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https://github.com/drakulic/Capstone

REAL ESTATE ANALYSIS

SAN FRANCISCO

DISTRICTS 7, 8, AND 10

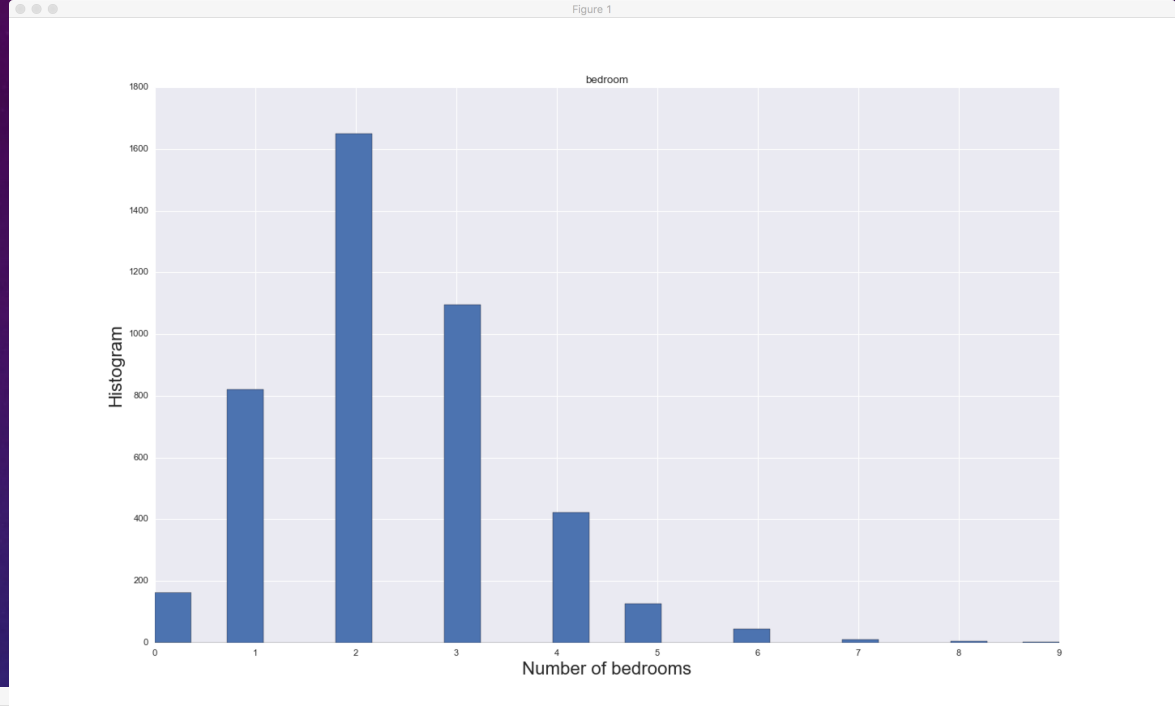
2013 NOVEMBER 12 – 2016 NOVEMBER 08

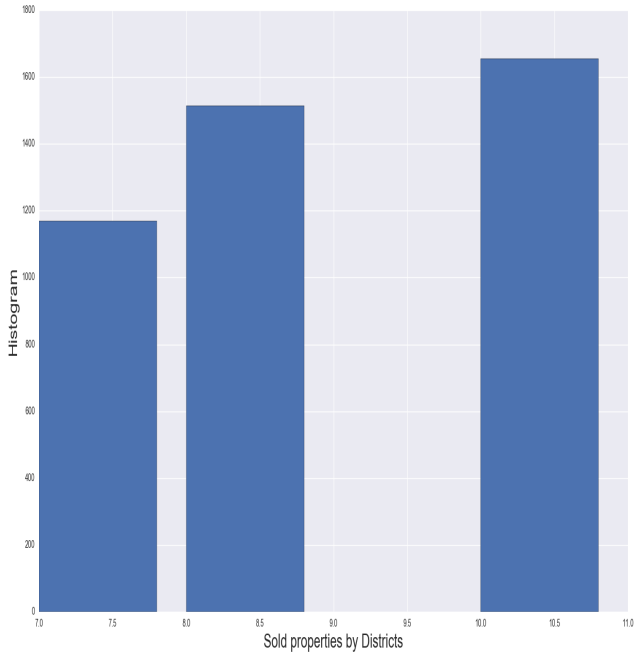
DISTRICTS 7, 8, AND 10

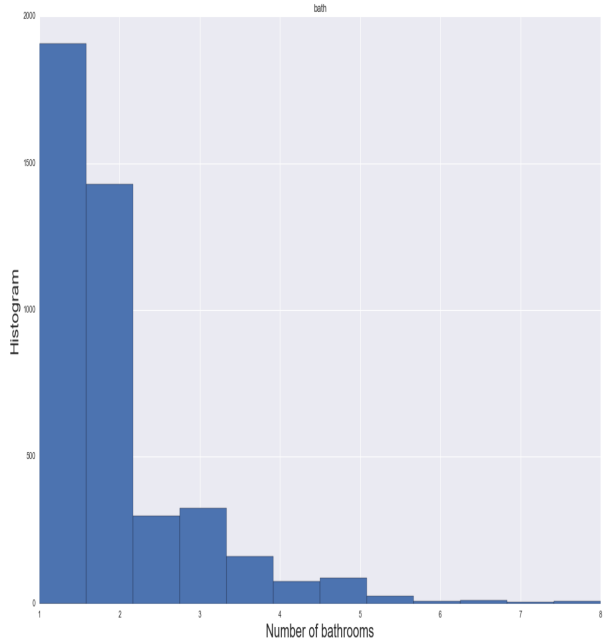
4339 DATA POINTS, 35 FEATURES

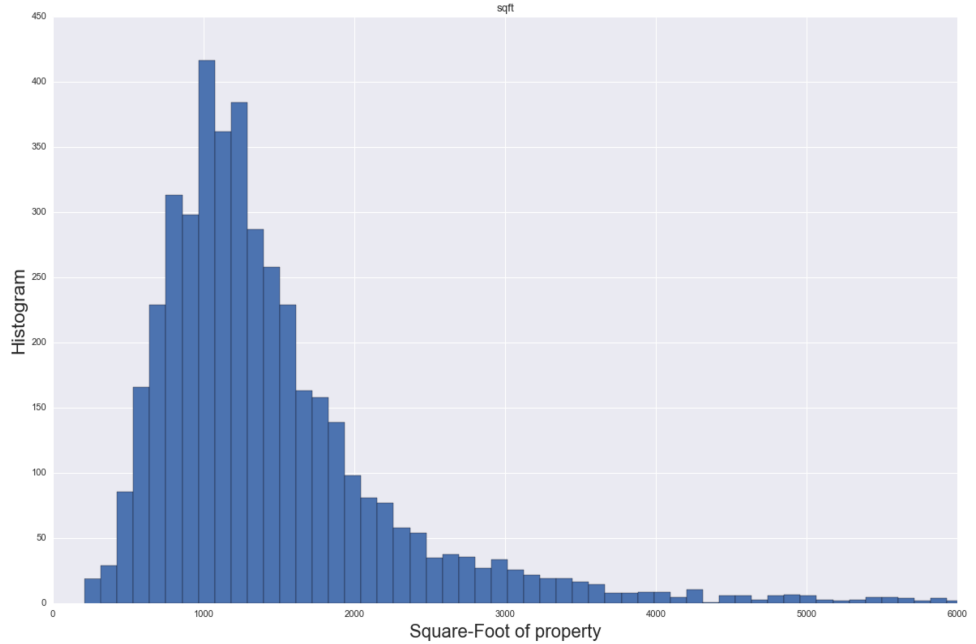
Bedroom
Bath
Parking
Sqft
home_own_ass
day_on_market
single_f_h
Condo
dist_no
sold_year
sold_month
Bayview Heights
Bayview
Candlestick Point
Cow Hollow
Crocker Amazon
Downtown
Excelsior
Financial District
Hunters Point
Little Hollywood
Marina
Mission Terrace
Nob Hill
North Beach
North Waterfront
Outer Mission
Pacific Heights
Portola
Presidio Heights
Russian Hill
Silver Terrace
Telegraph Hill
Van Ness/Civic Cente
Visitacion Valley

