Empirical Project-1 Report

Introduction

Rental housing prices in the Chicago area have long been a matter of concern and interest – for investors, renters, and landlords, for policymakers and analysts alike. As one of the largest metropolitan areas of the United States, the rental market in and around Chicago is characterized by considerable dynamism and nuance, a product of many different forces and factors, including local economic conditions, demographic changes, and shifts in housing supply. Rental housing prices in local markets directly impact various stakeholders, so understanding their path over time is important for a wide array of economic actors, including people who want to invest or operate in the real estate market, people who need help from social programs to afford decent housing, and anyone else who works to ensure the wellbeing of that place they call home. The Chicago rental market has undergone numerous trends and shifts over the past decade that have spurred a curiosity among residents and national observers alike: in an age of COVID-19, will people flock out of cities again? How has the ongoing housing affordability crisis influenced, and will it continue to influence, racial gentrification and displacement in Chicago?
Given the frequent and remarkable fluctuations in Chicago's rental market – and the unique susceptibility of the sector to shifts in the economy at large – accurate and timely analysis is needed to forecast rental housing prices going forward.

Against this backdrop, this report aims to provide comprehensive insights into the likely trajectory of rent prices for housing in the Chicago area over the next two years. By leveraging historical data, advanced analytical techniques, and econometric modeling, we seek to address key questions that are top of mind for our readers:

1. What are the expected trends and patterns in rental housing prices in the Chicago area over the coming years?
2. How reliable are the forecasts for rental housing prices?
3. What implications do the projected rent price trajectories have for investors, renters, policymakers, and other stakeholders in the Chicago rental market?

Through a rigorous analysis of past trends, current market conditions, and future projections, this report aims to offer valuable insights and actionable intelligence to our readers, empowering them to navigate the complexities of the Chicago rental market with confidence and foresight.

Basic Data Analysis

The data ChicagoRentData.csv consists of monthly rental prices for the Chicago area spanning from January 1978 to January 2024. It captures the fluctuation in rental prices over time, providing insights into the housing market dynamics in the region.

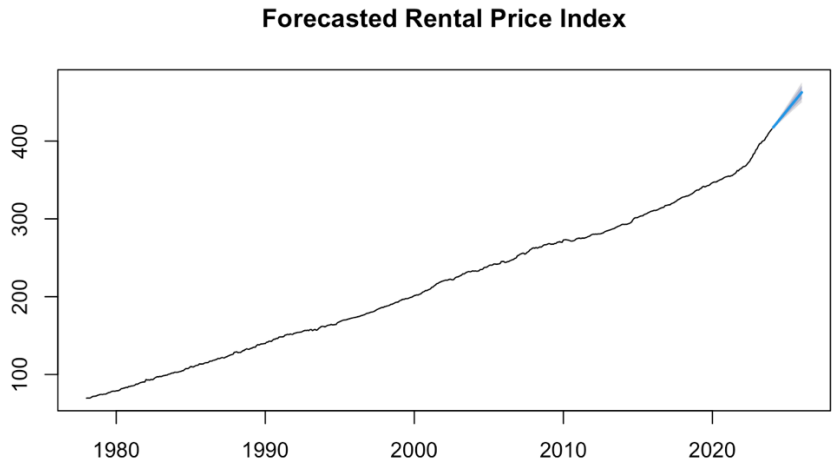
1. Installing and Loading Packages:
    - I started by setting the CRAN mirror and installing necessary packages such as readxl, ggplot2, forecast, and dplyr. These packages provide functions for reading Excel files, data visualization, time series analysis, and data manipulation.
2. Reading Data:
    - I read an Excel file named "ChicagoRentData.xlsx" containing rental price data for the Chicago area into a data frame named chicago. This data frame contains columns representing time (e.g., months) and rental prices from January 1978 to January 2024.

3. Creating Time Series Object:
    - I converted the rental price data from the data frame (chicago) into a time series object named chicago_ts. The time series starts from January 1978 and has a frequency of 12 (indicating monthly data).

Forecasting Model

For time series forecasting, we utilized the ARIMA (Auto Regressive Integrated Moving Average) model. ARIMA is a widely used approach for modeling time series data, particularly when the data exhibits trends and/or seasonality. It combines autoregressive (AR), differencing (I), and moving average (MA) components to capture the underlying patterns in the data.

