WHARTON ANALYTICS FELLOWS FALL 2022 DATA CHALLENGE

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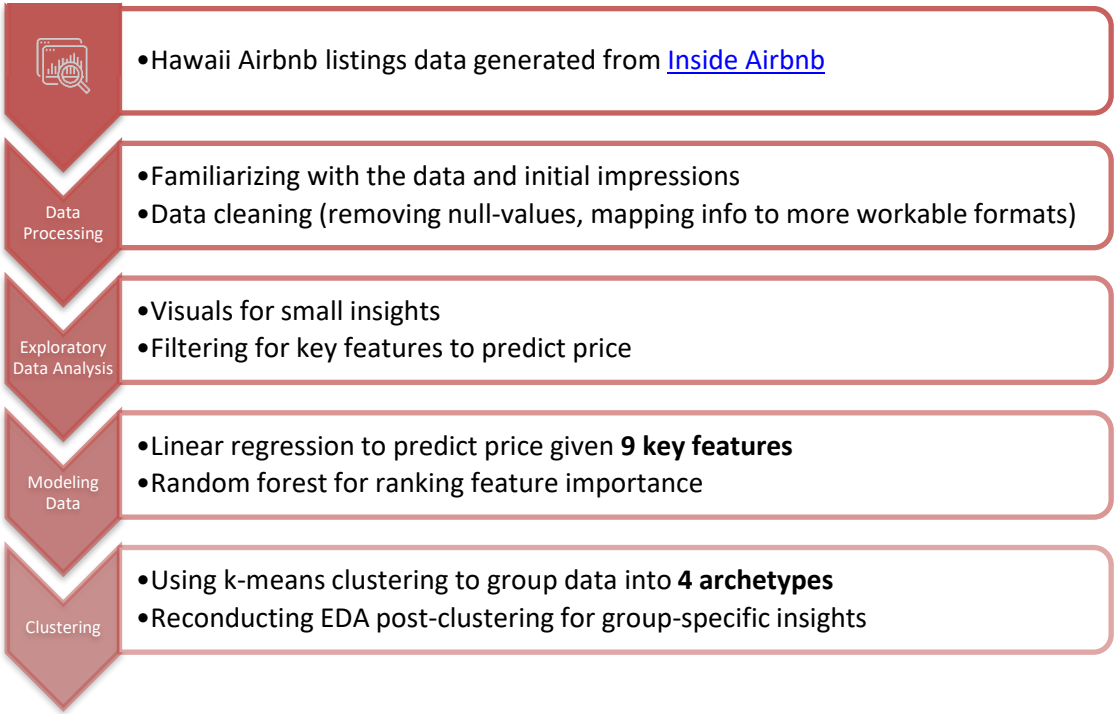
Introduction: Data Analytics Pipeline for Airbnb Data