EXPLORATORY DATA ANALYSIS



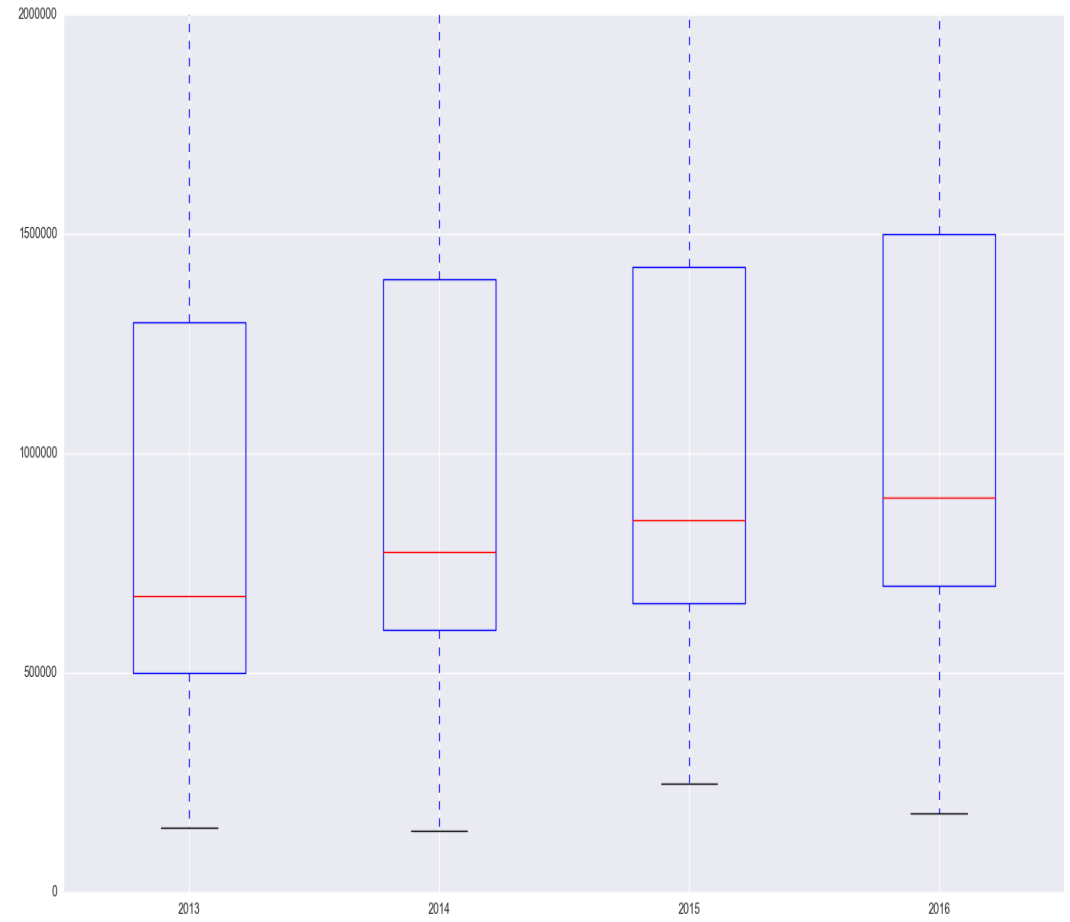




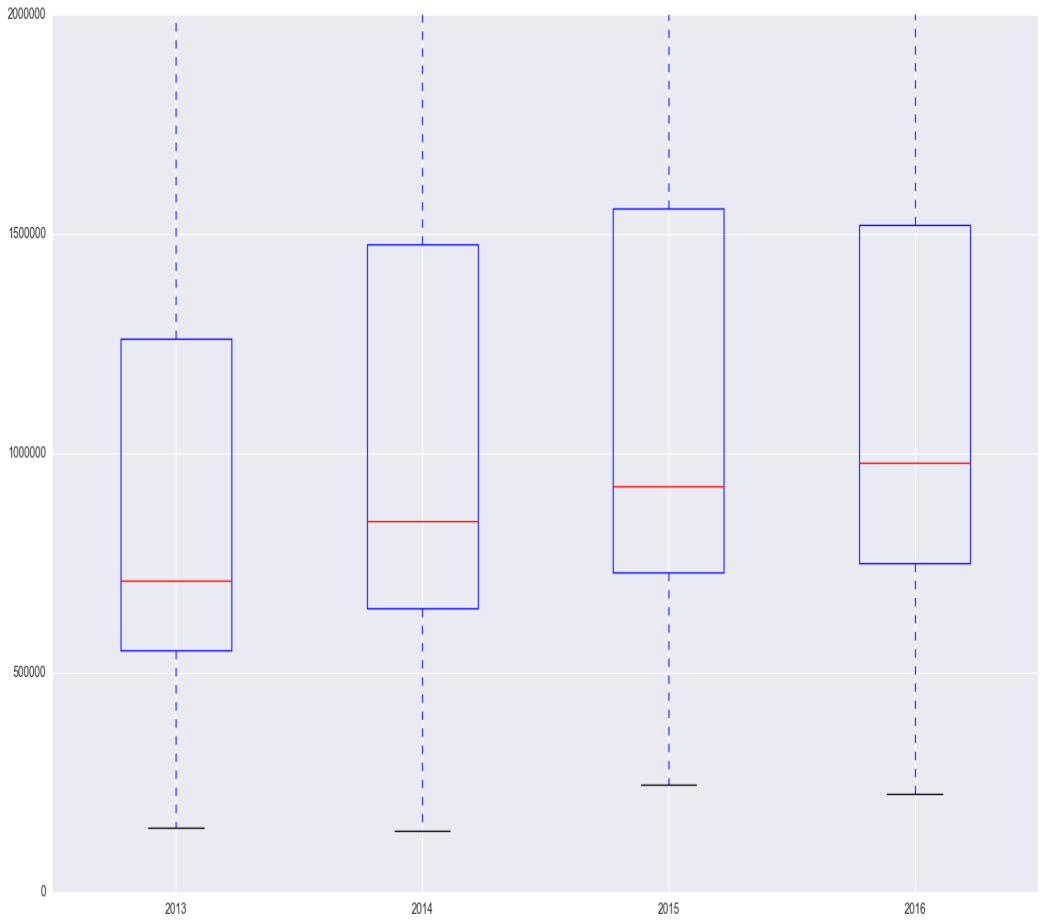


EXPLORATORY DATA ANALYSIS

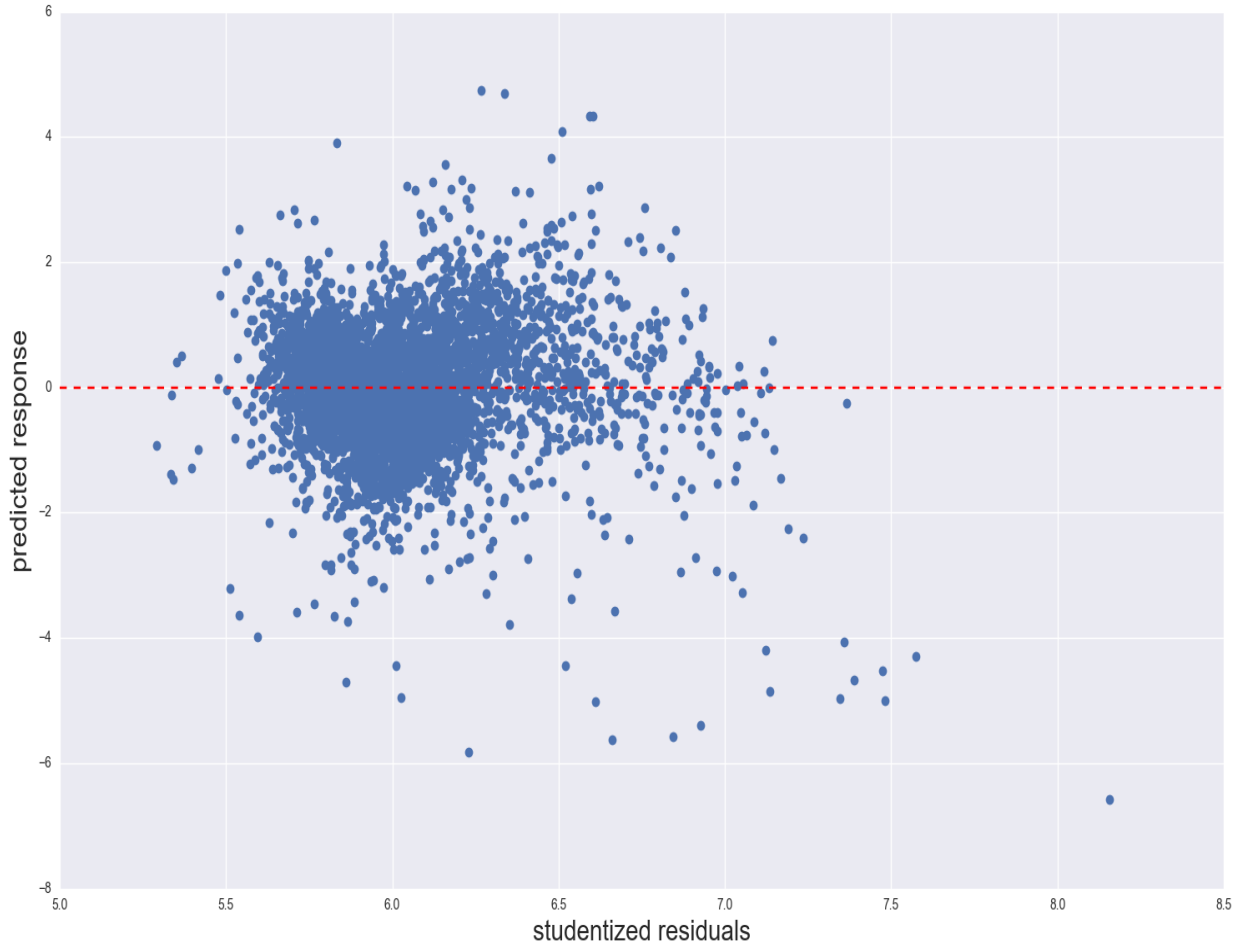
List price by year

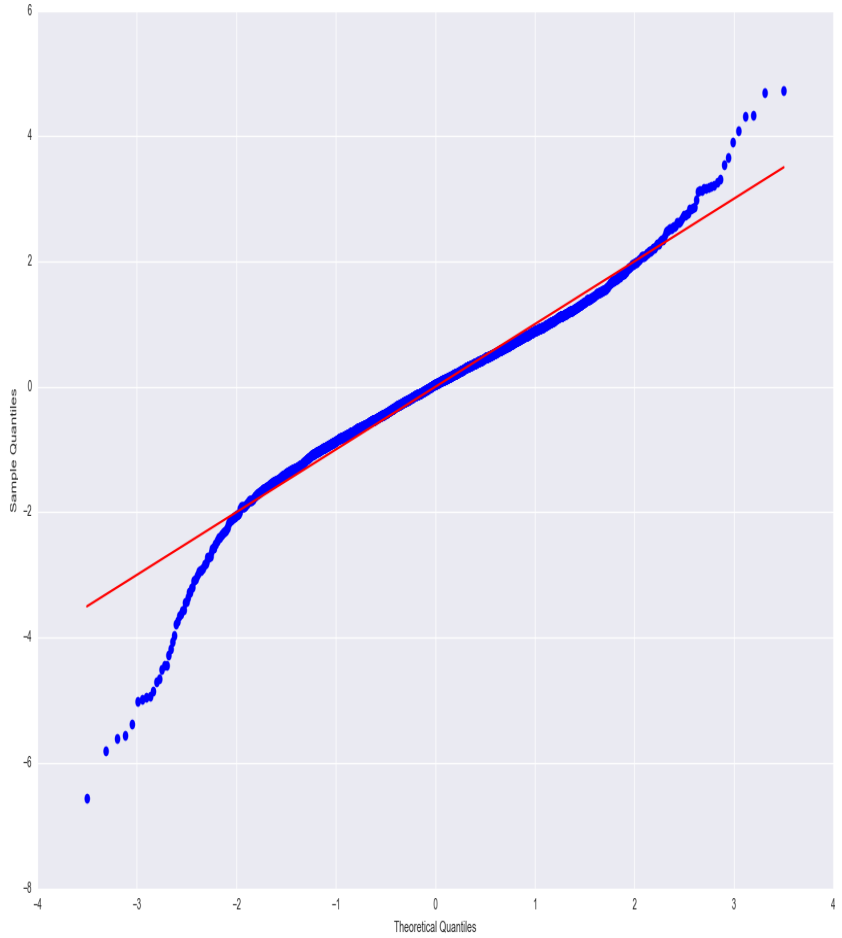


Sale price by year



EXPLORATORY DATA ANALYSIS





LINEAR REGRESSION WITH LIST PRICE

TRAIN VARIANCE SCORE: 0.98
TEST VARIANCE SCORE: 0.96
VALIDATION VARIANCE SCORE: 0.98

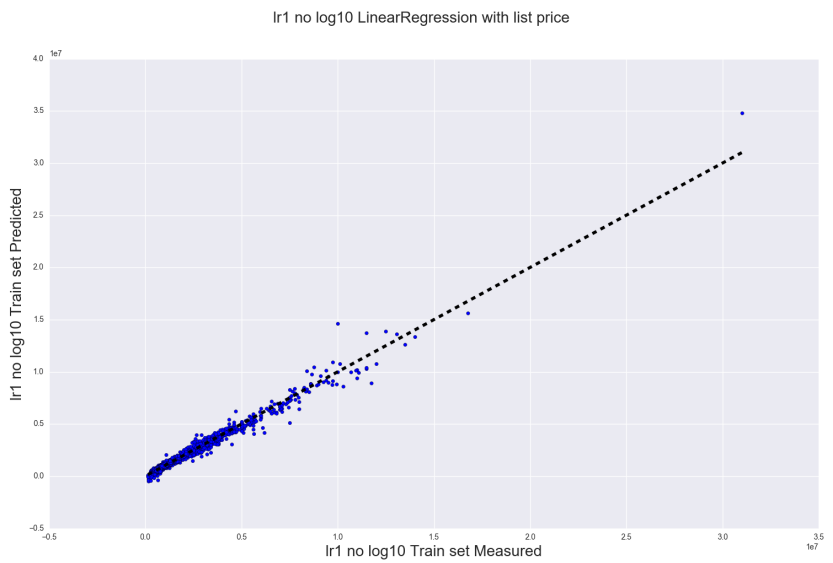
model with year month columns, no log10:

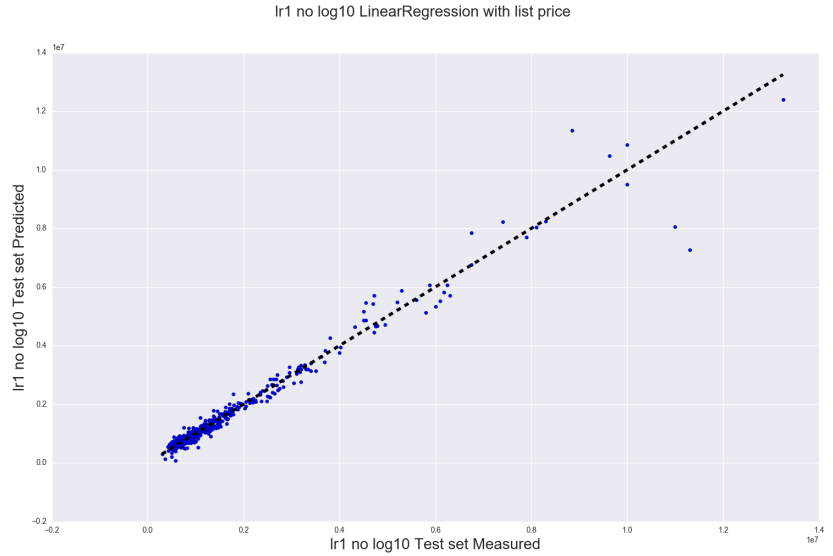
OLS Regression Results

==========

Dep. Variable:	sale_price	R-squared:	0.978
Model:	OLS	Adj. R-squared:	0.978
Method:	Least Squares	F-statistic:	5925.
Date:	Tue, 29 Nov 2016	Prob (F-statistic	0.00
Time:	12:25:23	Log-Likelihood	-59955.
No. Observations:	4339	AIC:	1.200e+05
Df Residuals:	4305	BIC:	1.202e+05
Df Model:	33		

Cross-Validated Predictions





LINEAR REGRESSION WITH LIST PRICE WITH LOG10 OF PRICES

TRAIN VARIANCE SCORE: 0.98
TEST VARIANCE SCORE: 0.96
VALIDATION VARIANCE SCORE: 0.98

