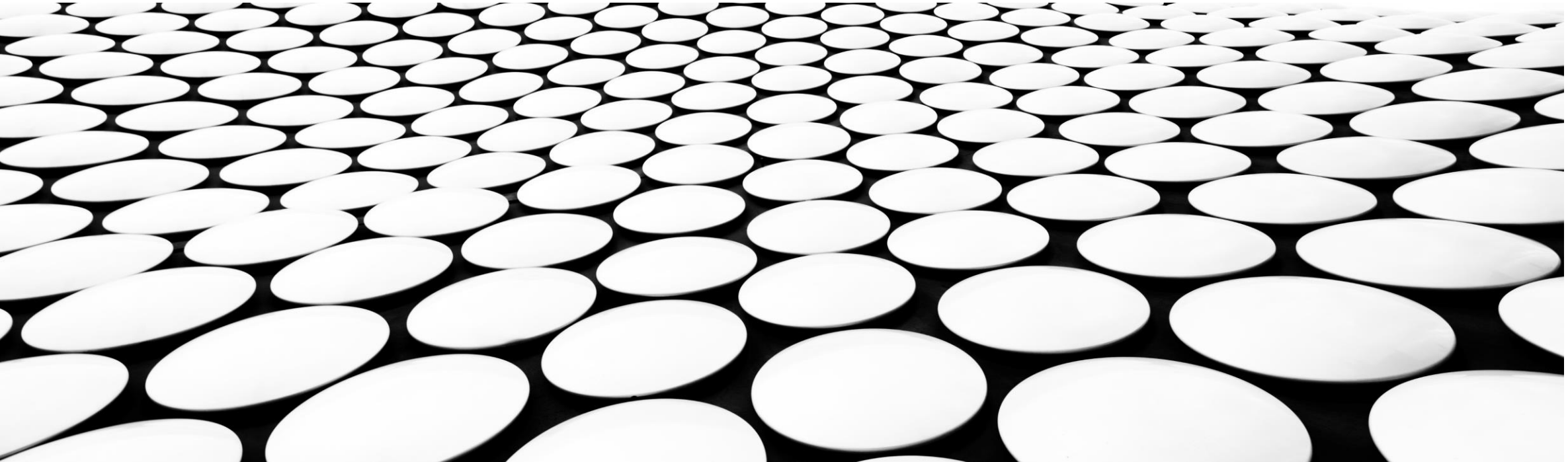


---

# Rental Property Investment With Time Series Model

Collin Loo



# OBJECTIVE

Business Case	Solution
<p>Identify top 5 zip codes for rental property investment</p>	<ul style="list-style-type: none"><li>» Develop a time series model to forecast future home values</li><li>» Compute ROI and Risk</li><li>» Select Zip Codes</li></ul>

# INVESTMENT STRATEGIES

Metrics	Criteria
Zip Code Evaluation Metrics	
» Return on Investment (ROI)	» ROI > 10%
» Price-to-Rent Ratio (PTR)	» PTR between 11 & 25
» Cash-on-Cash (COC)	» COC > 8%
» Rental Index Standard Deviation (RISD)	» RISD between 30 <sup>th</sup> and 60 <sup>th</sup> quantiles

$$ROI = \frac{\text{sale price after 5yr} - ((\text{purchase price} * 0.035) + \text{repair} + \text{purchase price})}{((\text{purchase price} * 0.035) + \text{repair} + \text{purchase price})}$$

0.035 = closing cost as a percent of the purchase price  
repair = 20,000

Appendix: [Metrics Calculation](#)

# DATA SOURCE

Obtain	Preprocess	Merge
<p>Zillow median home sale price</p> <ul style="list-style-type: none"><li>» Median sale price in 14,723 zip codes</li><li>» Date range 1996 to 2018</li></ul> <p>Zillow rental index</p> <ul style="list-style-type: none"><li>» Average rent in 106 metro areas</li><li>» Date range 2014 to 2020</li></ul>	<p>Calculate historical metrics with</p> <ul style="list-style-type: none"><li>» Home sale price</li><li>» Rental index</li></ul>	<p>Combine the two data sets based on metro information</p>

