Mod 4 project Executive Summary

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Assignment

- What are the top 5 best zip codes to invest in?
  - Use forecasted data (i.e. not data from the original data set) for your recommendations

- Define “Best”
  - Lowest risk investment ➔ which zip codes are the safest investment where I have the least chance of losing my money?

- Ada County (Boise), Idaho selected as best county in the country to invest for the lowest risk, 2-year investment*
  - Fueled by low mortgage rates and high demand/low supply

*https://www.noradarealestate.com/blog/boise-real-estate/

Why Boise, ID?


HOUSING MARKET OVERVIEW
BOISE, IDAHO
(YEAR-OVER-YEAR FIGURES - SEP 2020)
+18.8%
PRICE
(BOISE CITY)
+17.2%
PRICE
(ADA COUNTY)
BOISE
USA
-18.2%
SALES
(BOISE CITY)
2021 Price Forecast ↑ 8-10%
+27.5%
SALES
(ADA COUNTY)
Norada
REAL ESTATE INVESTMENTS

OSEMN process overview

Obtain

Scrub

Explore

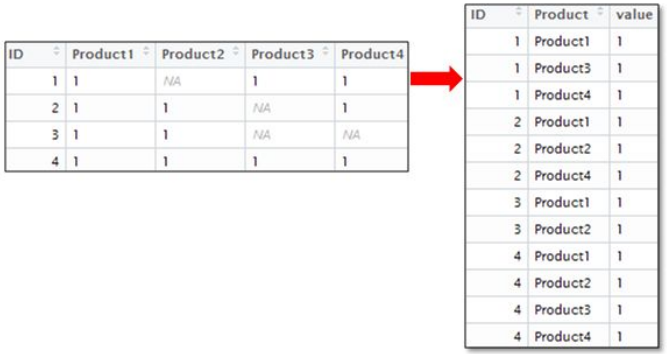
Model

iNterpret

Obtain/Scrub

- Zillow data overview
  - 14,723 zip codes with 265 months of data from 1996-04 to 2018-04 ➔ **sampled monthly**
  - Wide format
- Pre-processing steps
  - Drop unnecessary columns ➔ anything but County == ‘Ada’
  - Convert from Wide to Long format for visualization and modeling
  - Cut data from before 2013 ➔ only need data from +2-years ago (from 2018) to make forecasts 2-years into future (to 2020)