model with log10 list price:

OLS Regression Results

==========

Dep. Variable:	np.log10(sale_price)	R-squared:	0.980
Model:	OLS	Adj. R-squared:	0.980
Method:	Least Squares	F-statistic:	6302.
Date:	Tue, 29 Nov 2016	Prob (F-statistic	0.00
Time:	12:25:23	Log-Likelihood	7569.7
No. Observations:	4339	AIC:	-1.507e+04
Df Residuals:	4305	BIC:	-1.485e+04
Df Model:	33		

Cross-Validated Predictions

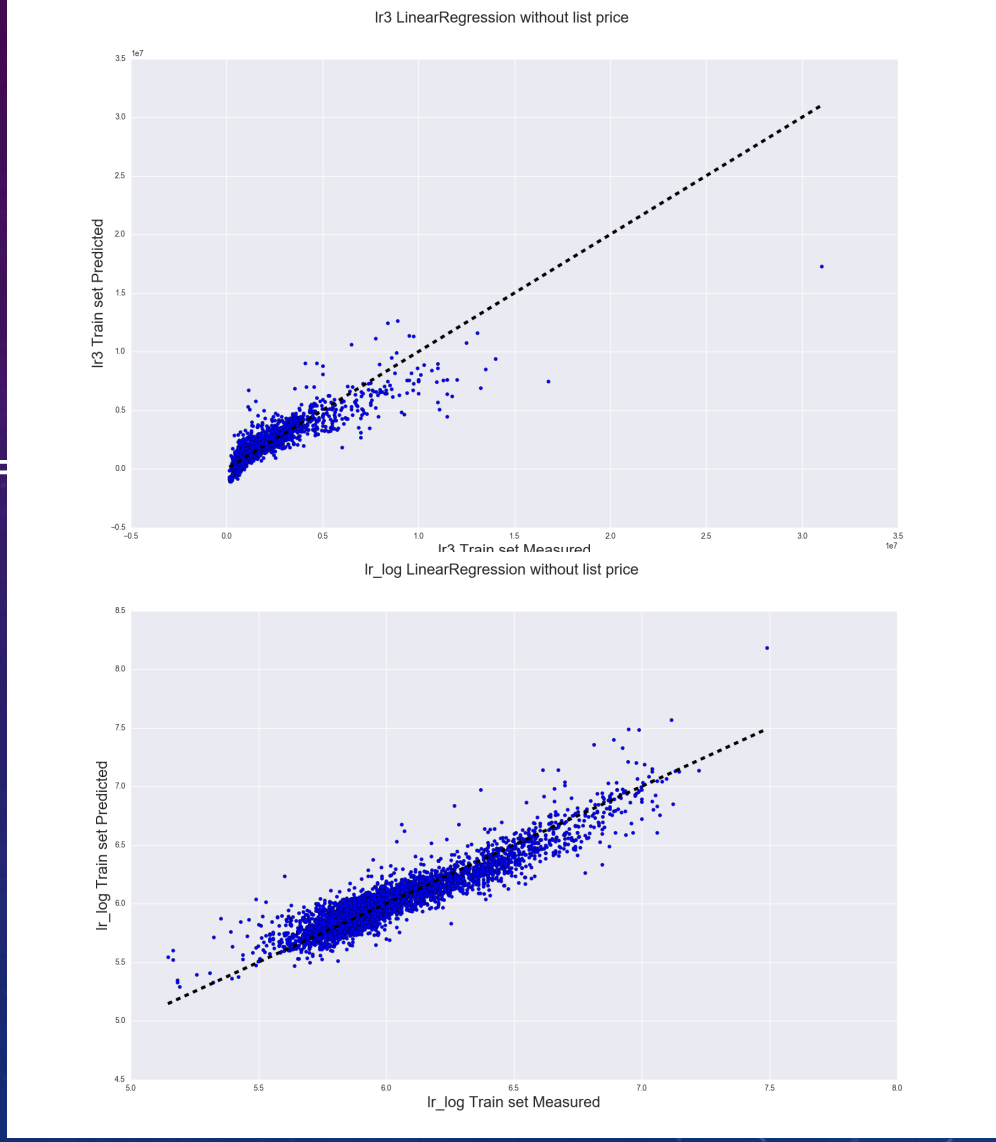
LINEAR REGRESSION WITHOUT LIST PRICE

model with log10 list price:

OLS Regression Results

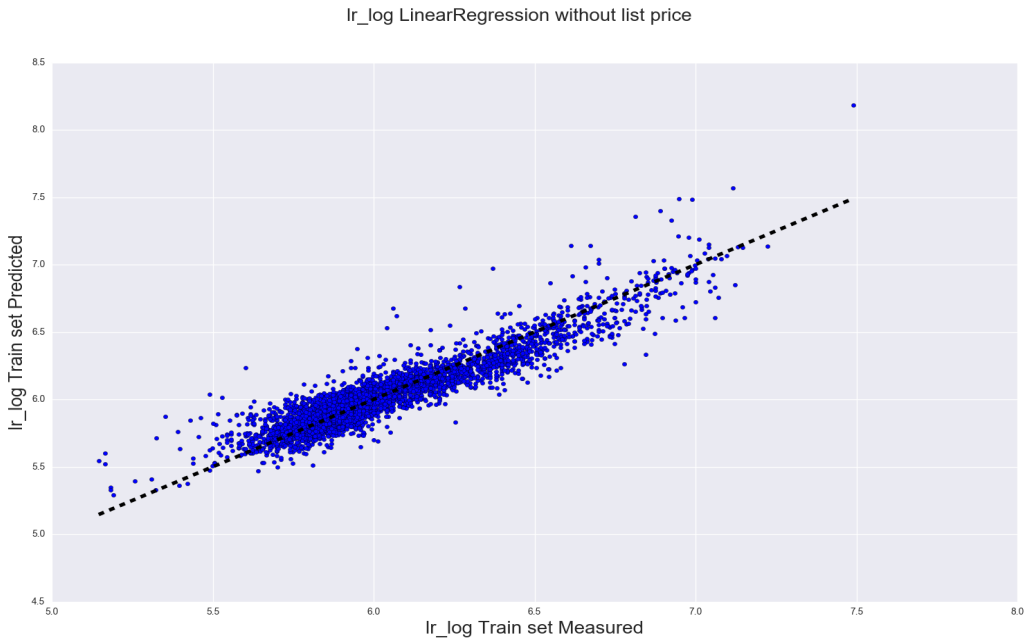
==========

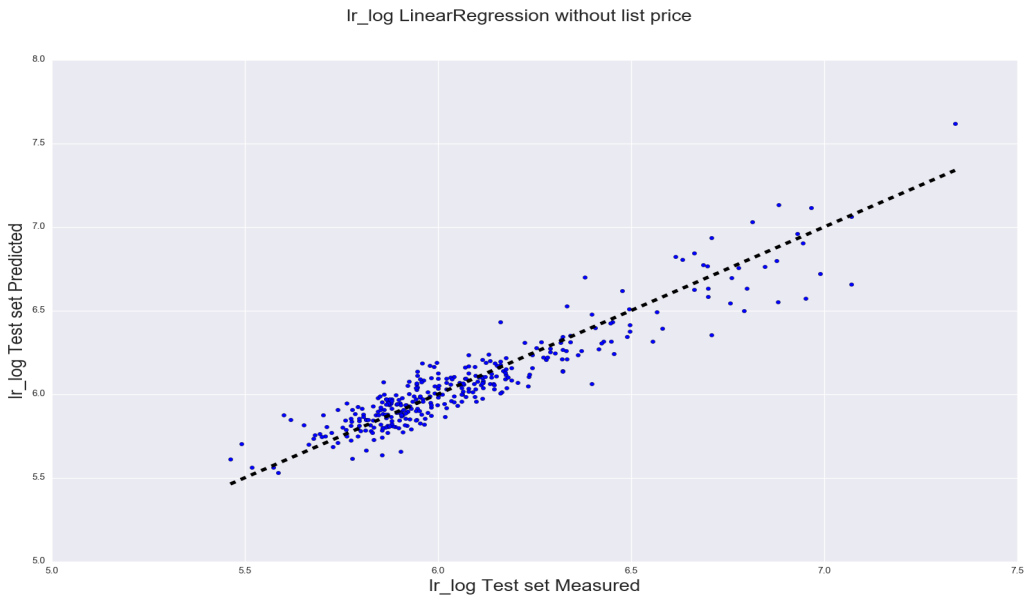
Dep. Variable:	np.log10(sale_price)	R-squared:	0.867
Model:	OLS	Adj. R-squared:	0.866
Method:	Least Squares	F-statistic:	880.6
Date:	Tue, 29 Nov 2016	Prob (F-statistic	0.00
Time:	12:25:23	Log-Likelihood	3496.9
No. Observations:	4339	AIC:	-6928.
Df Residuals:	4305	BIC:	-6717.
Df Model:	33		



Cross-Validated Predictions

LINEAR REGRESSION WITHOUT LIST PRICE, WITH LOG10 SALE PRICE



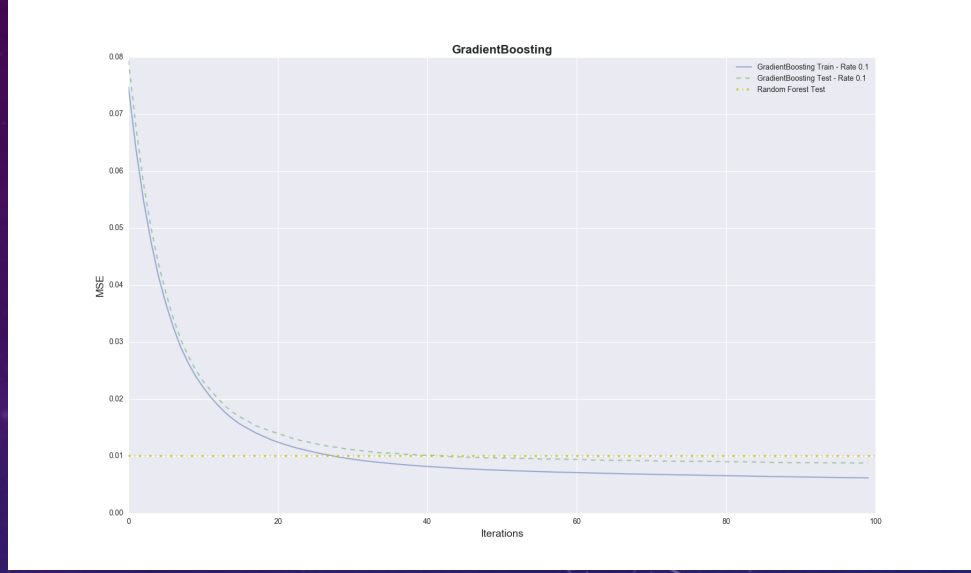


Date	Square-Foot	Sale-price	Predicted price
2016-08-16	1050	980,000	1,113,973.86
2016-08-16	1312	850,000	619,429.93
2016-08-16	700	917,500	1,207,900.75
2016-08-16	760	670,000	602,939.08
2016-08-16	4617	9,750,000	5,256,578.14
2016-08-17	550	699,000	951,734.09
2016-08-17	527	385,000	338,296.01
2016-08-17	1000	775,000	639,240.18
2016-08-17	1210	1,050,000	824,167.77
2016-08-17	975	790,000	625,026.51
2016-08-17	1140	1,100,000	973,377.38
2016-08-18	1290	755,000	883,667.87
2016-08-18	1841	1,850,000	2,044,310.57
2016-08-18	1350	1,475,000	1,382,372.23
2016-08-18	460	760,000	820,469.61
2016-08-19	825	595,000	530,407.16
2016-08-19	1300	925,000	716,916.79