# STREAMLINE DATA

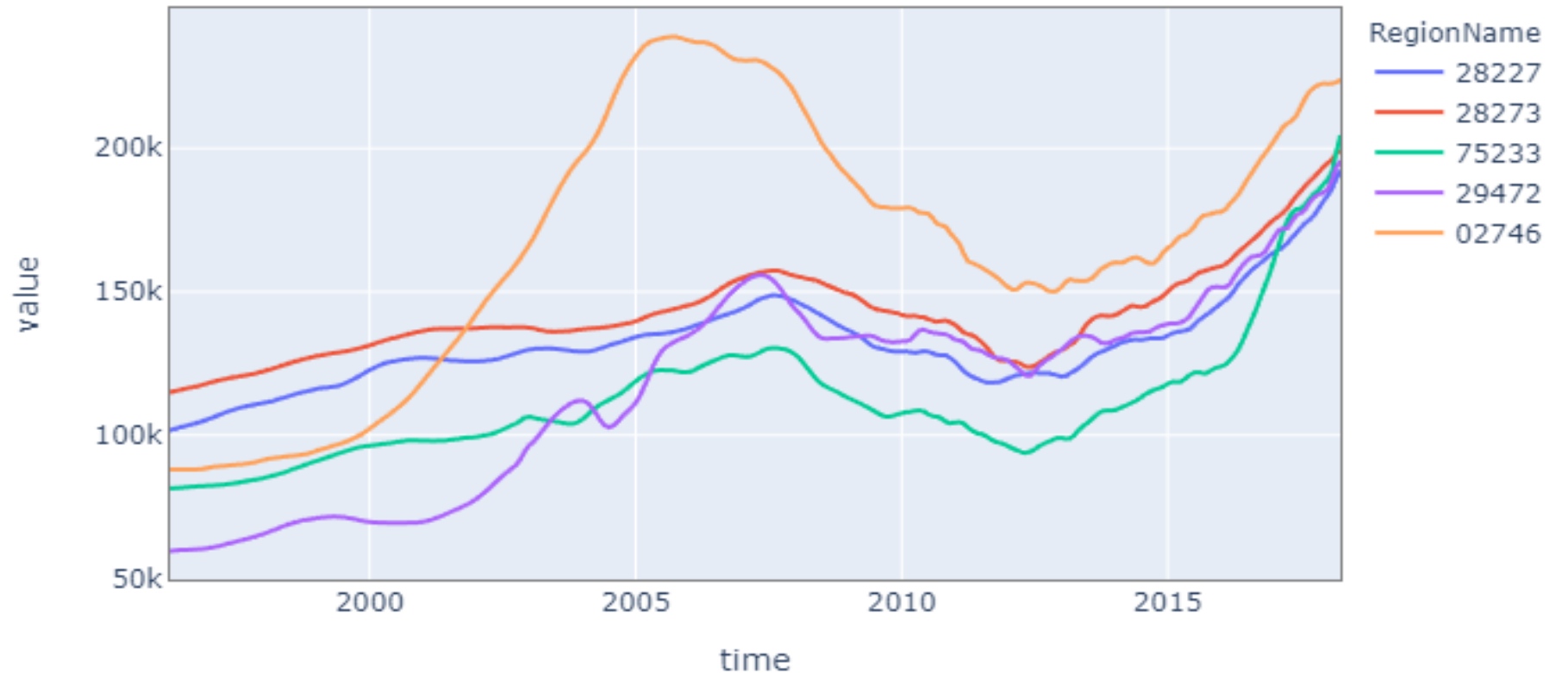
Filter	Subset	Select
Retain zip codes that meet the following <ul style="list-style-type: none"><li>» ROI &gt; 10%</li><li>» PTR between 11- 25</li><li>» COC &gt; 8%</li><li>» RISD between 30<sup>th</sup> and 60<sup>th</sup> quantile</li></ul>	Select top 3 zip code with the highest ROI from each state	Zip codes with highest ROI and minimum risk <ul style="list-style-type: none"><li>» 28227 Mint Hill, NC</li><li>» 29472, Ridgeville, SC</li><li>» 28273, Charlotte, NC</li><li>» 75233, Dallas, TX</li><li>» 02746, New Bedford, MA</li></ul>

# EXAMINE DATA I

## General Trend

- » 2008 housing bubble caused the 2008 -2010 decline in home value
- » 02746 posted the biggest decline

Home Value by Zip Code

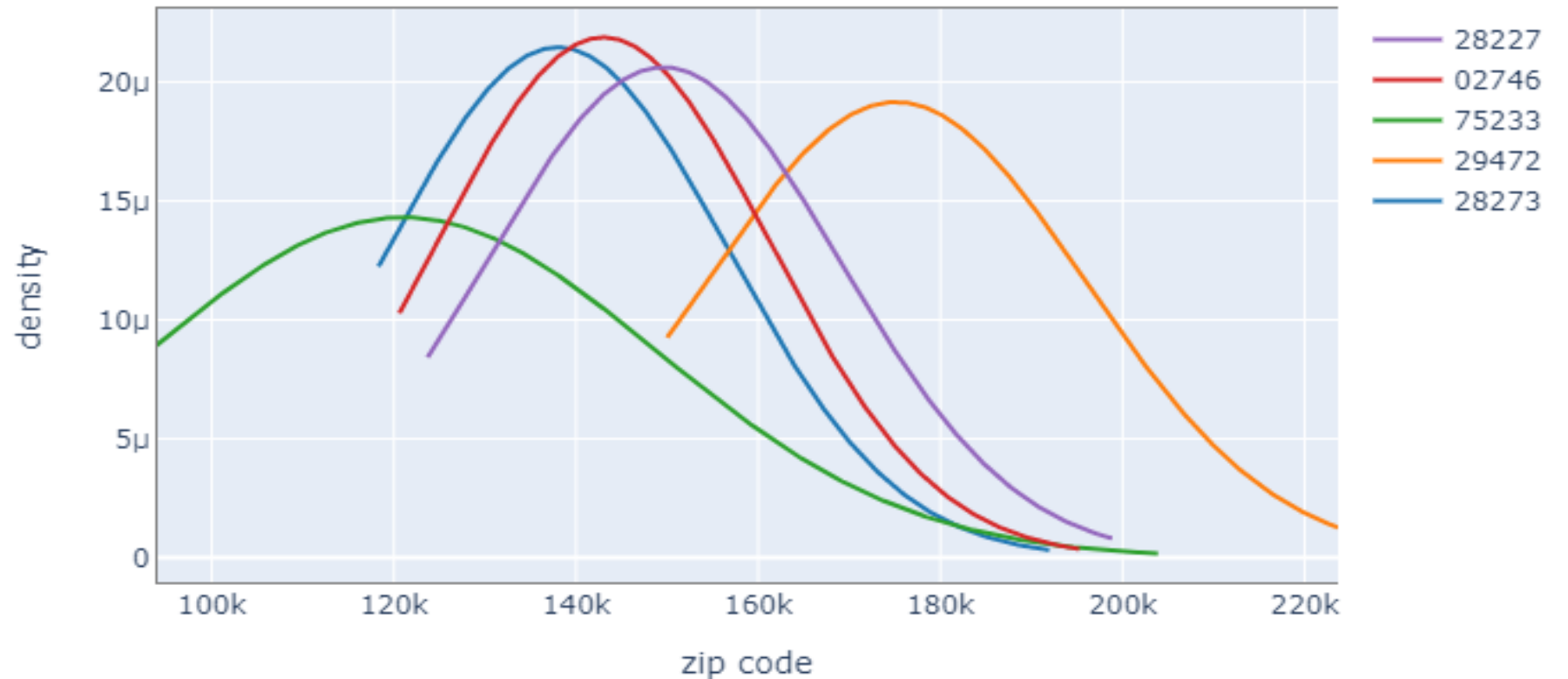


# EXAMINE DATA II

## Data Distribution

- » Home values are normally distributed
- » Normality in data is crucial to the model