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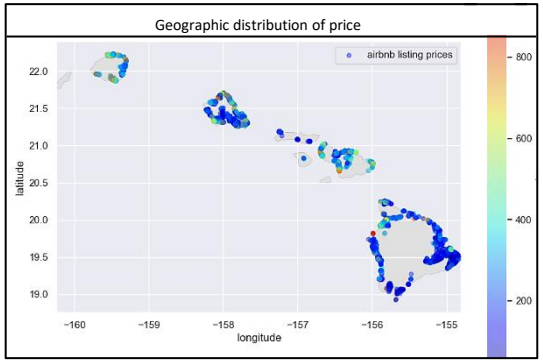
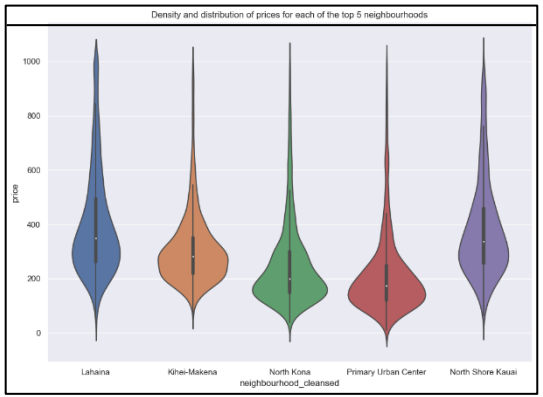
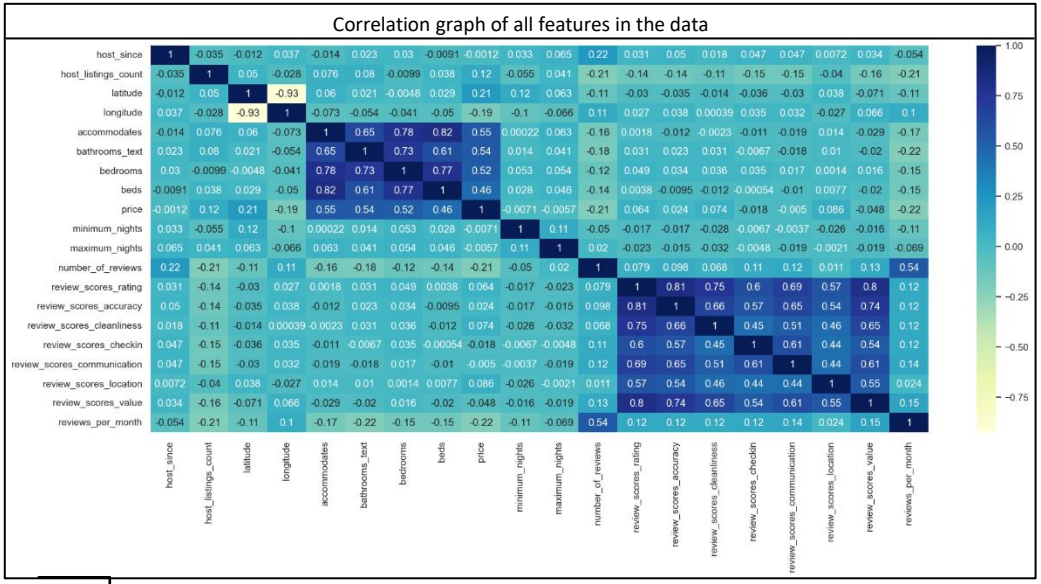
Part 1. Exploratory Data Analysis







9 key features selected: host experience, # of people accommodated, # of bathrooms, review score, latitude, longitude, host listing count, reviews per month, and number of reviews.

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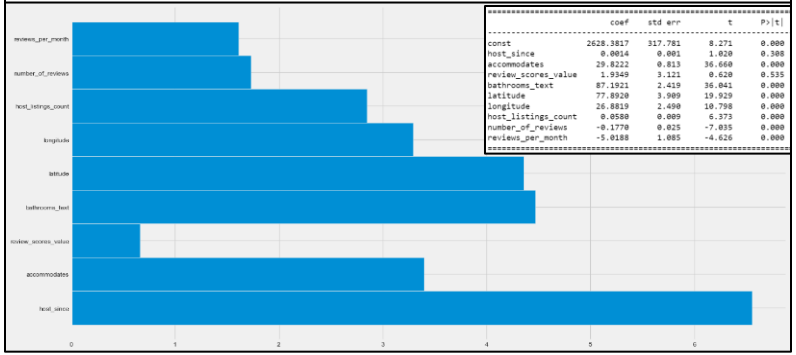
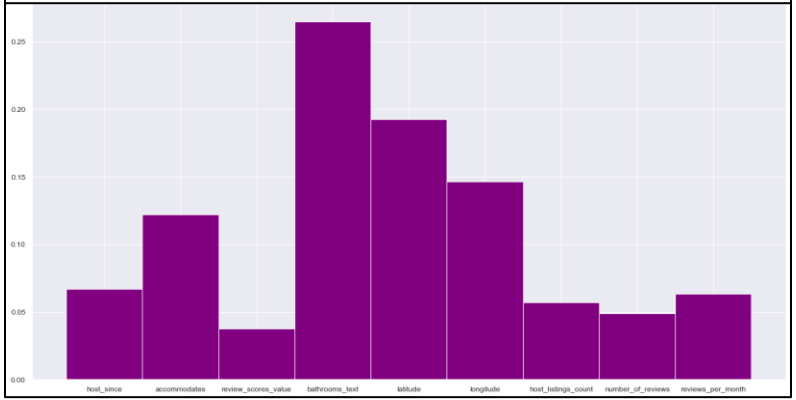
Part 2. Modeling Data

Linear regression coefficients corresponding to features (log scale)



	coef	std err	t	P>|t|
const	2628.3817	317.781	8.271	0.000
host_since	0.0014	0.001	1.020	0.308
accommodates	29.8222	0.813	36.660	0.000
review_scores_value	1.9349	3.121	0.620	0.535
bathrooms_text	87.1921	2.419	36.041	0.000
latitude	77.8920	3.909	19.929	0.000
longitude	26.8819	2.490	10.798	0.000
host_listings_count	0.0580	0.009	6.373	0.000
number_of_reviews	-0.1770	0.025	-7.035	0.000
reviews_per_month	-5.0188	1.085	-4.626	0.000

