Determinants of Public Housing Rent in Aarhus

Introduction

The primary aim of this project is to explore the determinants of public housing rent prices in Aarhus, Denmark. Specifically, we focus on price per square meter ("price/sqm") and how it relates to structural characteristics like area, the number of rooms, and deposit requirements. Public housing rents deviate from typical market dynamics due to regulatory factors and location-specific features. Previous research highlights the following trends:

1. Housing prices are influenced by structural characteristics and proximity to urban centers (Sirmans et al., 2006)
2. Smaller apartments often command higher price/sqm due to greater demand for urban-friendly living spaces (European Commission. Directorate General for Economic and Financial Affairs., 2022).
3. Location remains a crucial determinant, with proximity to amenities driving up prices (Melecky & Paksi, 2024).

Given these findings, we investigate how these variables affect rents in Aarhus public housing and evaluate the utility of Bayesian analysis for this purpose.

Methods

Data Collection and Cleaning

The dataset after cleaning consists of 44,090 public housing entries from Aarhus Kommune (2024). Data cleaning steps included:

1. Removing missing or zero values for essential variables such as area, rent, and deposit.
2. Calculating derived variables: net_price_per_sqm and gross_price_per_sqm.
3. Handling outliers, e.g., properties with unrealistic rents (<1000 DKK or price/sqm <40 DKK).

The cleaned dataset showed imbalances in variables like postal codes, limiting generalizability.

Operationalization

Key variables:

- Dependent Variable: Net price per square meter.
- Independent Variables: Area (m²), number of rooms, and deposit amount.

Model Description

We employed two modeling techniques: linear regression and Bayesian generalized linear modeling (Bayesian GLM). The Bayesian approach incorporated weakly informative priors:

- Intercept: Normal(100, 30).
- Area coefficient: Normal(0, 4).
- Deposit coefficient: Normal(0, 4).

Data preprocessing was performed using Python, while model fitting was done in R.

Results

Descriptive Analysis

- Smaller apartments had a higher price/sqm.
- Area and number of rooms were positively correlated (0.62).
- Deposit amount showed minimal variation and no significant effect on rent.

Bayesian GLM Output

The Bayesian GLM confirmed the findings of the standard linear regression:

- Intercept**:** 75.01 (±0.16), representing the baseline price/sqm when all other variables are zero.
- Area coefficient: -0.25 (±0.01), indicating a decrease in price/sqm with increasing area.
- Deposit coefficient: 0.00 (±0.01), suggesting no impact on rent.
- Model fit diagnostics ($\widehat{R} \approx 1$) indicated convergence.

Visualizations

We created multiple visualisations of the data to aid in the exploratory data analysis.