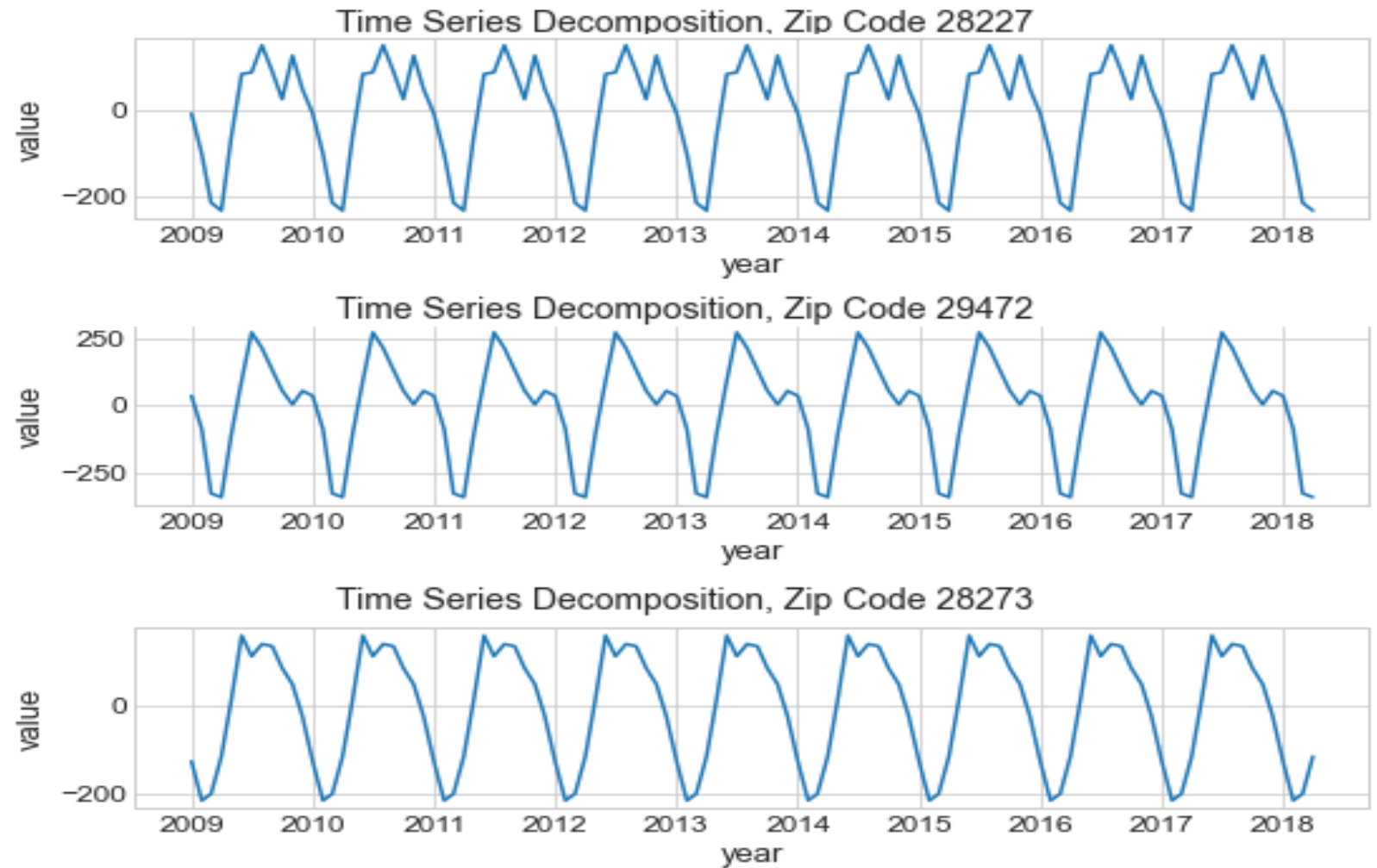
Home Values Data Distribution by Zip Code



# EXAMINE DATA III

## Seasonality

- » Samples of zip codes seasonality
- » Data don't have significant cyclical patterns





# ARIMA TIME SERIES MODEL

## Optimization

- » Define a range for the ARIMA model parameters
- » Calculate all possible combinations
- » Fit models with combinations