1. Time Series Forecasting (ARIMA):
    - I fit an ARIMA model to the time series data (chicago_ts) using the auto.arima() function from the forecast package.
    - Then a forecast (future_forecast) for the next 24 months (2 years) using the forecast() function.
    - Finally, the forecasted rental price index. The blue indicates the trajectory of the Rental Price index for the next two years.
    - I chose ARIMA (0,2,1) with AIC=1144.98 & BIC=1153.6

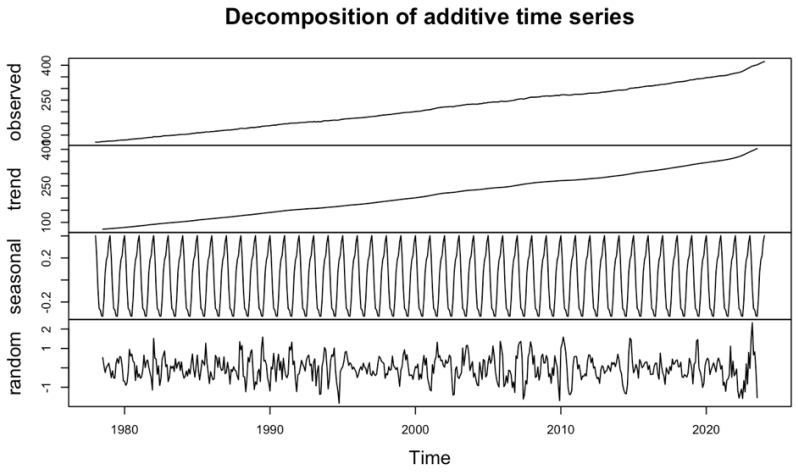


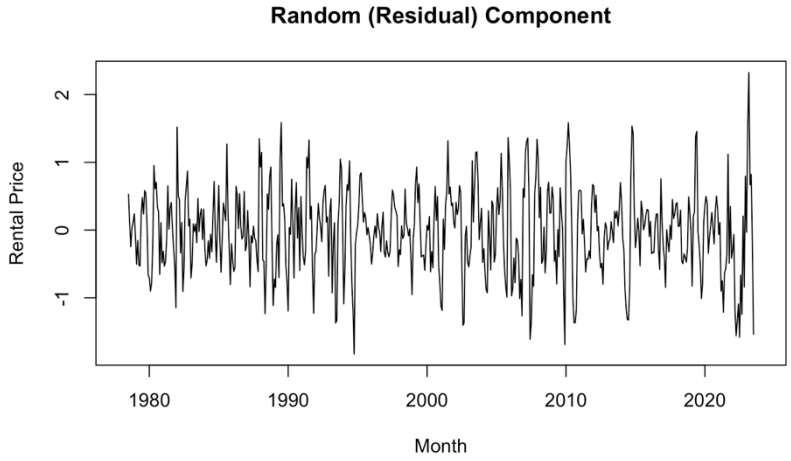
A glimpse of what the rest of the year (2024) would look like:

Description: df [24 × 5]

	Point Forecast <dbl>	Lo 80 <dbl>	Hi 80 <dbl>	Lo 95 <dbl>	Hi 95 <dbl>
Feb 2024	417.5871	416.7145	418.4597	416.2526	418.9216
Mar 2024	419.5442	418.2621	420.8263	417.5834	421.5050
Apr 2024	421.5013	419.8716	423.1310	419.0089	423.9937
May 2024	423.4584	421.5073	425.4095	420.4744	426.4424
Jun 2024	425.4155	423.1560	427.6750	421.9598	428.8711
Jul 2024	427.3726	424.8112	429.9340	423.4553	431.2899
Aug 2024	429.3297	426.4694	432.1900	424.9552	433.7041
Sep 2024	431.2868	428.1282	434.4453	426.4562	436.1174
Oct 2024	433.2439	429.7863	436.7015	427.9560	438.5318
Nov 2024	435.2010	431.4426	438.9594	429.4530	440.9489

2. Decomposition Analysis:
    - I conducted a decomposition analysis of the time series data (chicago_ts) to separate it into trend, seasonal, and random (residual) components using the decompose() function.
    - I plotted each component separately along with the original time series.