Feature importance scores generated by random forest decision model



- Linear regression coefficients corresponding to features graphed on a logarithmic scale
- Larger magnitude implies a larger influence on resulting prediction
- Statistics were calculated for each feature; ‘host_since’ and ‘review_scores_value’ insignificant

- Feature importance scores as determined by random forest decision model
- Higher scores (larger magnitude) means that the specific feature will have a larger effect on the price model
- # of bathrooms is the most important feature, followed by latitude, longitude, and # of people accommodated

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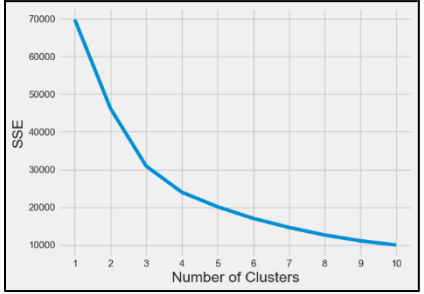
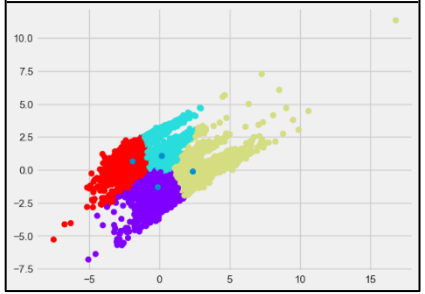
Part 3. Clustering and Post-EDA

Scale features → Use principal component analysis (PCA) for dimension reduction → Use K-means algorithm for clustering → Find 2D vector coordinates → Graph clusters → Conduct post-clustering EDA

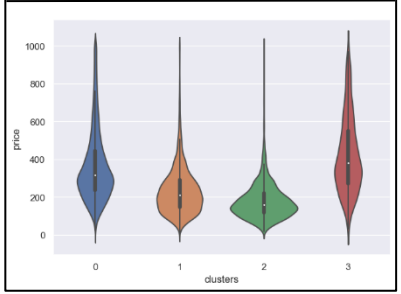
Elbow method graph for cluster count



Graphing coordinates for 2-D post-PCA vectors



Density and distribution of price for 4 clusters



Centroids for four main archetypes of Hawaii Airbnb listings

Cluster	Days hosting	Host listing count	Latitude	Longitude	Guests	Bathrooms	Bedrooms	Beds	Price	Review Score	Reviews	Reviews/month
1	2259.383	111.5177	20.33584	-156.211	5.463832	1.92021	1.975775	2.988989	363.1719	4.647645	18.05997	0.713817
2	2264.835	35.77911	21.30692	-157.692	3.626732	1.059996	1.195245	1.923624	232.4216	4.73904	42.06496	1.411348
3	2547.212	7.241441	19.95914	-155.826	3.102354	1.085949	1.217546	1.691869	177.5453	4.818006	101.4458	2.615278
4	2182.065	103.6904	21.7785	-158.813	5.822527	1.99726	2.169863	3.218874	423.1081	4.529105	13.3726	0.611513

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Conclusions and Extensions

Step 1. EDA

- Cleaned and processed data
- Created a geographic distribution for price that displays association between latitude and price
- Found neighborhoods with most listings and graphed price density and distribution
- Created correlation graph to isolate 9 key features for regression model

Step 2. Modeling

- Trained linear regression model
- Calculated coefficients and corresponding significance values (p-values) for 9 key features identified in EDA
- Trained a random decision forest to rank feature importance

Step 3. Clustering

- Scaled data down for use in clustering algorithm
- Used PCA to reduce dimension of data from 9 to 2 (for graphing)
- Used K-means clustering algorithm to group data
- Found 4 main archetypes of Hawaii Airbnb listings, as well as centroid for each

Conclusions

- According to the linear regression model, the top 3 features for predicting price are # bathrooms, # of people accommodated, and the latitude
- According to the random decision forest model, the top 3 most important features are # bathrooms, latitude, and longitude, followed by the # of people accommodated

Extension and Improvement

- If I had more time, I would do the following:
  - See how a gradient-boosted tree would predict prices based on features
  - Rigorously check for collinearity before selecting features for models
  - Use Tableau for EDA visualizations (ran into pandas export error)
  - Learn how to implement NLP on text descriptions description

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Thank you for your time and consideration!