## Selection

Select a model with the lowest Akaike's Information Criterion

# MODEL FORECAST HOME VALUE

Mint Hill, NC

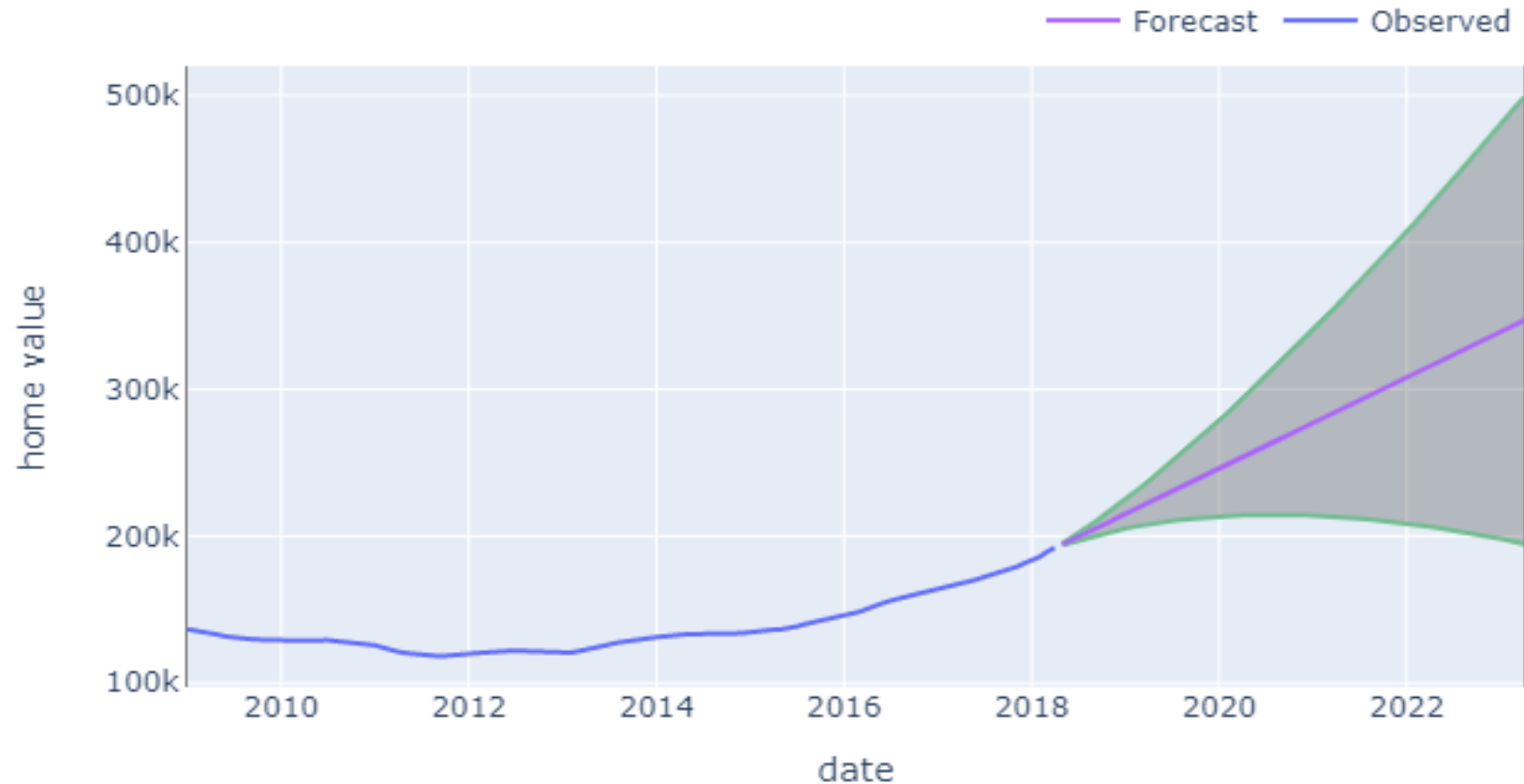
Forecast values  
on 2023-04

- » Avg: 347K
- » Max: 499K
- » Min: 195K

Purchase price  
on 2018-04

- » 192K

28227 Five Years Forecast



# MODEL FORECAST HOME VALUE

Ridgeville, SC

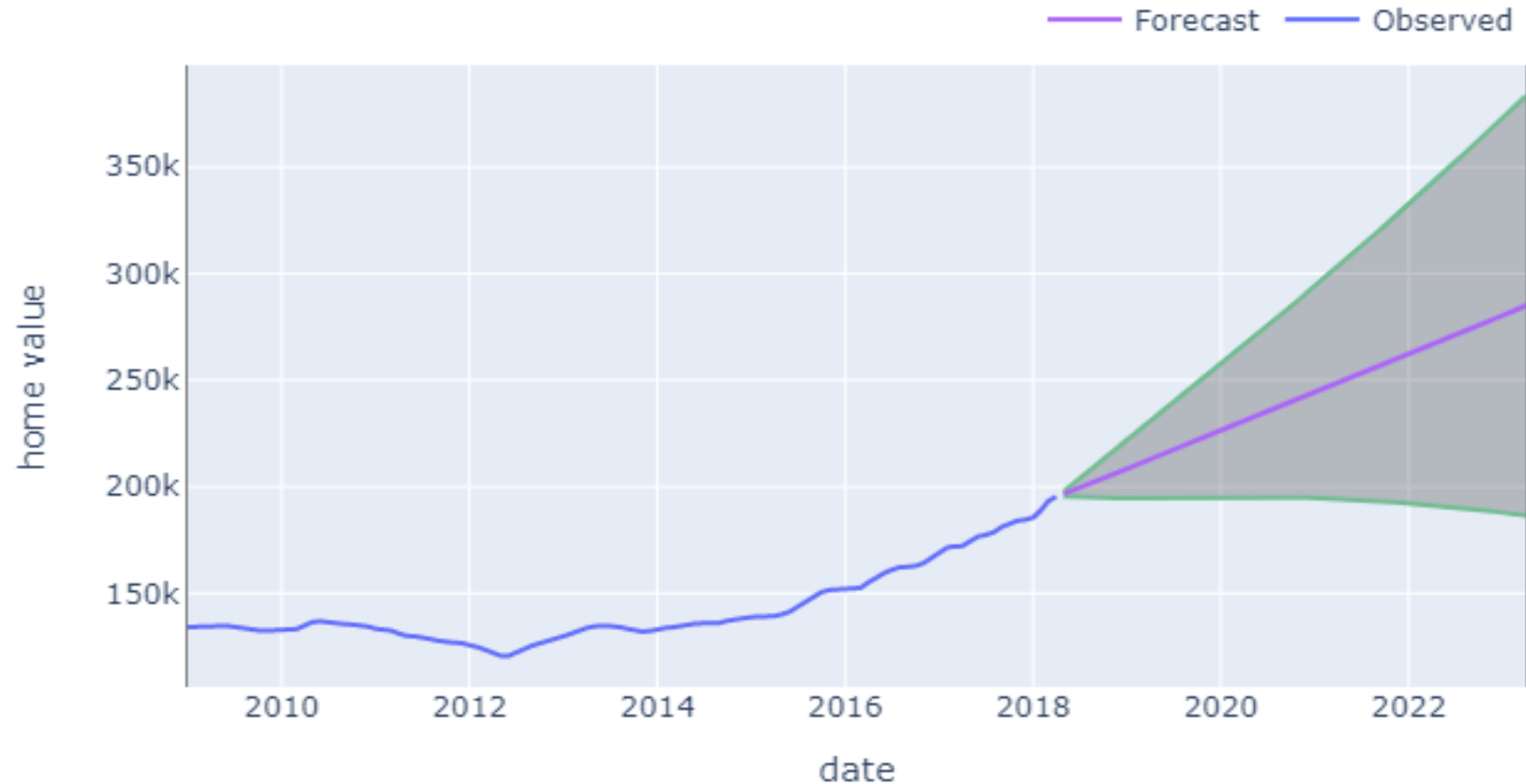
Forecast values  
at 2023-04

- » Avg: 285K
- » Max: 383K
- » Min: 186K

Purchase price  
on 2018-04

- » 195K

29472 Five Years Forecast



# MODEL FORECAST HOME VALUE

Charlotte, NC

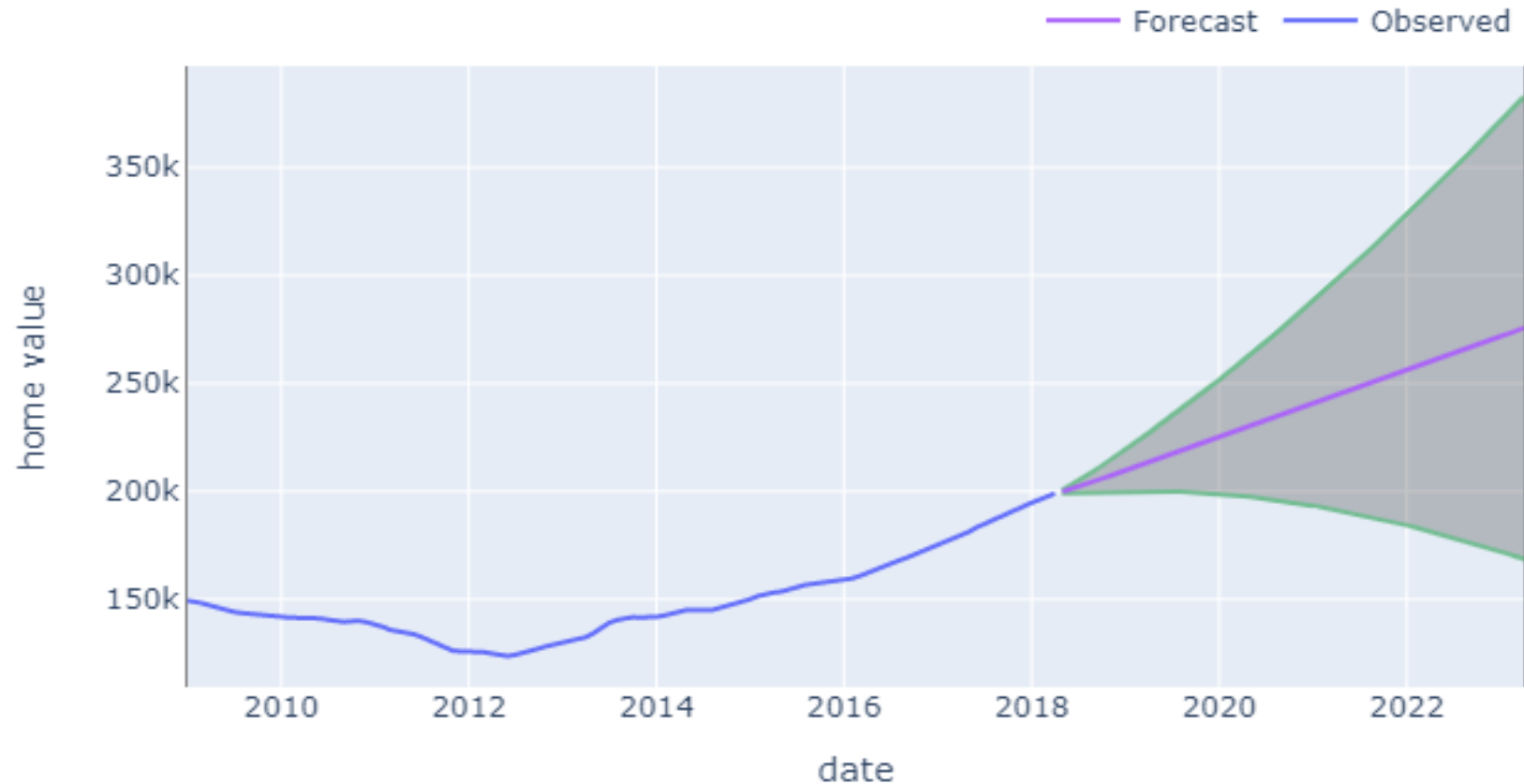
Forecast values  
at 2023-04

- » Avg: 276K
- » Max: 383K
- » Min: 167K

Purchase price  
on 2018-04

- » 199K

28273 Five Years Forecast



# MODEL FORECAST HOME VALUE

Dallas, TX

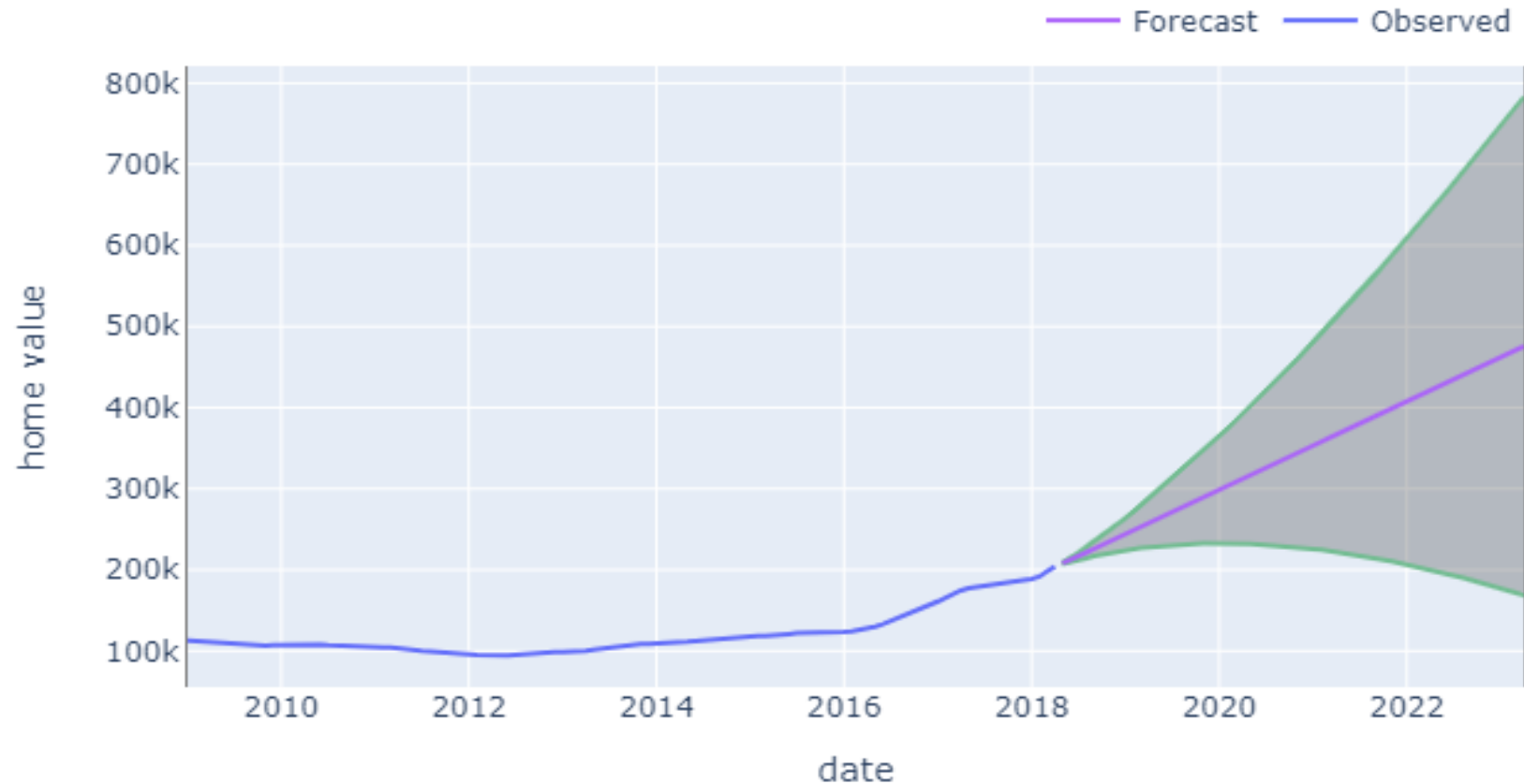
Forecast values  
at 2023-04

- » Avg: 476K
- » Max: 783K
- » Min: 169K

Purchase price  
on 2018-04

- » 204K

75233 Five Years Forecast



# MODEL FORECAST HOME VALUE

New Bedford,  
MA

Forecast values  
at 2023-04

» Avg: 297K

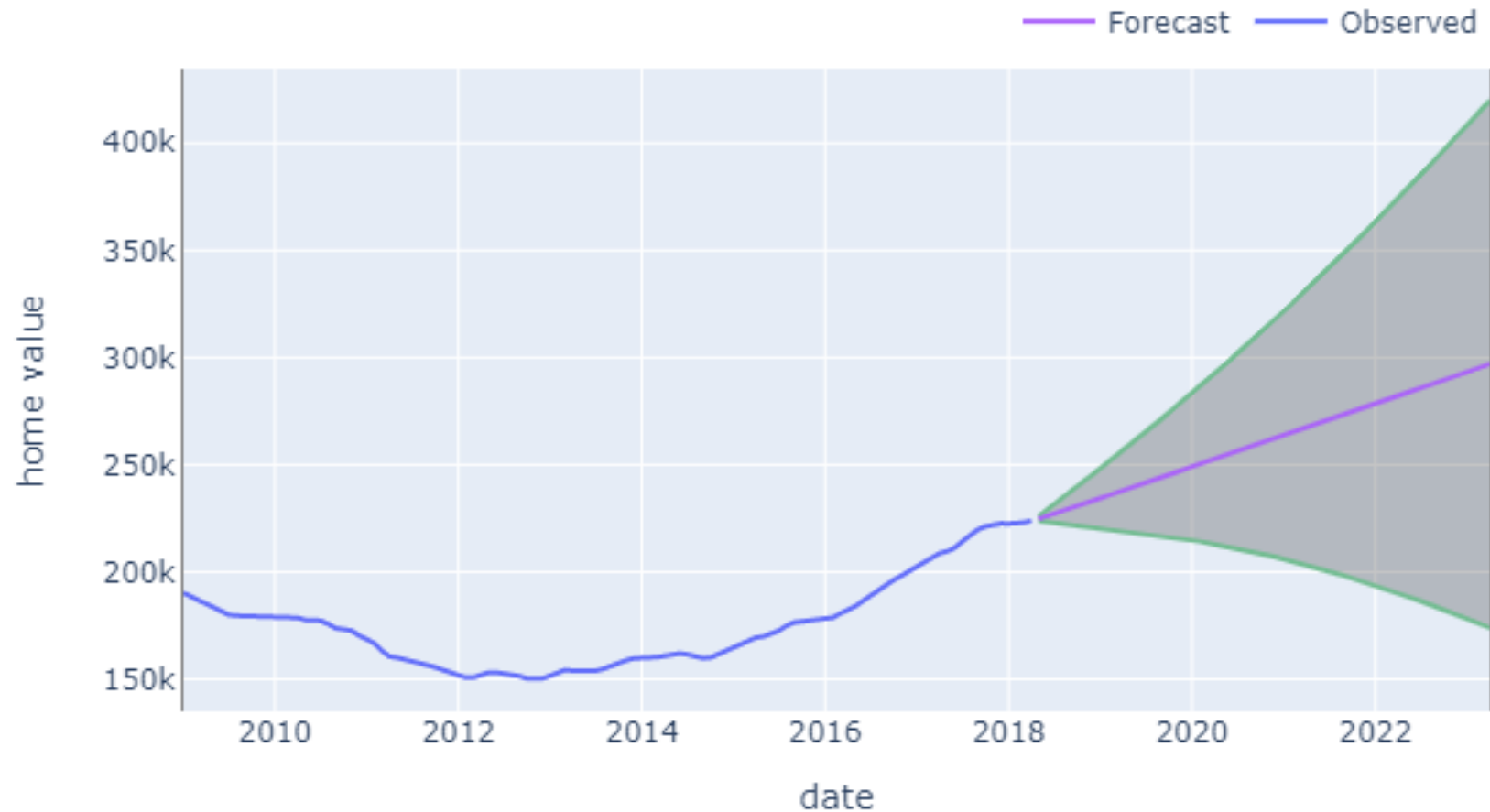
» Max: 419K

» Min: 174K

Purchase price  
on 2018-04

» 224K

02746 Five Years Forecast

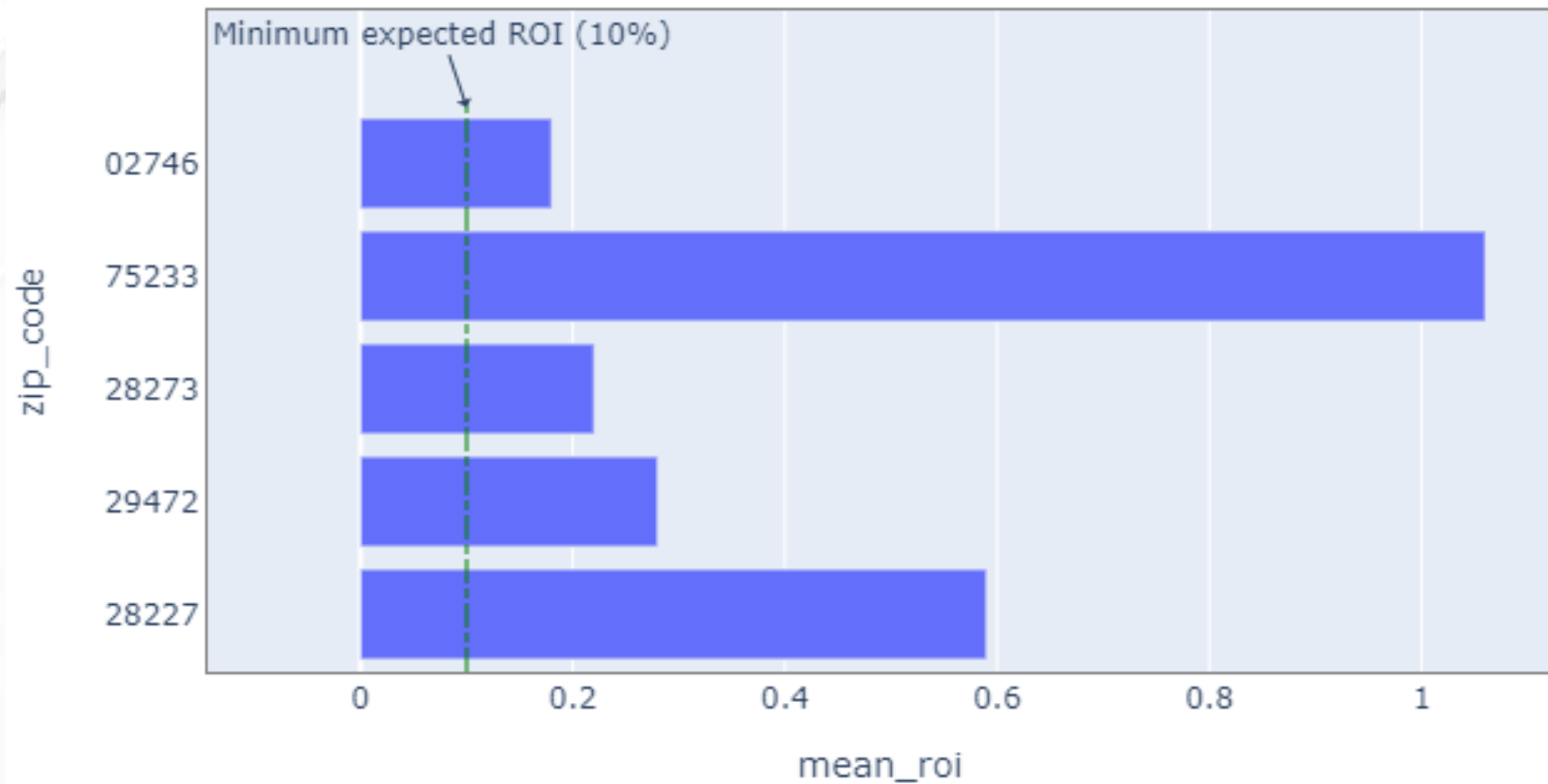


# MODEL FORECAST ROI

## ROI by Zip Codes

All five zip codes exceed the minimum ROI requirement

Mean ROI Forecast by Model

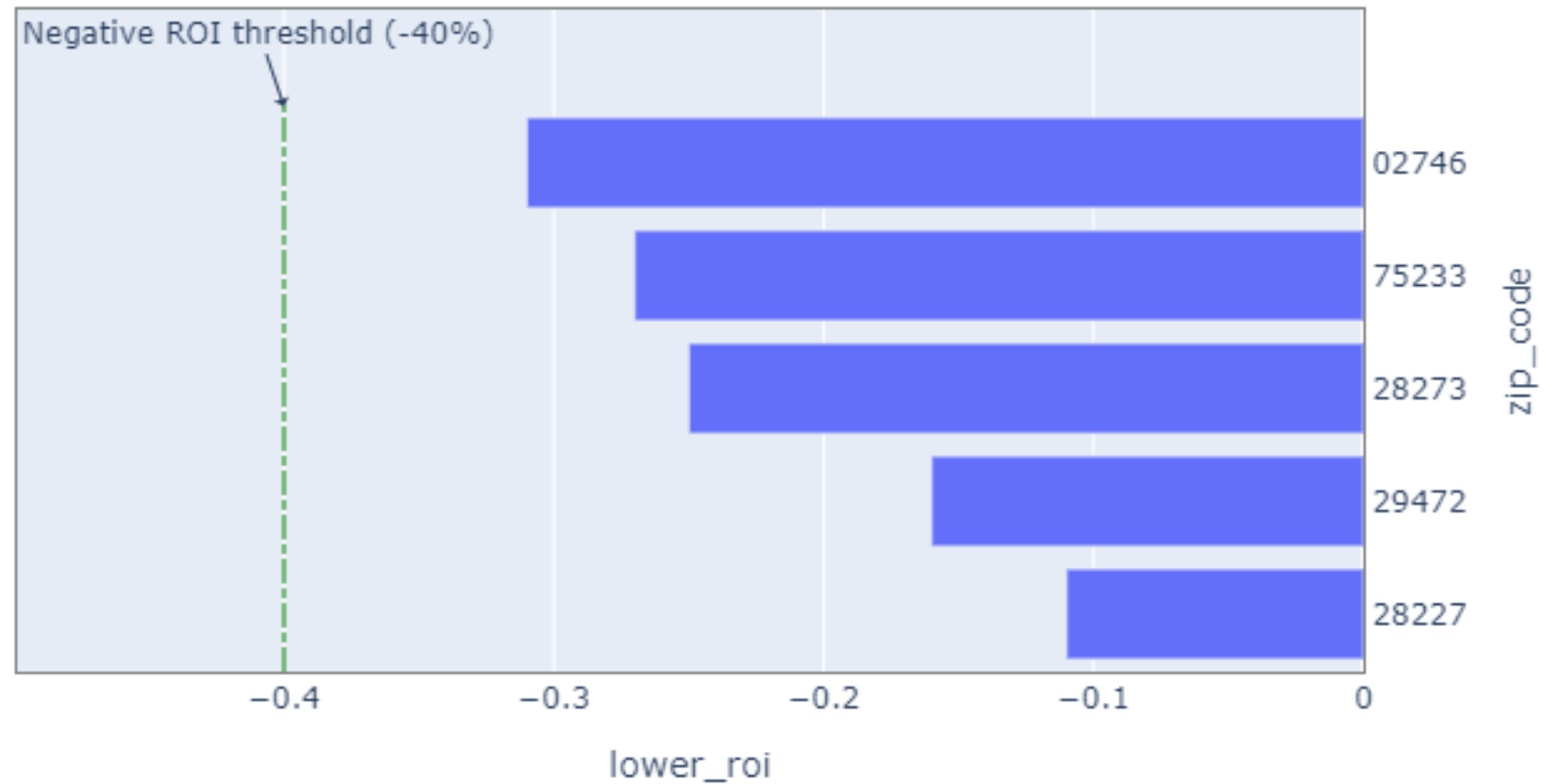


