Development of a Robust Bayesian Approach for Real Estate Valuation in Areas with Few Transactions

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SUMMARY

The real estate valuation is realized by three different valuation methods in Germany. However, the sales comparison approach is the method, which has the nearest affinity to the real estate market. Often, regression analysis is used in this case. The regression model needs normally 15 purchases per independent variable for an accurate estimate in real estate valuation. For this reason in areas with few transactions (if only 10 to 30 purchases exist) the solution of regression is not satisfactory. Furthermore, the detection of outliers is a challenging task, because the number of purchases is small and each detected outlier reduce the sample size.

Actually, in areas with few transactions, the real estate expert estimates the value by his own experience under considering the available market data, e.g. purchases or offer prices. The purpose of this study is to demonstrate a mathematical-statistical approach for the combination of all kind of data. Here, a robust Bayesian approach is introduced, which uses an independent Student-distribution instead of the normal distribution to ensure the robustness. The selection of Student density function (non-conjugate prior density) leads to the problem, that the analytical solution cannot be derived. In this paper, we apply a numerical Markov Chain Monte Carlo method based on the popular Gibbs sampler to solve the aforementioned problem.

The focus of this paper lies on the development of an optimal weighting approach between different market data. This study uses three different data sets, which consist of purchases, knowledge of real estate experts and offer prices. The available data groups have the main characteristic of heteroscedasticity and non-normality, which would be challenging in terms of optimal weighting estimation. In addition, systematic offset can be assumed between two data sets, e.g. offer prices are often higher as purchases.

A statistical approach for the combination of heterogeneous data sets in other geodetic application is the variance components estimation. It estimates the variance weight for each data set by minimizing the residuals over all data. The integration of the variance component estimation in the robust Bayesian approach follows in two steps. First, we developed a closed loop simulation to validate and optimize the algorithm. For this propose, we use three different data sets. In this simulation, the characteristics of the real data are reproduced. In the second step the optimized algorithm is validated on the real market.