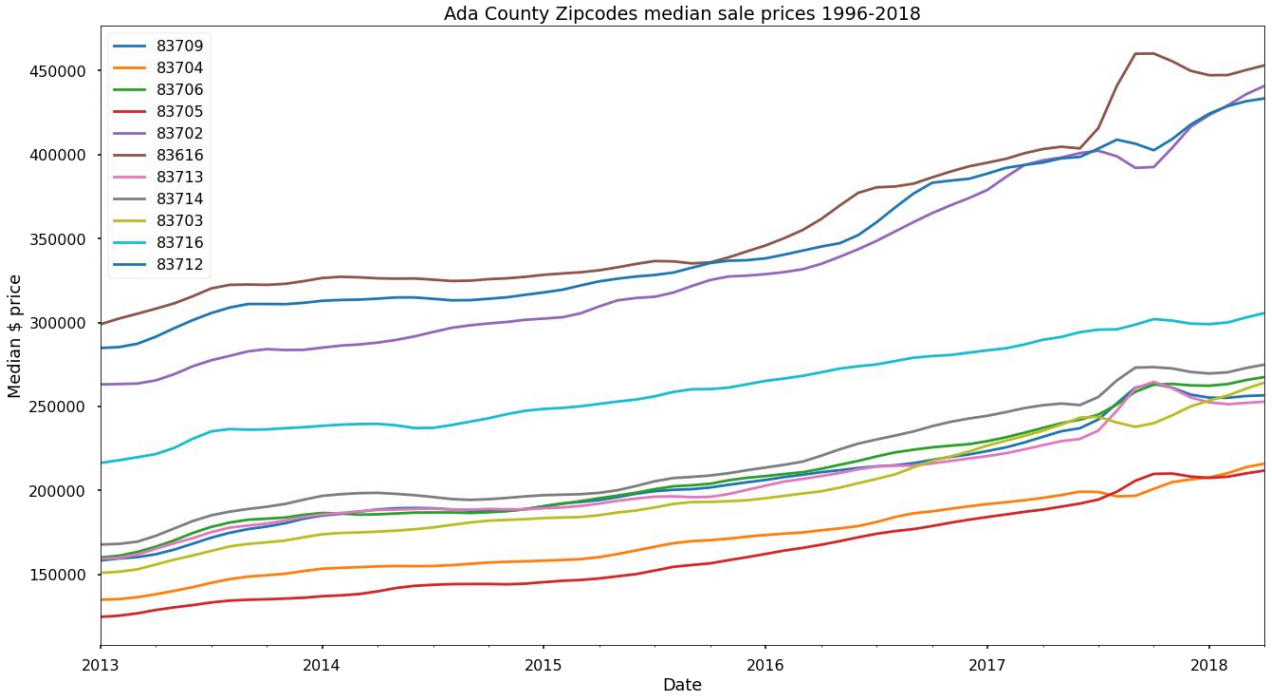
Wide-to-Long format



ID	Product1	Product2	Product3	Product4
1	1	NA	1	1
2	1	1	NA	1
3	1	1	NA	NA
4	1	1	1	1

ID	Product	value
1	Product1	1
1	Product3	1
1	Product4	1
2	Product1	1
2	Product2	1
2	Product4	1
3	Product1	1
3	Product2	1
4	Product1	1
4	Product2	1
4	Product3	1
4	Product4	1

