as well with wide range of diverse attributes. Another limitation is that the analyst will still subjectively rank or rate the productivity features for the subject property and the set of comparable properties selected for analysis. Though the empirical literature provides some reliability but it is not yet enough to make a complete unbiased model.

**References**:

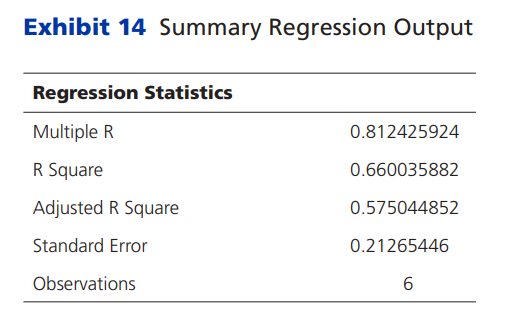
[1] A. Ason Okoruwa, “Regression Analysis of Property Productivity Index and Value,” *The Valuation Journal, National Association of Romanian Valuers*, vol. 12(1), pages 58-93, 2017.

[2] Hans Isakson, “The Linear Algebra of the Sales Comparison Approach*,” Journal of Real Estate Research,* Vol. 24, No. 2, pp. 117-128, 2002.

[3] Conover, W. J., and Ronald L. Iman. “Rank Transformations as a Bridge Between Parametric and Nonparametric Statistics.” *The American Statistician 35*, no. 3 (1981): 124–129.

**Appendices**:

Appendix A:



Appendix B:

