Richmond Metro Area Housing Price Forecasting Using Time Series Analysis

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Business Problem

- Hired by house flipping company in Richmond, Virginia
- Takes them 1 year to buy, renovate and sell a house
- They have limited resources in terms of how many houses they can invest in
- Target areas with a higher likelihood of better investment returns
- My goal: Find the best area

Process

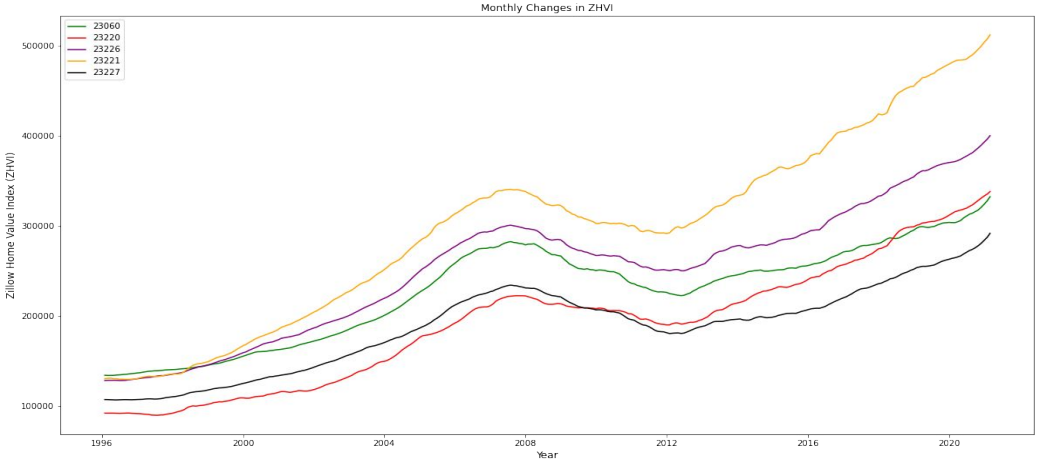
- Build SARIMA model per ZIP code
  - Find the best parameters
- Build Facebook Prophet model per ZIP code
- Use both models to make one year forecasts
- Calculate one year price appreciation
- Take average results of both models
- Make a determination of the best ZIP code for investments

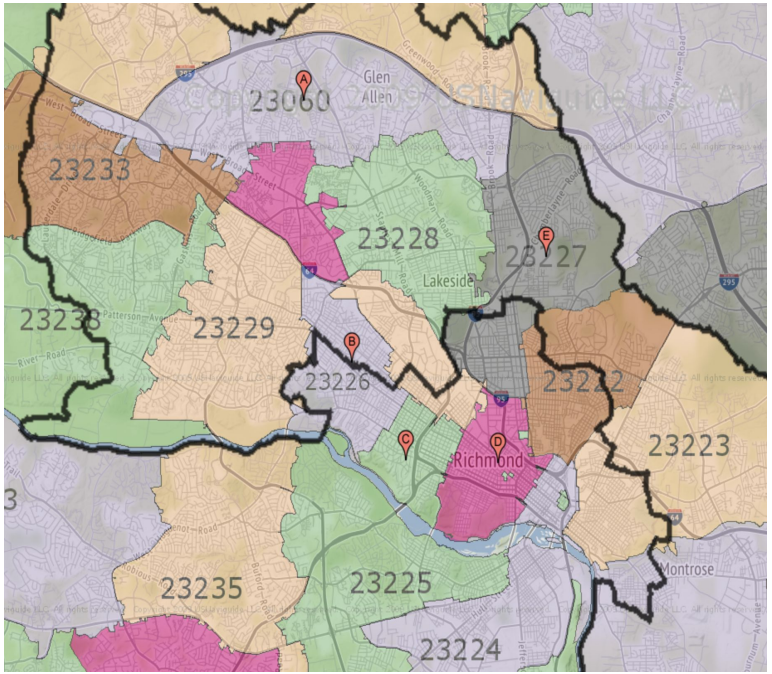
Data

- Gathered from Zillow
- Target is the Zillow Home Value Index (ZHVI)
- ZHVI is a smoothed, seasonally adjusted measure of the typical home value and market changes across a given region and housing type. It reflects the typical value for homes in the 35th to 65th percentile range.
- Only single family homes
- Monthly Date Range: January 1996 to February 2021

ZIP Code Information

- 23060 (A) contains of the towns of Glen Allen and Innsbrook, suburbs of Richmond
- 23226 (B) contains the West End
- 23221 (C) contains Carrytown, the Museum District, and Windsor Farms, thriving cultural areas of the city and adjacent suburbs.
- 23220(D) contains the Fan District a central urban neighborhood where VCU is located, and surrounding areas.
- 23227(E) contains the neighborhood of Bellevue, a picturesque area just outside the city and the town of Chamberlayne.