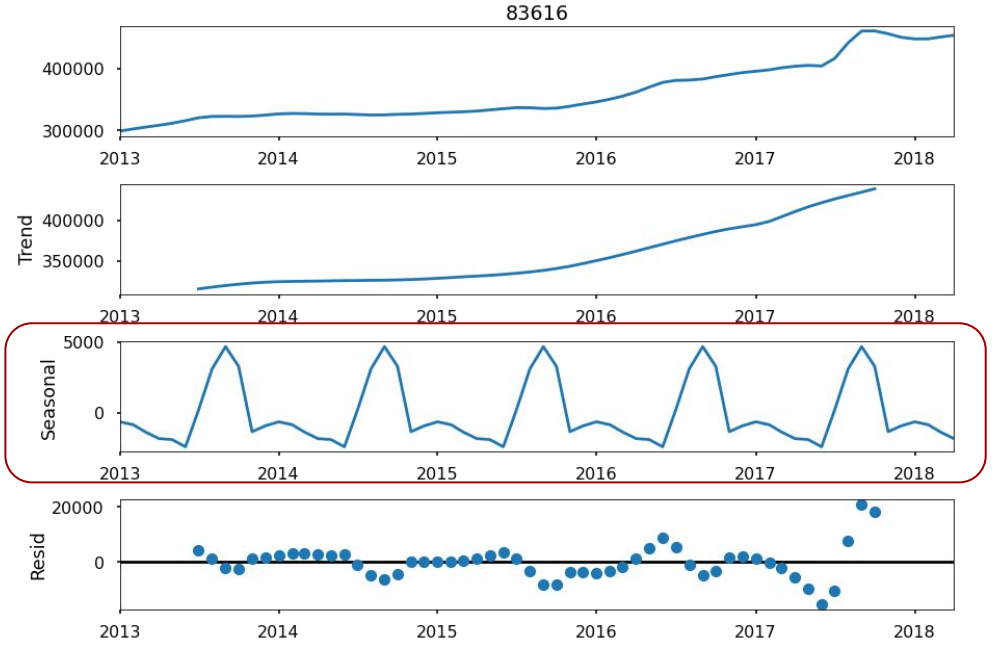
Explore - Non-stationary analysis



Strong positive trend in all zip codes

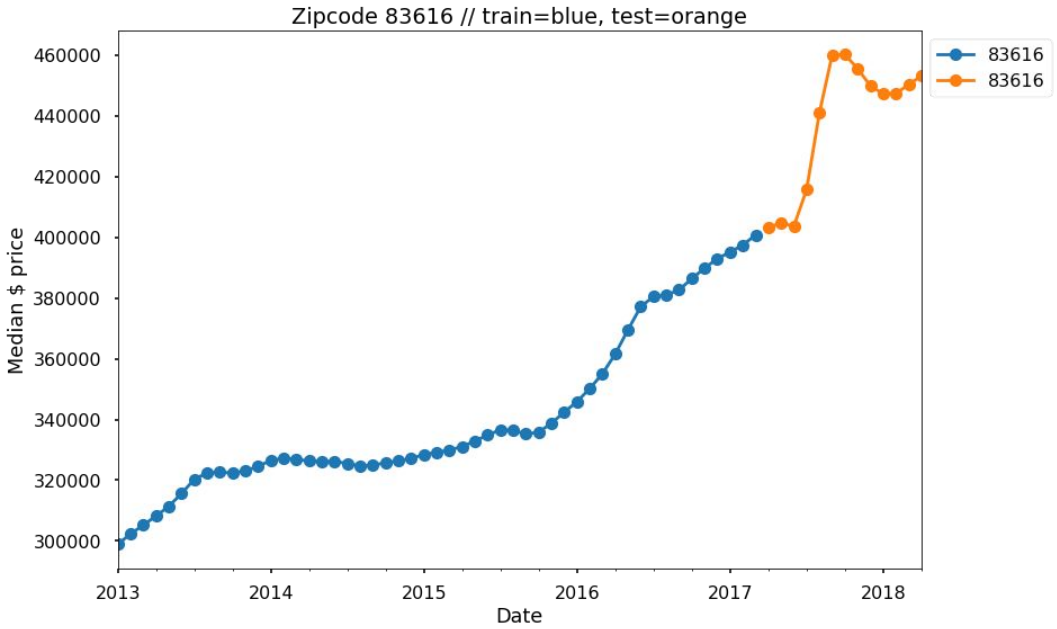
Explore - Non-stationary analysis (cont.)

- Seasonal_decompose library from statsmodels
- Explore one zip code (83616)
- Positive trend confirmed, Seasonal component uncovered (**~$5K increase in median price during summer months!**)
- Use **auto_arima** for parameter selection to determine best way to deal with non-stationary features