Train Variance score: 0.87
Test Variance score: 0.87

CHOOSING THE FINAL MODEL:

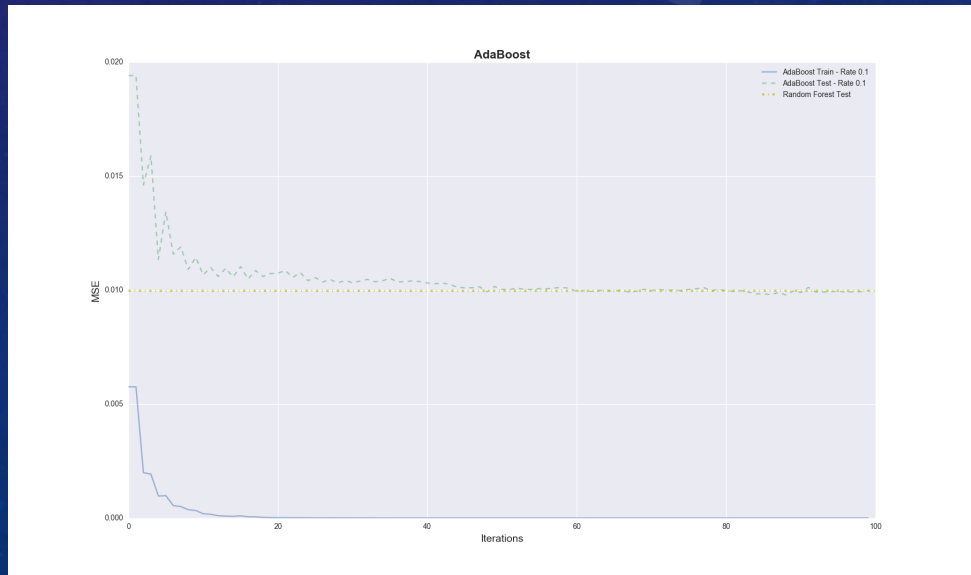
- Random Forest Regressor
- Gradient Boosting Regressor
- Ada Boosting Regressor



RandomForestRegressor Train CV | MSE: 0.008 | R2: 0.904

GradientBoostingRegressor Train CV | MSE: 0.008 | R2: 0.906

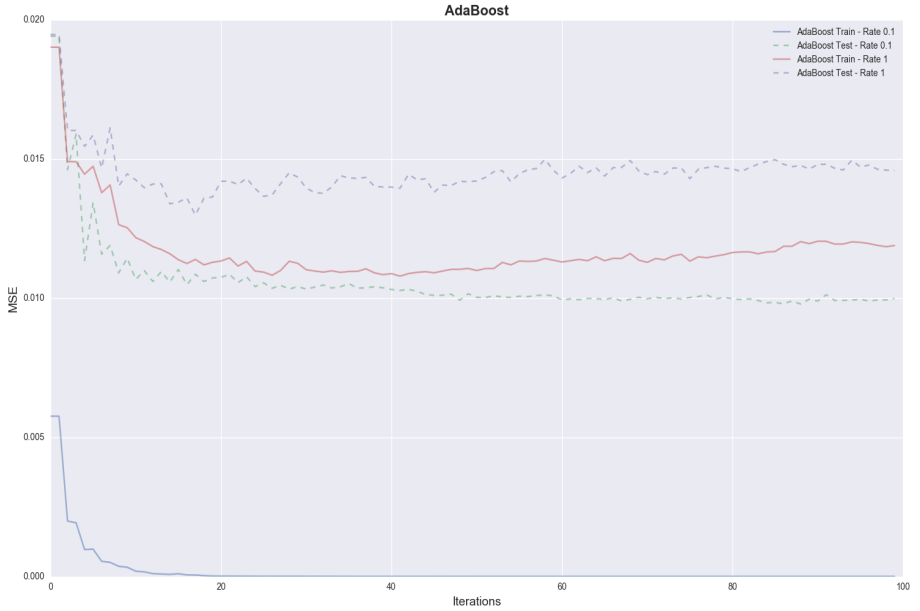
AdaBoostRegressor Train CV | MSE: 0.009 | R2: 0.901

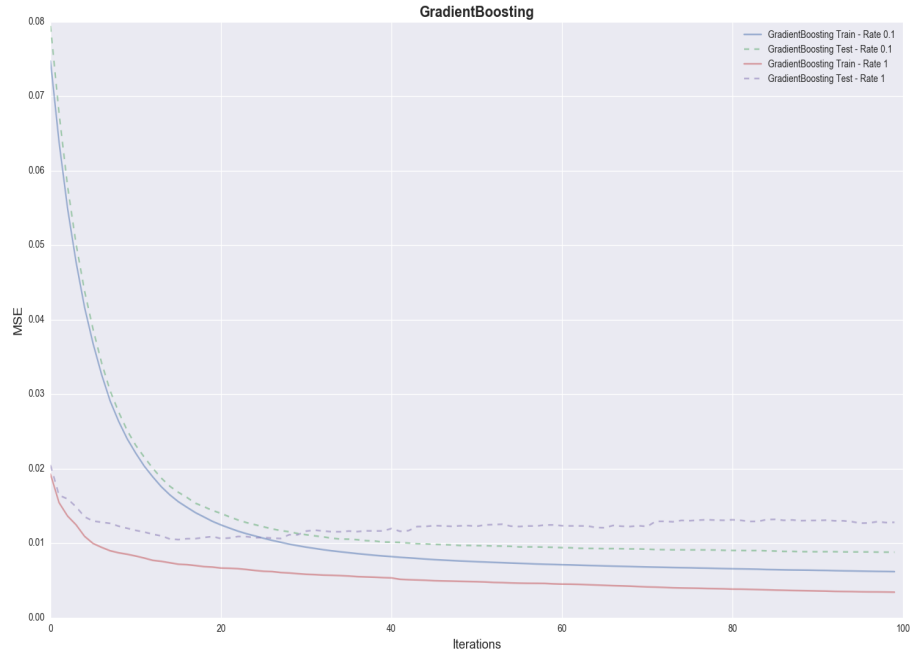


CHOOSING THE FINAL MODEL: GRID SEARCH FOR BEST ESTIMATORS

Grid search RandomForestRegressor
Fitting 3 folds for each of 324 candidates, totalling 972
Done 52 tasks | elapsed: 2.1s
Done 352 tasks | elapsed: 14.0s
Done 657 tasks | elapsed: 28.2s
Done 972 out of 972 | elapsed: 45.5s finished