SARIMA Modeling

- Each ZIP analyzed individually

-Exogenous variable, financial crisis flag, added to capture trend during period of Great Recession

- Second differencing required to achieve stationarity

- PACF plot showed potential for 3 AR terms and a 12 month seasonal term

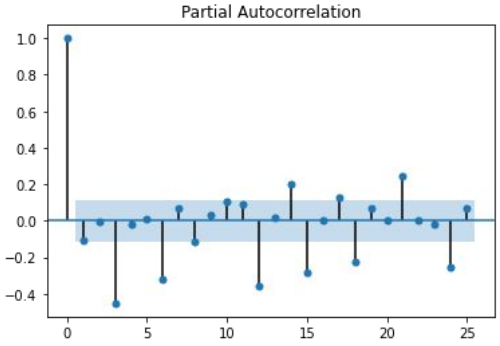
- ACF plot showed potential for 3 MA terms and a 12 month seasonal term

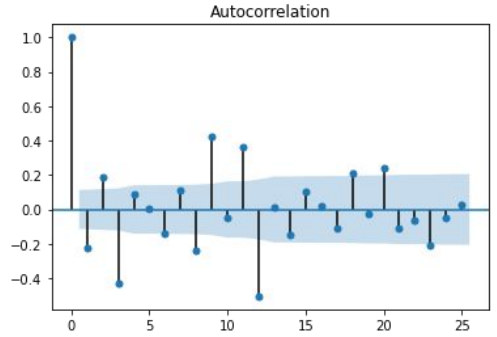
- Used mix of minimizing AIC and 12 Month Stepwise Test RMSE to determine final parameters

- Final Parameters:

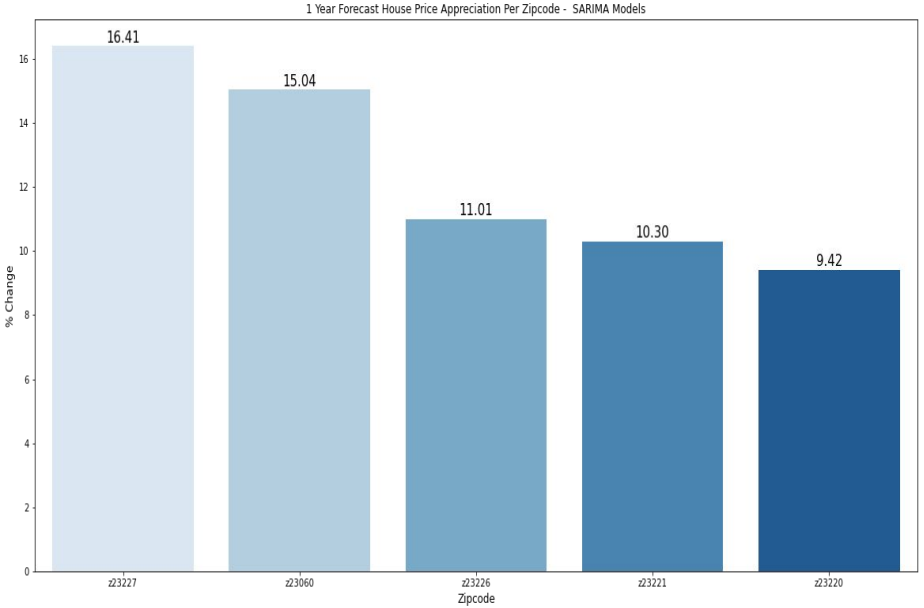
    -order= (0,2,3)

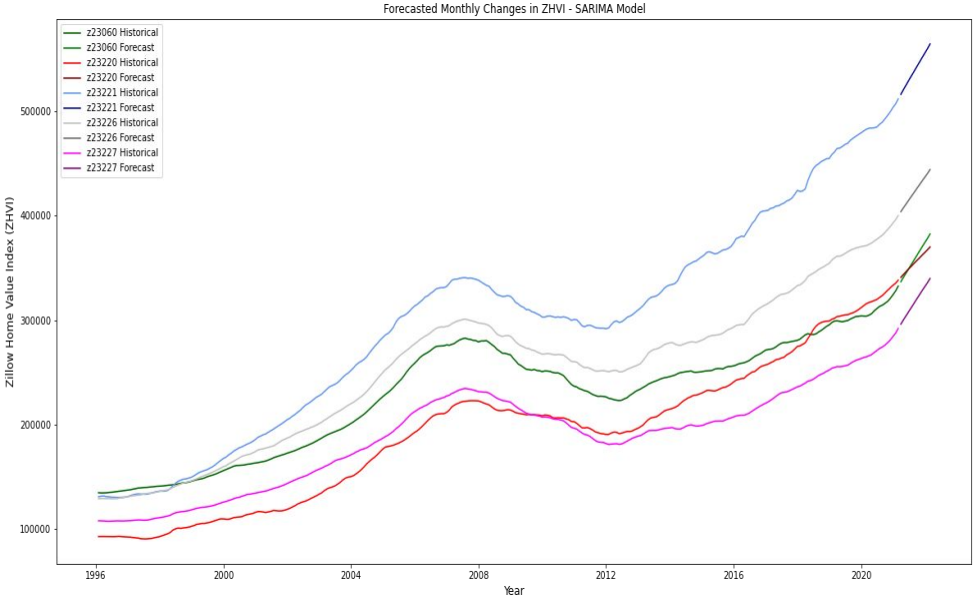
    -seasonal order = (0,0,1,12)