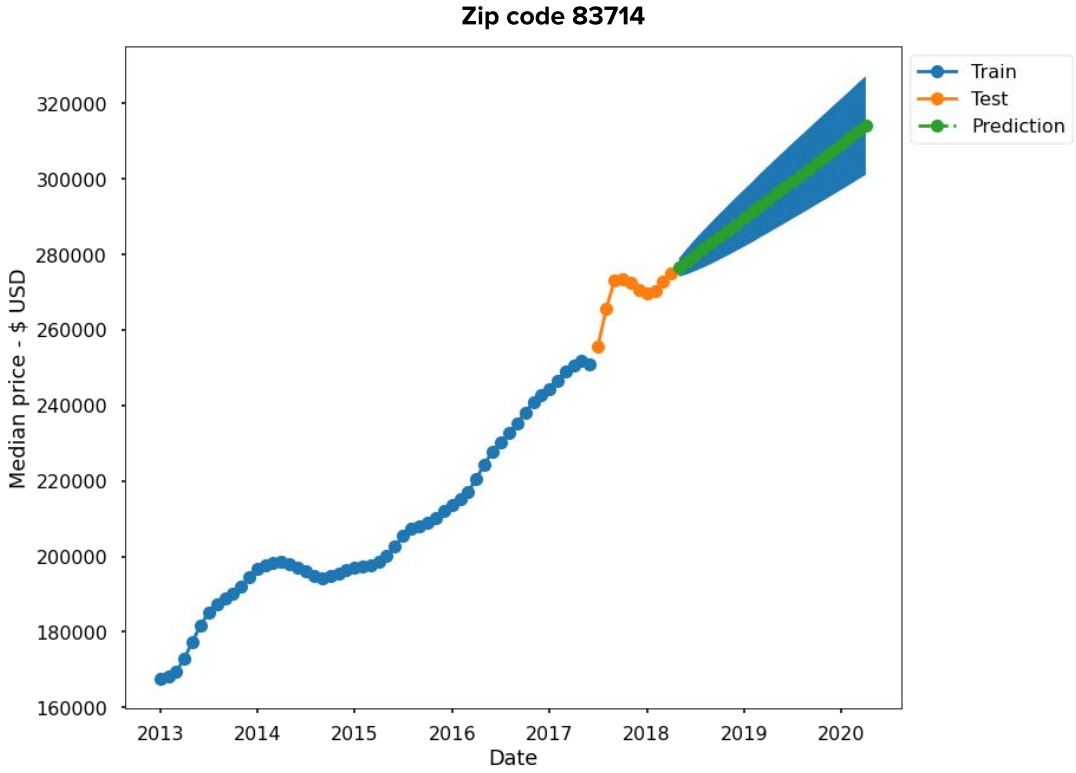
Model - Importance of Train/Test split

- Visualize train/test split with time series
- Models and forecasts are very sensitive to where the split occurs
- Balance between goodness-of-fit and overfitting can change drastically by adjusting train/test split



Model - auto_arima and SARIMAX

- auto_arima for model and parameter selection



iNterpret

- Model with SARIMAX using parameters selected by auto_arima
- Use **lowest relative** Akaike Information Criteria (AIC) to gauge model performance (assess goodness-of-fit)

ZIPCODE: 83705

SARIMAX Results

Dep. Variable:	83705	**No. Observations:**	48
Model:	SARIMAX(0, 2, 2)	**Log Likelihood**	-343.421
Date:	Sun, 20 Dec 2020	**AIC**	692.843
Time:	23:56:18	**BIC**	698.328
Sample:	01-01-2013	**HQIC**	694.898
	- 12-01-2016		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ma.L1	-0.0444	0.085	-0.525	0.600	-0.210	0.121
ma.L2	-0.0441	0.083	-0.533	0.594	-0.206	0.118
sigma2	1.763e+05	4.77e+04	3.695	0.000	8.28e+04	2.7e+05

Ljung-Box (L1) (Q):	1.67	**Jarque-Bera (JB):**	0.24
Prob(Q):	0.20	**Prob(JB):**	0.89
Heteroskedasticity (H):	0.84	**Skew:**	-0.00
Prob(H) (two-sided):	0.75	**Kurtosis:**	2.65

ZIPCODE: 83702

SARIMAX Results

Dep. Variable:	83702	**No. Observations:**	48
Model:	SARIMAX(0, 2, 0)	**Log Likelihood**	-382.589
Date:	Sun, 20 Dec 2020	**AIC**	767.178
Time:	23:56:19	**BIC**	769.006
Sample:	01-01-2013	**HQIC**	767.863
	- 12-01-2016		
Covariance Type:	opg		

