Predicting NYC Rents using SARIMAX Modeling

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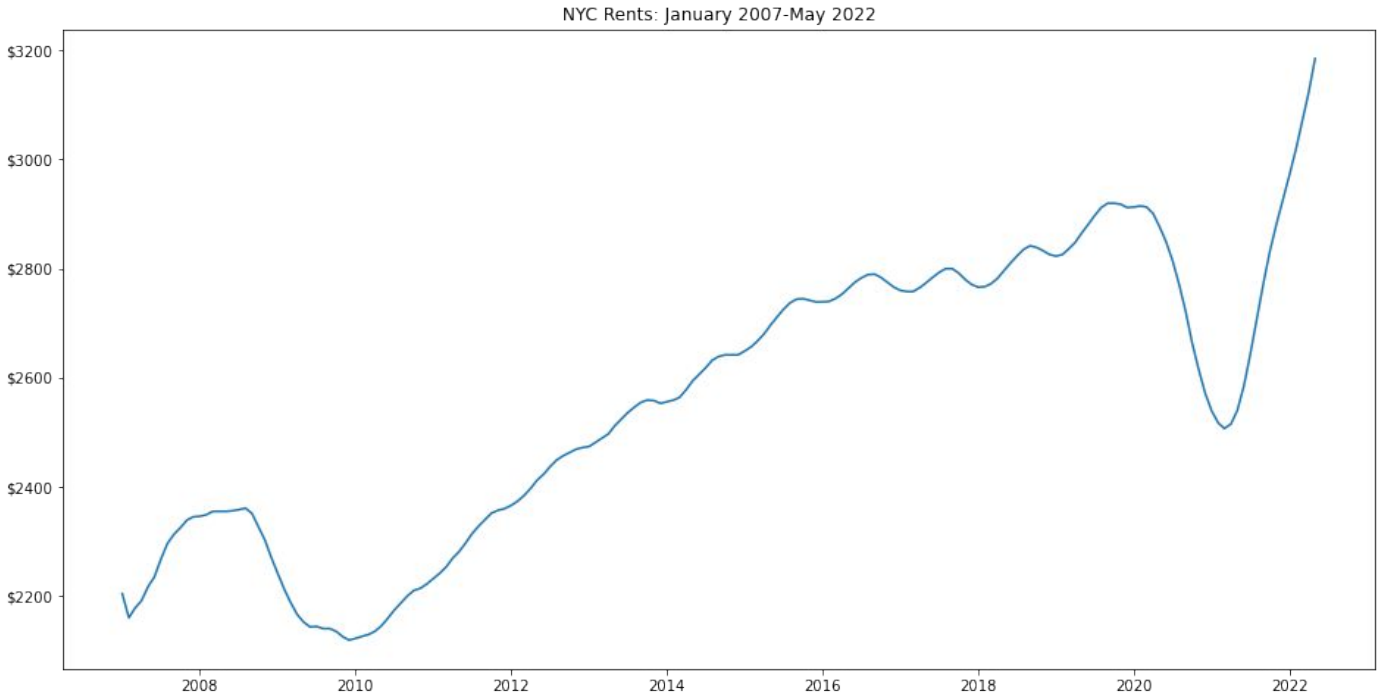
August 2, 2022

The New York City Rental Crisis

- New York is currently facing a crisis of rising rents
- The StreetEasy Rental Index lists the median asking price for a new rental at $3185/month as of May 2022.
- This represents an increase of over 25% compared to the previous year.

Data source: https://streeteasy.com/blog/data-dashboard

NYC Rental Trends since 2007



Data source: https://streeteasy.com/blog/data-dashboard

Year over Year Changes in Rent

Data source: https://streeteasy.com/blog/data-dashboard

Problem for Renters

- If price increases are likely to continue, then renters should:
  - lock in new leases sooner rather than later
  - opt for long term leases if possible, even if it means a higher monthly rent.
- If increases are likely to slow or even be reversed, then renters should:
  - hold off on signing new leases
  - avoid longer term leases at higher price points.

Can we predict future rental prices?

