IN PROGRESS Out [12]: Click here to toggle on/off the raw code. 1. Introduction Airbnb is easily one of the most successful start-ups in recent memory. Airbnb's business model has been a disruptive force in the short-term rental market and was valued at \$31 billion prior to the Corona Virus epidemic (<u>source</u>%20%2D%20Airbnb%20Inc's%20new,the%20matter%20said%20on%20Tuesday.&text=Airbnb%20was%20valued%20at%20%2431,recent%20private% However, like many other businesses, COVID-19 had dire impacts on the company's business model. Due to the massive sweeps of lockdowns all across the world, the industry titan's valuation plummeted to nearly half of what it once was (source). In this analysis, I will be exploring the Airbnb rental market in San Francisco from 7/1/2018 through 6/7/2020 to develop a better understanding about the impact COVID-19 is having specifically on SF market and what it means for the company moving forward in 2020. 1.1 Objectives • Conduct an analysis of the impact COVID-19 has had on Airbnb's daily gross rental income in the San Francisco area since the lockdown began on 3/19/2020. Forecast 2020 Q2, Q3, and Q4 losses if lockdown conditions remain the same for the rest of the year. • Create a per night rental price predictor for Airbnb properties in San Francisco. Extract out the most pertinent features that predict prices best. Create a guide for first-time hosts that illustrates features and amenities that can be added to Airbnb rental to increase per night rental price. 1.2 Impact Understanding the impact COVID-19 has had on daily gross rental income will allow us to forecast losses for the rest of the year. Creating a worst-case scenario of earnings for the rest of 2020 will allow company leadership to manage expectations for shareholders and table/prioritize certain projects over others for the foreseeable future. Developing an accurate price predictor model will provide Airbnb hosts a more accurate representation of how much their property is worth on the rental platform. Doing so will increase the likelihood tourists and long-term renters will want to rent out their property. Additionally, providing an accurate guide of features and amenities for first-time hosts to consider including with their rental will not only allow for more successful first-time experiences, but also increase the number of regular Airbnb hosts throughout the year. 2. Table of Contents 1. Introduction 1.1 Objectives 1.2 Impact 2. Table of Contents 3. Data Overview 3.1 About the Data 3.2 Preview Data 3.3 Data Overview - Metrics 4. Impact of COVID 19 on Gross Rental Revenue 4.1 Methodology 4.2 Results 4.3 Decision Recommendations 5. Airbnb Rental Prices in San Francisco 5.1 Methodology 5.2 Base Model Decision Tree Model 5.3 Tuned XGBRegressor Model 5.4 Decision Recommendations 6. Conclusion 6.1 Takeaways 6.2 Future Research 3. Data Overview 3.1 About the Data Airbnb Listings data was acquired from Inside Airbnb (no affiliation with Airbnb). Inside Airbnb is an independent, non-commercial set of tools and data that allows you to explore how Airbnb is really being used in cities around the world. By analyzing publicly available information about a city's Airbnb's listings, Inside Airbnb provides filters and key metrics so you can see how Airbnb is being used to compete with the residential housing market. 