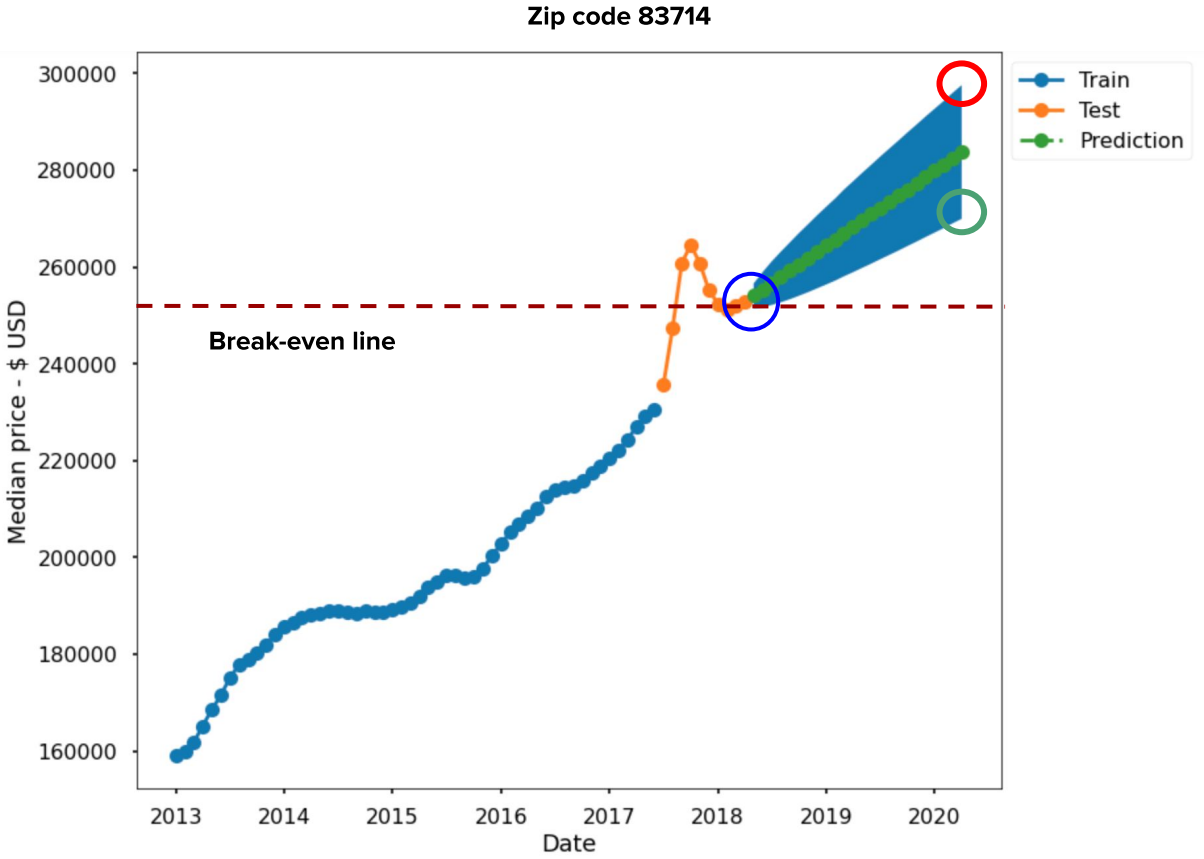
	coef	std err	z	P>|z|	[0.025	0.975]
sigma2	9.795e+05	2.37e+05	4.127	0.000	5.14e+05	1.44e+06

Ljung-Box (L1) (Q):	8.24	**Jarque-Bera (JB):**	0.64
Prob(Q):	0.00	**Prob(JB):**	0.73
Heteroskedasticity (H):	0.60	**Skew:**	-0.17
Prob(H) (two-sided):	0.33	**Kurtosis:**	2.53

Zip code 83705 has a lower AIC [692.843] compared to 83702 [767.178]

iNterpret (cont.)

- **Visualize confidence intervals** to determine risk of losing money
- If confidence interval drops below current value, negative ROI is more likely
- Calculate highest and lowest ROI potential by subtracting the last known **median price** [2018-04-01] from the **upper** and **lower** confidence interval on price [2020-04-01]



Recommendations

- The top five lowest risk zip codes to invest in based off 2-year forecasts are:

Zipcode	Investment price	Mean ROI	High ROI	Low ROI	% ROI	% High	% Low
83702	$ 441000	$ 561000	$ 874121	$ 247879	27.21	98.21	-43.79
83705	$ 211800	$ 252170	$ 361442	$ 142899	19.06	70.65	-32.53
83703	$ 264200	$ 350600	$ 507763	$ 193437	32.7	92.19	-26.78
83616	$ 453200	$ 453200	$ 502013	$ 404387	0	10.77	-10.77
83709	$ 256600	$ 256600	$ 280831	$ 232369	0	9.44	-9.44
83712	$ 433500	$ 433500	$ 466340	$ 400660	0	7.58	-7.58
83704	$ 215900	$ 215900	$ 231685	$ 200115	0	7.31	-7.31
83716	$ 305600	$ 305600	$ 323706	$ 287494	0	5.92	-5.92
83706	$ 267500	$ 278187	$ 288254	$ 268120	4	7.76	0.23
83713	$ 252800	$ 283785	$ 297604	$ 269967	12.26	17.72	6.79
83714	$ 274900	$ 314179	$ 327259	$ 301098	14.29	19.05	9.53

Lowest probability of negative ROI

Future Work

- Dig deeper into auto_arima to see if there are better options for hyper parameter tuning to improve our models' fit.

- Get more recent data (the current data set only includes dates up to April 2018) to be able to forecast more accurately into the future.

- Research the Zillow “Zestimate” calculation

Thank you!

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