- Predictions for time series such as price movements are often made using SARIMA models
- SARIMA models regress values of a time series on past values of the same series
- While SARIMA is good at modeling short term market patterns, it doesn't take into account the impact of exogenous variables.

Modeling Rents with SARIMAX (SARIMA with Exogenous predictors)

- Fortunately, it's very easy to add exogenous variables to SARIMA models, producing a SARIMAX model.
- What's more challenging is determining which exogenous variables are likely to produce a good SARIMAX model.
- In this case, our question is:
  - What leading indicators are good at predicting changes in the rental market?

What makes a good leading indicator?

- If we want to predict the future of the rental market, then the leading indicators that we use as exogenous variables in our model should have these properties:
  - Predictors be correlated with rental prices at a lag.
  - Correlations should hold true not only for the most recent period of rent increases, but for all periods.

Exogenous Variables used for modeling

After evaluating eleven potential leading indicators, I was able to identify four that showed consistent positive correlations with rental prices at a specific lag:

- The PPI (Producer Price Index) for Building Materials (12 Month Lag)
- The number of employees in construction in New York State (6 Month Lag)
- Manhattan Sale Prices (6 Month Lag)
- Total Wages and Salaries earned in New York State (6 Month Lag)

Best SARIMAX Model

- The best SARIMAX model used three out of the four variables as exogenous predictors:
  - Building Materials, 12 Month Lag
    - Accounting for $730 in total rental price variation between 2007 and 2022
  - Employees in Construction 6 Month Lag
    - Accounting for $430 in rental price variation
  - Manhattan Sale Prices 6 Month Lag
    - Accounting for $40 in rental price variation (not statistically significant)
- This Model showed low error on a set of testing data and also modeled the training data better than other high-performing models.

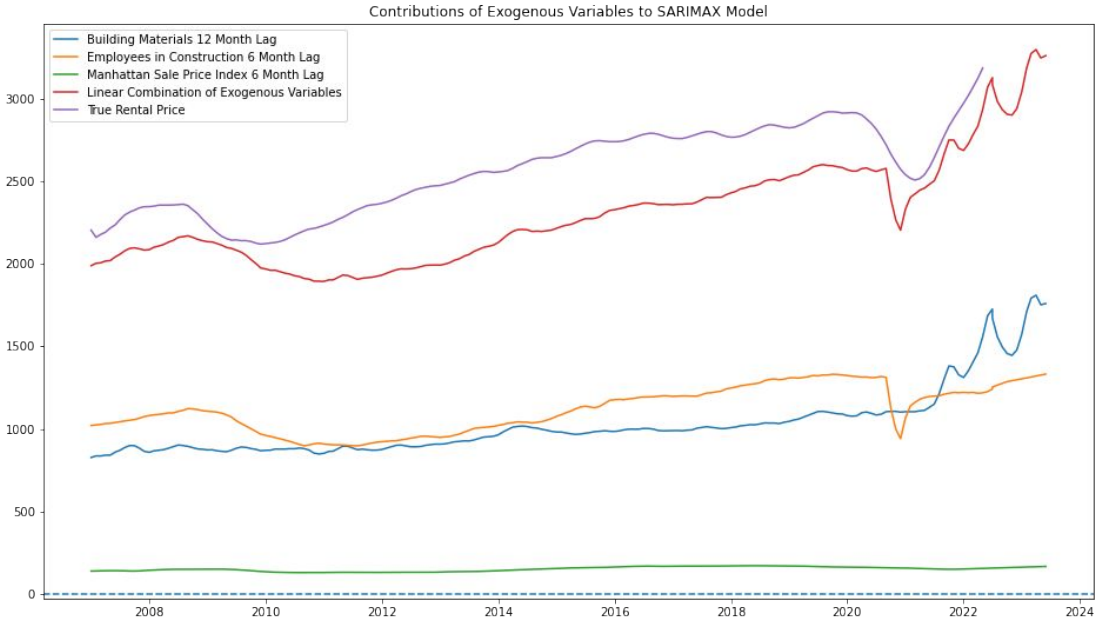
Effect of Predictors on Model

Data sources:

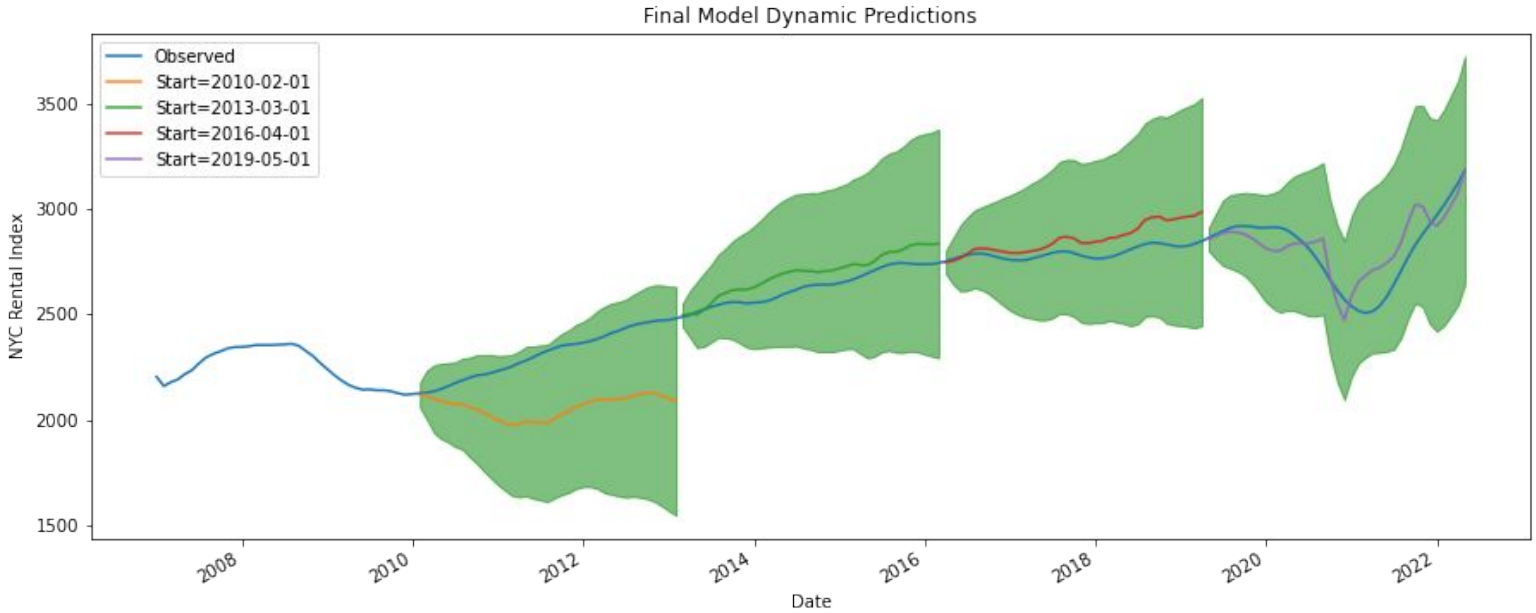
StreetEasy Data Dashboard

U.S. Bureau of Labor Statistics, Producer Price Index by Industry: Building Material and Supplies Dealers [PCU44414441], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/PCU44414441, July 19, 2022.