Grid search GradientBoostingRegressor
Fitting 3 folds for each of 96 candidates, totalling 288
Done 34 tasks | elapsed: 6.0s
Done 184 tasks | elapsed: 44.4s
Done 288 out of 288 | elapsed: 1.2min finished





FINAL MODEL: GRADIENT BOOSTING REGRESSOR

- GradientBoostingRegressor Train CV | MSE: 0.007 | R2: 0.919
- RandomForestRegressor Train CV | MSE: 0.007 | R2: 0.914
- Gradient Boost Test MSE: 0.00806594315088
- Gradient Boost Test R2: 0.90601555473
- Random Forest Test MSE: 0.00834159580026
- Random Forest Test R2: 0.900919571981
- Gradient Boost Test MSE: 0.00806594315088
- Gradient Boost Test R2: 0.90601555473

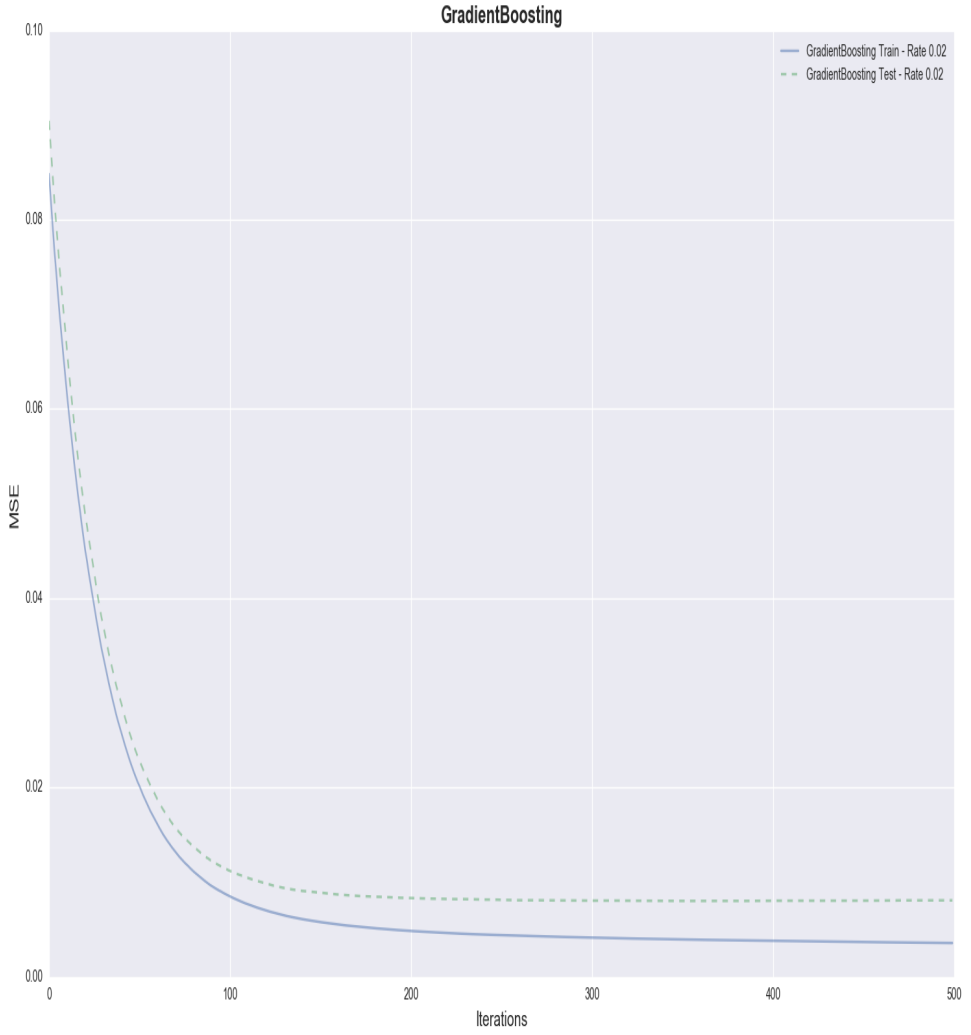
GradientBoostingRegressor best estimator:

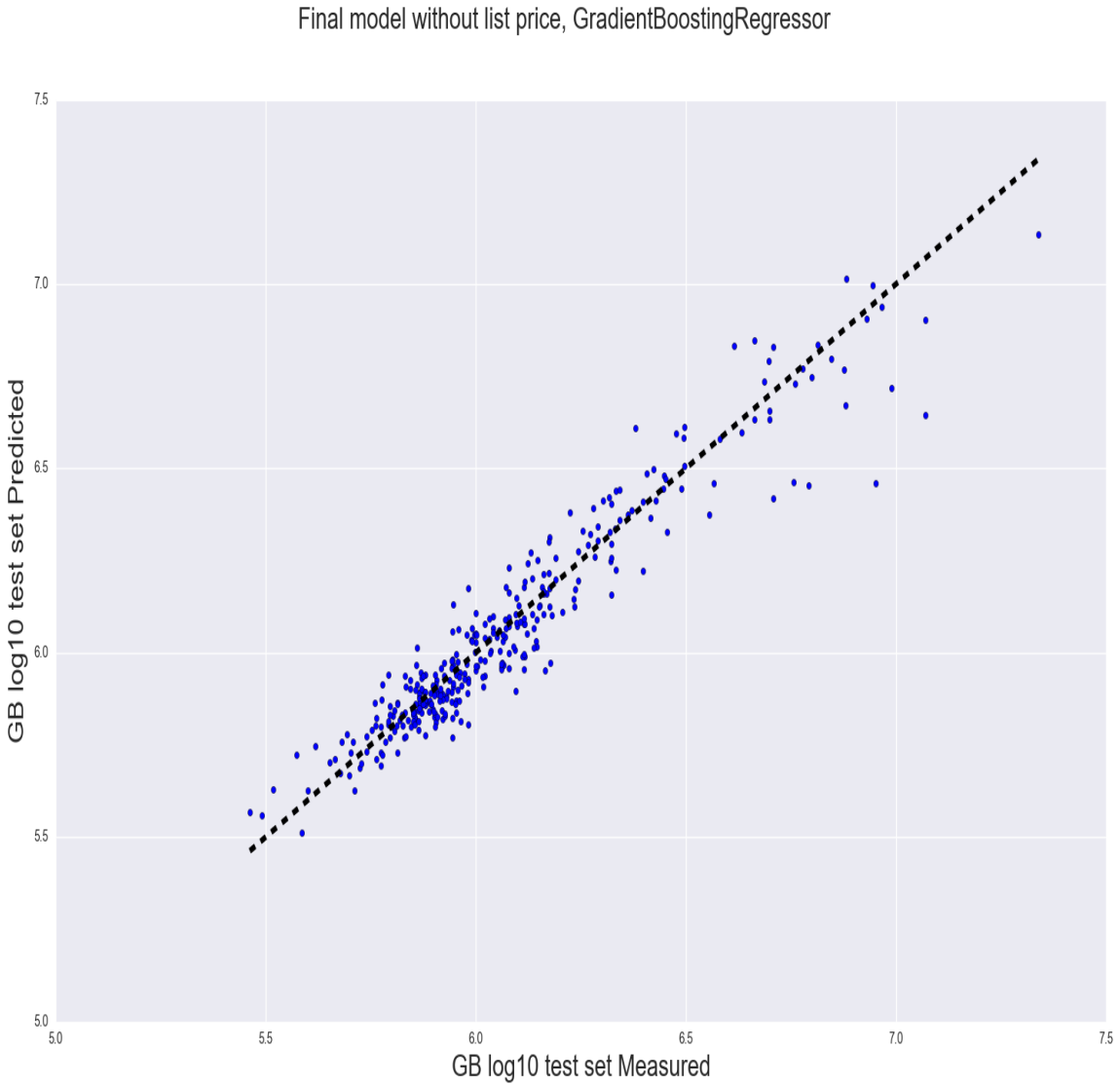
GradientBoostingRegressor(alpha=0.9, criterion='friedman_mse', init=None, learning_rate=0.02, loss='ls', max_depth=6, max_features=0.3, max_leaf_nodes=None, min_impurity_split=1e-07, min_samples_leaf=5, min_samples_split=2, min_weight_fraction_leaf=0.0, n_estimators=500, presort='auto', random_state=1, subsample=1.0, verbose=0, warm_start=False)