Figure 1: Area vs. Gross Rent

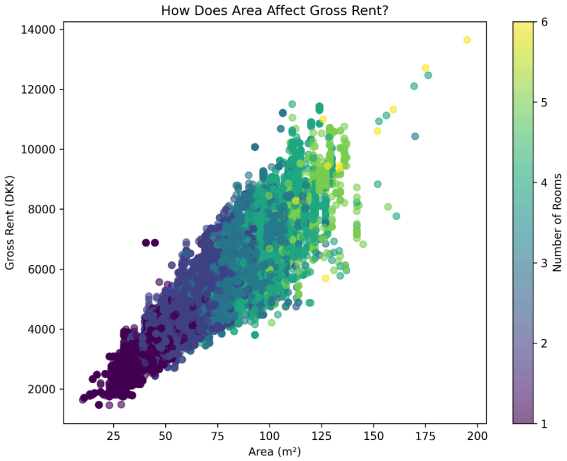


Figure 2: Area vs. Net Rent

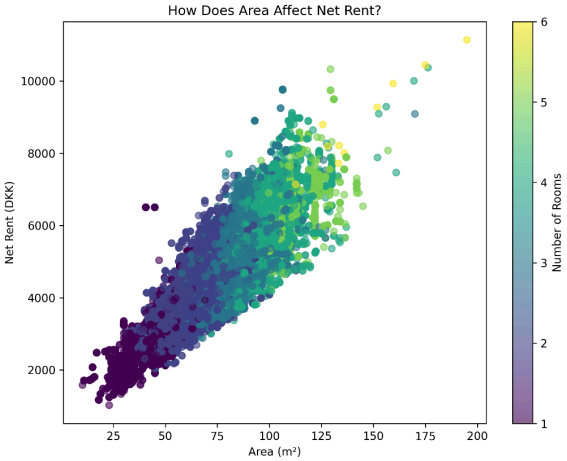


Figure 3: Distribution of Apartment Types

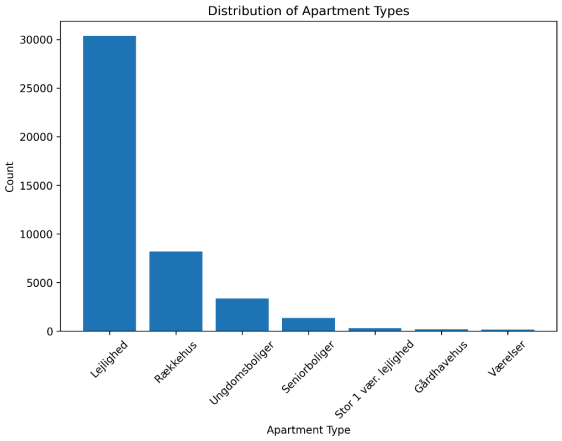


Figure 4: Distribution of Number of Rooms

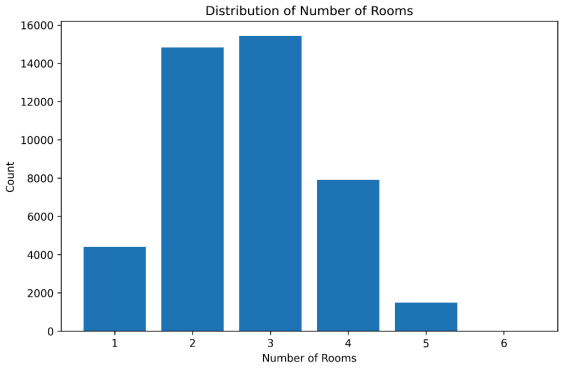


Figure 5: Distribution of Net Price/Sqm

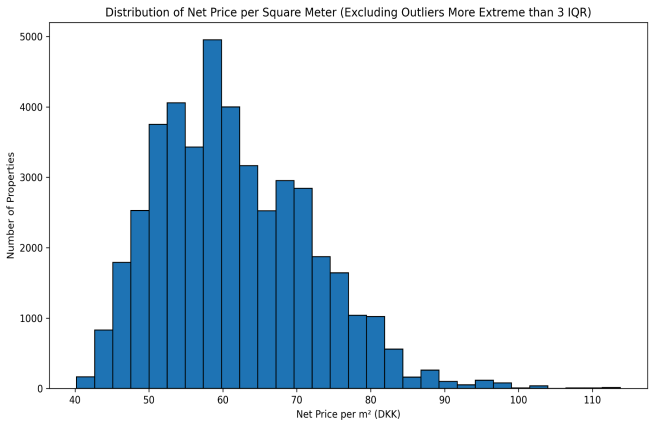


Figure 6: Correlation Matrix of Variables

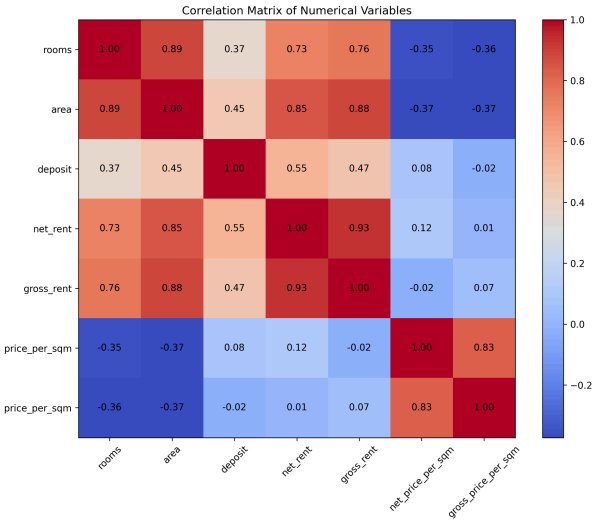


Figure 7: Distribution of Net Rent

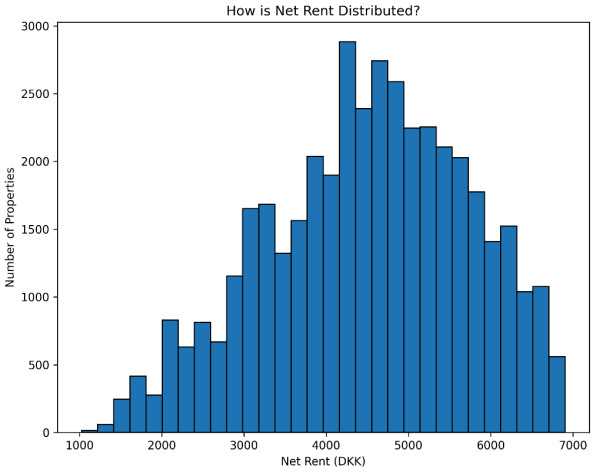
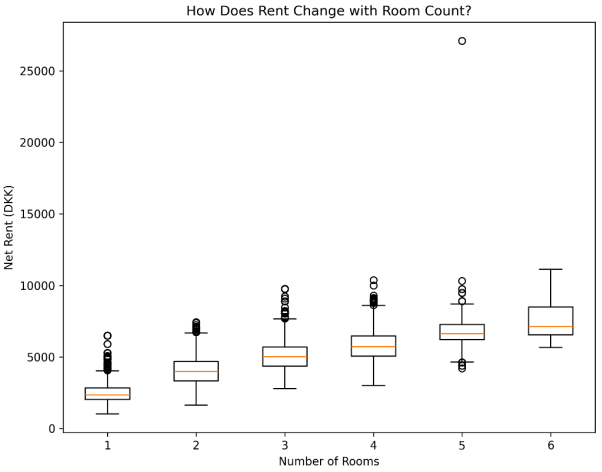


Figure 8: Box Plot of Net Rent Based on Rooms



Discussion

Our findings support the hypothesis that structural characteristics like area and the number of rooms significantly influence public housing rent in Aarhus. However, deposit amounts and smaller cities within Aarhus Kommune showed no substantial effects. These results align with prior studies emphasizing the role of apartment size and urban demand.

Limitations

- Data Quality: Imbalanced representation of certain postal codes (e.g., Harlev J).
- Operationalization Issues: Key factors such as distance to city center and renovation year were not included.

Conclusion

The Bayesian approach offered inferences about rent determinants. Future research should incorporate locational and temporal features to better predict rent variability in public housing markets.

References

European Commission. Directorate General for Economic and Financial Affairs. (2022). *Housing market developments in the euro area: Focus on housing affordability.* Publications Office. https://data.europa.eu/doi/10.2765/74242

Melecky, A., & Paksi, D. (2024). Drivers of European housing prices in the new millennium: Demand, financial, and supply determinants. *Empirica*, *51*(3), 731–753. https://doi.org/10.1007/s10663-024-09611-5

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