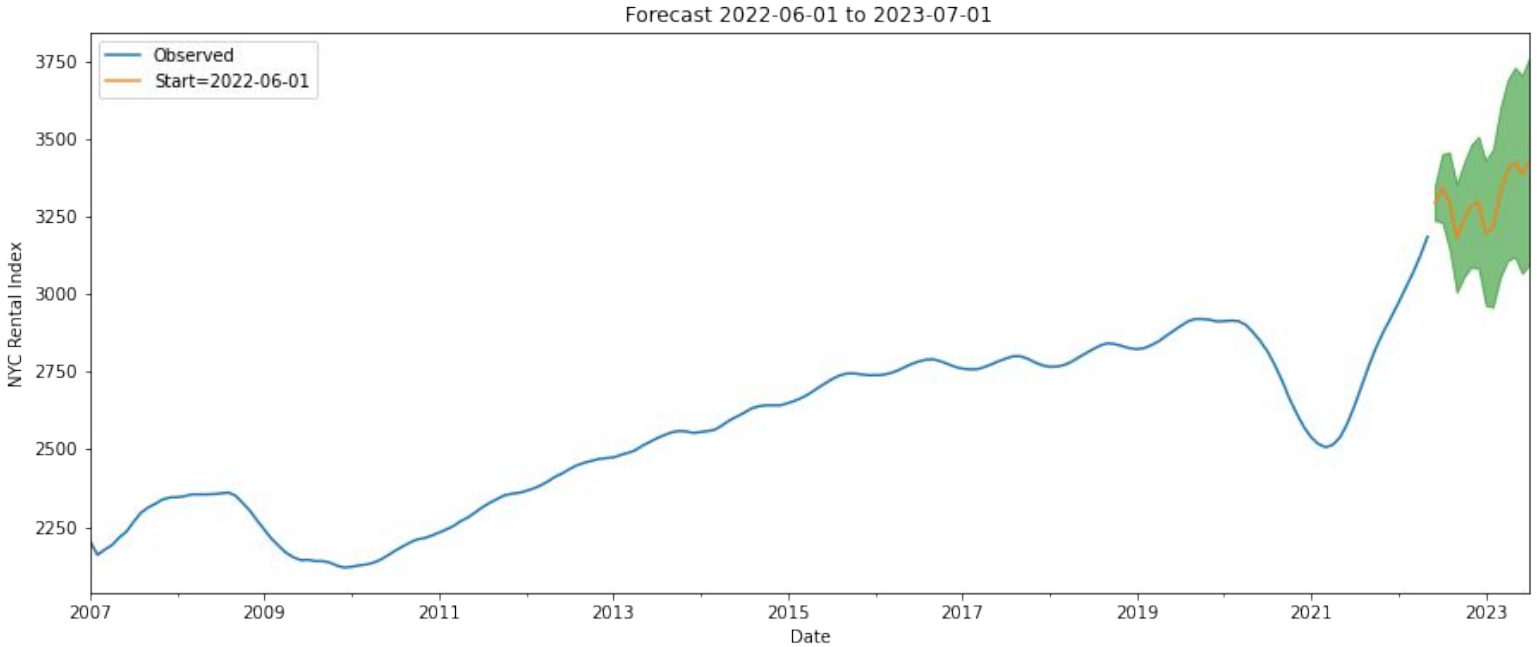
U.S. Bureau of Labor Statistics and Federal Reserve Bank of St. Louis, All Employees: Construction: Residential Building Construction in New York [SMU36000002023610001SA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SMU36000002023610001SA, July 22, 2022.



Dynamic Predictions of Model: 2007-2022



Model Predictions: May 2022-July 2023



Summary of Predictions

- Our model's mean prediction is that rents will fall through September to a low of $3180/month and stay below $3300/month through February, before rising above $3400 in the Spring and Summer of 2023
- We should therefore expect a YOY increase of around 7.5%, as compared with 25% over the past year.
- Finally we have 97.5% confidence that rents will not rise above $3730/month prior to May 2023.

Caveats

- Data only goes back to 2007
- There are definitely exogenous variables that we were unable to incorporate into our model but that nevertheless have important effects on the rental market: e.g. Fed Interest Rates.
- Nevertheless, the consistent reliability of this model for the 2007-2022 period gives us good reason to trust our model's 95% confidence interval.

Recommendations

- Renters should avoid moving or signing new leases until the fall or winter, when prices are expected to fall to a short term low.
- Renters should only sign two year leases if they’re able to negotiate rents at or below 7.5% of what they would be paying for a 1-year lease, since this is how much rents are expected to rise over a one year period.

Thank you for viewing!

Data and code used for this presentation can be viewed at:

https://github.com/DavidKRichter/dsc-rental-project

Please email me with any questions at:

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