# MODEL FORECAST LOWEST ROI

## Lowest ROI by Zip Codes

All five zip codes are within the minimum ROI requirement

Negative ROI Forecast by Model





# CONCLUSION

## Investment Strategies Recap

- » ROI > 10%
- » PTR > 11 < 25
- » COC > 8%
- » RISD between 30<sup>th</sup> and 60<sup>th</sup> quantile
- » Forecast ROI > 10%
- » Forecast Lowest ROI < -40%

## Recommendations

Following zip codes have the highest forecast ROI and lowest ROI

- » 75233, Dallas, TX
- » 28227, Mint Hill, NC
- » 29472, Ridgeville, SC
- » 28273, Charlotte, NC
- » 02746, New Bedford, MA

# FUTURE WORK

Without Data Filter	Parameterize Investment criteria	Different Forecast Method
Fit the model without subset the data based on requirements	Parameterize investment requirements to generate data set on-the-fly	Deploy Facebook Prophet time series forecasting

# CHANGE THINGS

AT FLATIRON SCHOOL YOU LEARN HOW THE FUTURE IS BEING BUILT, SO YOU CAN CHANGE ANYTHING, STARTING WITH A NEW CAREER IN CODE, DATA SCIENCE, OR CYBERSECURITY.

## Thank You

Collin Loo 

collinloo@yahoo.com 

[Flatiron School](#) 

KODE WITH  
KLÖSSY

BIRCHBOX♦

citi



NYC

GitHub



OUT  
IN TECH

SeatGeek

WOMEN WHO  
CODE



# APPENDIX

ROI	Price-to-Rent	Cash-on-Cash
$\frac{(sp - (cc(pp) + gr + pp))}{(cc(pp) + gr + pp)}$ <ul style="list-style-type: none"> <li>sp=sale price after 5 yrs</li> <li>cc=closing cost percentage, 0.035</li> <li>pp=purchase price</li> <li>gr=general repair, 20k</li> </ul>	$sp / 12(zori)$ <ul style="list-style-type: none"> <li>sp=sale price after 5 yrs</li> <li>zori=zillow rental index</li> </ul> <div>Rental Standard Deviation</div> $numpy.std(zori)$ <p>zori=zillow rental index</p>	$\frac{12(zori) - (mp+ins+va)}{(dp + cc)}$ <ul style="list-style-type: none"> <li>zori=zillow rental index</li> <li>mp=mortgage payment, loan x ((Int rate/12) x (1+Int rate/12))sq(Mort. Term) / (1+Int rate/12))sq(Mort.Term)-1)</li> <li>loan=80% of purchase price</li> <li>int rate = 2.5%</li> <li>mort. term = 360</li> <li>ins=(purchase price/100K)(40)</li> <li>va=vacancy allowance, zori(10%)</li> <li>dp=down payment, 20%(purchase price)</li> </ul>