PREDICTIONS:

Date	Square-Foot	Sale-price	Predicted price
2016-08-16	1050	980,000	1,167,352.68
2016-08-16	1312	850,000	763,698.09
2016-08-16	700	917,500	885,745.47
2016-08-16	760	670,000	634,854.98
2016-08-16	4617	9,750,000	5,233,383.73
2016-08-17	550	699,000	800,931.58
2016-08-17	527	385,000	326,196.34
2016-08-17	1000	775,000	691,178.71
2016-08-17	1210	1,050,000	950,538.13
2016-08-17	975	790,000	704,674.36
2016-08-17	1140	1,100,000	1,256,932.34
2016-08-18	1290	755,000	781,256.91
2016-08-18	1841	1,850,000	1,955,437.64
2016-08-18	1350	1,475,000	1,450,500.51

GRADIENT BOOSTING REGRESSOR





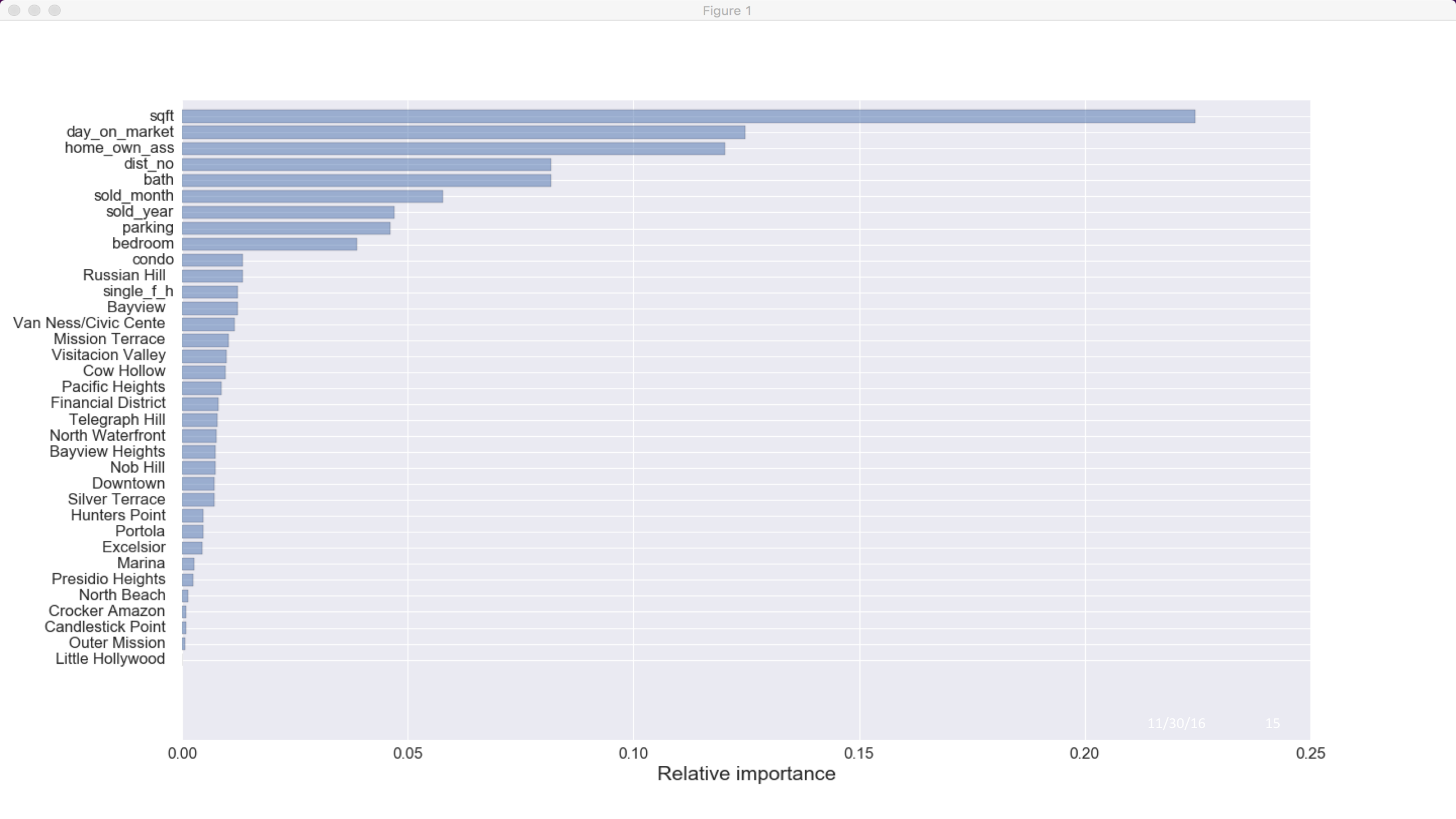


Figure 1
sqft
day_on_market
home_own_ass
dist_no
bath
sold_month
sold_year
parking
bedroom
condo
Russian Hill
single_f_h
Bayview
Van Ness/Civic Cente
Mission Terrace
Visitacion Valley
Cow Hollow
Pacific Heights
Financial District
Telegraph Hill
North Waterfront
Bayview Heights
Nob Hill
Downtown
Silver Terrace
Hunters Point
Portola
Excelsior
Marina
Presidio Heights
North Beach
Crocker Amazon
Candlestick Point
Outer Mission
Little Hollywood
0.00
0.05
0.10
0.15
0.20
0.25
Relative importance
11/30/16
15

CONCLUSION AND FUTURE WORK

test set sale price avg:	1,642,855.04
test set with list price avg:	1,655,398.35
diff:	-12,543.31
test set without list price avg:	1,607,460.92
diff:	35,394.12

- More data is needed: individual sales across the City, for all districts for at least 5 years. That data would allow us to analyze time series better, and the model selection through grid-search and cross-validated estimator would give us more reliable results.