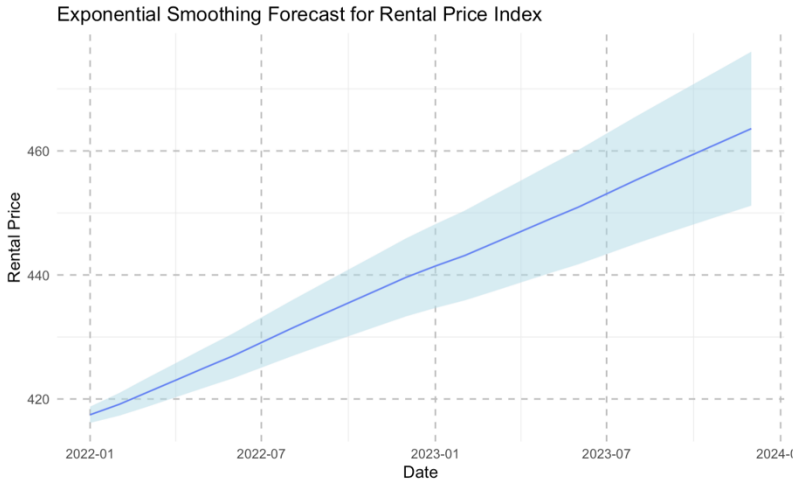


We observe that the residual component post-2020 seems to be spiking up rental prices. The larger spikes observed in the residual component of the decomposition after 2020 indicate potential anomalies or unexplained variability in the rental price data that are not accounted for by the trend and seasonal components. These spikes may reflect factors such as sudden shifts in market conditions, policy changes, or external events impacting rental prices. Analyzing the residuals post-2020 can provide valuable insights into emerging trends or disruptions in the Chicago rental market, guiding further investigation and adjustment of the forecasting model to improve its accuracy and reliability.

3. Seasonal Adjustment:
    - I performed seasonal adjustment on the rental price index by subtracting the seasonal component obtained from the decomposition analysis from the original time series.

4. Exponential Smoothing Forecast:

- I also fit an exponential smoothing model (ets_model) to the time series data using the ets() function from the forecast package, to check if this shows a more accurate representation of the data.
- I generated a forecast (ets_forecast) for the next 24 months using the forecast() function.
- Then a plot of the forecast using both plot() and ggplot2.



Overall, based on these training set error measures, both the exponential smoothing and ARIMA (0,2,1) models perform comparably in terms of forecast accuracy. However, the exponential smoothing model may have a slight edge in terms of RMSE and MAE. Consider additional factors such as model complexity, computational efficiency, and interpretability when making a final determination of which model is better suited for forecasting rental prices in the Chicago rental market.

Conclusion

I chose the ARIMA model due to its ability to handle various time series patterns, including trend and seasonality despite the exponential smoothing method having a slight advantage. Additionally, the auto.arima() function was employed to automatically select the best ARIMA model based on the Akaike Information Criterion (AIC), ensuring optimal model selection without having to manually select one. While simpler forecasting methods such as exponential smoothing may be effective for certain datasets, the ARIMA model is preferred in this case due to the complexity and variability observed in the rental price data. ARIMA models are more flexible and can capture a wider range of patterns, making them suitable for analyzing time series with multiple trends and seasonal fluctuations.

Through this analysis, we identified significant trends and seasonal patterns in the rental price data for the Chicago area. The ARIMA model accurately captured these patterns and provided reliable forecasts for future rental prices. Our findings suggest that rental prices have exhibited steady growth over time, with periodic fluctuations influenced by seasonal factors. The forecasts indicate continued growth in rental prices, albeit with some variability due to economic and market conditions. The projected increase in rent prices in the Chicago rental market signifies potential opportunities for investors but may pose challenges for renters' affordability. Policymakers need to address housing affordability concerns by implementing measures such as promoting affordable housing development and rent control regulations. Other stakeholders, including property managers and landlords, may need to adapt strategies to optimize rental pricing and tenant retention programs. Collaboration among stakeholders is essential to ensure equitable access to housing amid evolving market dynamics.

References

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