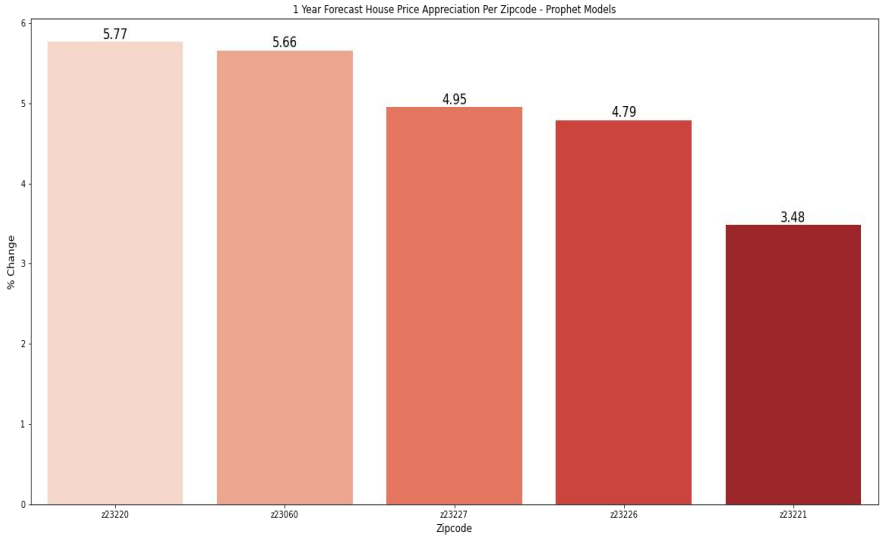


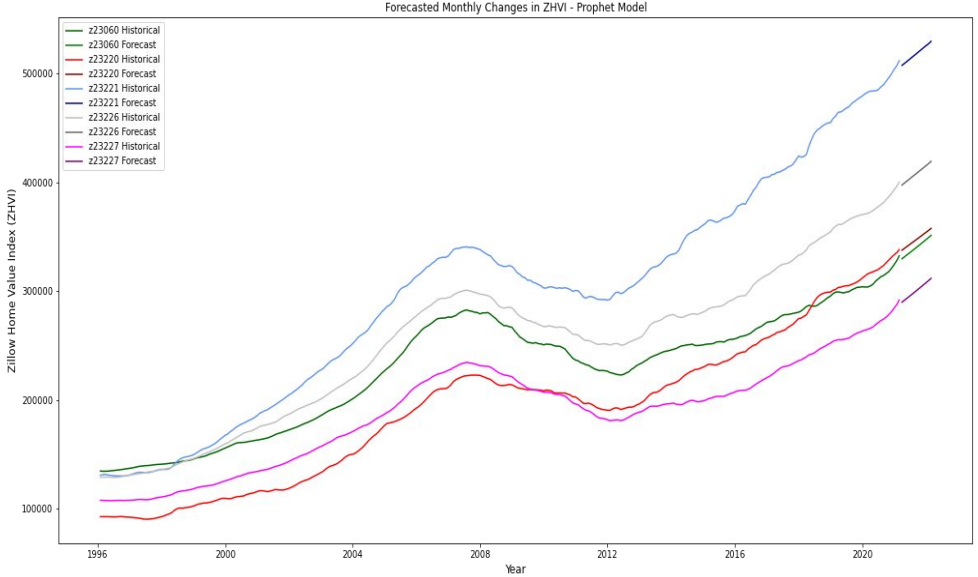
SARIMA Forecast Results



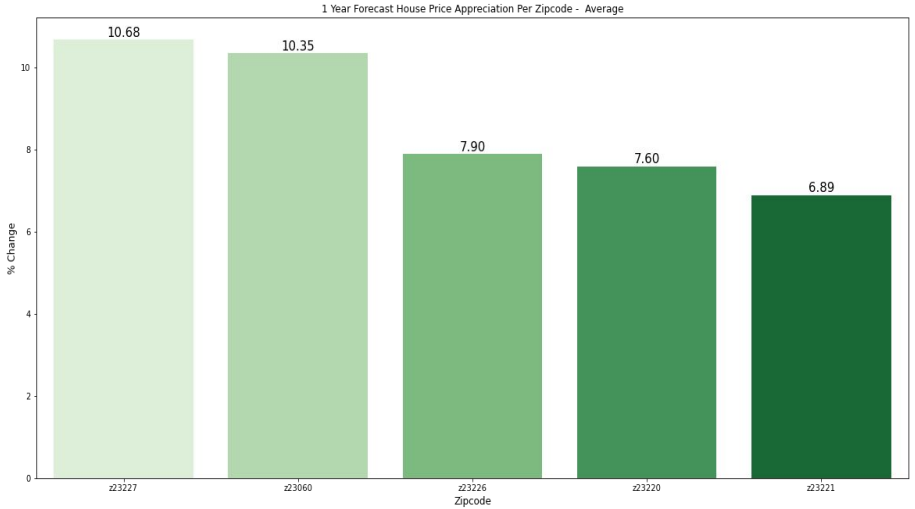


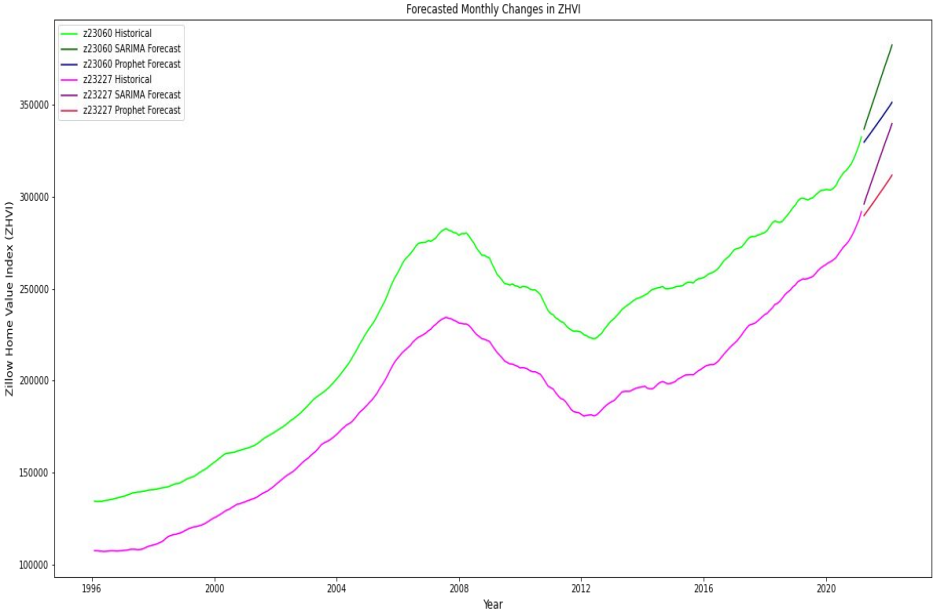
Facebook Prophet Forecast Results





Final Results

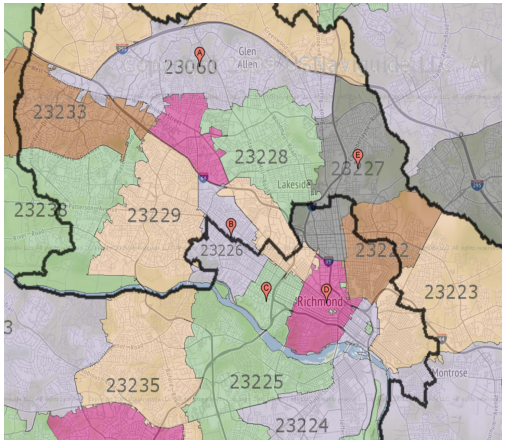




	Zipcode	Forecast_1_Year_%_Appreciation_SARIMAX	Forecast_1_Year_%_Appreciation_Prophet	Average
4	z23227	16.414476	4.954359	10.684418
3	z23060	15.040855	5.660040	10.350447
2	z23226	11.010286	4.788662	7.899474
0	z23220	9.423679	5.766928	7.595304
1	z23221	10.298132	3.480595	6.889363

Conclusion

- 23227 is my recommendation for most profitable ZIP code with forecasted return: 10.7%
- 23060 is close second with forecasted return 10.4%
- Both ZIPs are most suburban out of the five
    - COVID effect boosting near term appreciation in these areas



Next Steps

- Add more ZIP codes to the analysis
- Do more model tuning with Facebook Prophet
- Interview real estate agents about the market trends to get qualitative analysis