3.2 Preview Data Cleaned Data Shape: (126258, 48) accommodates amenities availability_30 availability_365 availability_60 availability_90 bathrooms bed_type bedrooms beds calculat TV, Cable TV 1.0 Real Bed 1.0 2.0 ,Internet,Wifi,Kitchen, Pets liv... TV,Internet,Wifi,Kitchen, Free 30 4.0 Real Bed 1.0 1.0 TV,Internet,Wifi,Kitchen,Heating, 1.5 Real Bed 2.0 2.0 TV, Cable TV 1.0 Real Bed 2.0 3.0 6 ,Internet,Wifi,Kitchen, Free par... 3 TV, Cable TV ,Internet,Wifi, Paid 131 19 1.0 Real Bed 1.0 2.0 3.3 Data Overview - Metrics **Data Description** Out[15]: **25**% **50**% **75**% count mean 1.000000 2.000000e+00 2.000000e+00 4.000000e+00 1.600000e+01 **accommodates** 126258.0 3.217230e+00 1.947620e+00 **availability_30** 126258.0 9.534984e+00 1.049743e+01 0.000000 0.000000e+00 5.000000e+00 1.700000e+01 3.000000e+01 0.000000 2.500000e+01 1.070000e+02 2.630000e+02 3.650000e+02 **availability_365** 126258.0 1.430715e+02 1.260210e+02 $\textbf{availability_60} \quad 126258.0 \quad 2.290179e{+01} \quad 2.104954e{+01}$ 0.000000 1.000000e+00 1.800000e+01 4.100000e+01 6.000000e+01 **availability_90** 126258.0 3.827428e+01 3.168983e+01 0.000000 5.000000e+00 3.500000e+01 6.600000e+01 9.000000e+01 1.000000e+00 1.000000e+00 1.500000e+00 1.400000e+01 **bathrooms** 126258.0 1.341998e+00 8.540870e-01 **bedrooms** 126258.0 1.354290e+00 9.212903e-01 0.000000 1.000000e+00 1.000000e+00 2.000000e+00 1.400000e+01 **beds** 126258.0 1.768339e+00 1.206100e+00 1.000000e+00 1.000000e+00 2.000000e+00 1.600000e+01 **calculated_host_listings_count** 126258.0 1.164335e+01 3.751799e+01 1.000000 1.000000e+00 2.000000e+00 4.000000e+00 3.010000e+02 calculated_host_listings_count_private_rooms 105994.0 2.726702e+00 7.322385e+00 0.000000 0.000000e+00 0.000000e+00 2.000000e+00 8.700000e+01 calculated_host_listings_count_shared_rooms 105994.0 4.762628e-01 2.893476e+00 0.000000 0.000000e+00 0.000000e+00 0.000000e+00 3.600000e+01 **cleaning_fee** 126258.0 8.963388e+01 7.931858e+01 0.000000 3.500000e+01 7.500000e+01 1.200000e+02 1.350000e+03 **extra_people** 126258.0 1.860098e+01 3.113538e+01 0.000000 0.000000e+00 5.000000e+00 2.500000e+01 3.000000e+02 1.000000 1.000000e+00 1.000000e+00 2.000000e+00 1.600000e+01 guests_included 126258.0 1.797233e+00 1.407876e+00 **host_has_profile_pic** 126258.0 9.942895e-01 7.535227e-02 0.000000 1.000000e+00 1.000000e+00 1.000000e+00 1.000000e+00 **host_id** 126258.0 4.915301e+07 6.890265e+07 28.000000 3.677879e+06 1.628587e+07 6.464682e+07 3.452837e+08 **host_identity_verified** 126258.0 5.709816e-01 4.949379e-01 0.000000 0.000000e+00 1.000000e+00 1.000000e+00 1.000000e+00 **host_is_superhost** 126258.0 5.115636e-01 4.998682e-01 0.000000 0.000000e+00 1.000000e+00 1.000000e+00 1.000000e+00 host_response_rate 126258.0 8.534871e+01 3.282895e+01 0.000000 9.700000e+01 1.000000e+02 1.000000e+02 1.000000e+02 id 126258.0 1.709399e+07 1.140872e+07 958.000000 6.495015e+06 1.771798e+07 2.584326e+07 4.348882e+07 instant_bookable 126258.0 3.895436e-01 4.876487e-01 0.000000 0.000000e+00 0.000000e+00 1.000000e+00 1.000000e+00 0.000000 1.000000e+00 1.000000e+00 1.000000e+00 1.000000e+00 **is_location_exact** 126258.0 8.863676e-01 3.173655e-01 **latitude** 126258.0 3.776334e+01 2.287561e-02 37.704170 3.774793e+01 3.776351e+01 3.778060e+01 3.781031e+01 -122.513065 -1.224454e+02 -1.224277e+02 -1.224120e+02 -1.223670e+02 longitude 126258.0 -1.224327e+02 2.740284e-02 maximum_nights 126258.0 1.747421e+04 6.043664e+06 1.000000 2.800000e+01 9.000000e+01 1.125000e+03 2.147484e+09 1.000000 2.000000e+00 3.000000e+00 3.000000e+01 9.990000e+02 minimum_nights 126258.0 1.072605e+01 1.590519e+01 monthly_price 19067.0 4.177245e+03 2.740558e+03 700.000000 2.500000e+03 3.500000e+03 4.999000e+03 2.500000e+04 **number_of_reviews** 126258.0 6.153323e+01 8.585735e+01 0.000000 6.000000e+00 2.600000e+01 8.400000e+01 8.210000e+02 **price** 126258.0 2.130139e+02 3.284934e+02 10.000000 9.900000e+01 1.490000e+02 2.390000e+02 1.000000e+04 require_guest_phone_verification 126258.0 5.468168e-02 2.273588e-01 0.000000 0.000000e+00 0.000000e+00 0.000000e+00 1.000000e+00 4.589016e-02 2.092477e-01 0.000000e+00 0.000000e+00 0.000000e+00 1.000000e+00 require_guest_profile_picture 126258.0 0.000000 **requires_license** 126258.0 9.941865e-01 7.602461e-02 0.000000 1.000000e+00 1.000000e+00 1.000000e+00 1.000000e+00 **review_scores_rating** 126258.0 9.570775e+01 6.869996e+00 20.000000 9.500000e+01 9.800000e+01 1.000000e+02 1.000000e+02 **reviews_per_month** 126258.0 2.048854e+00 2.088294e+00 0.000000 4.200000e-01 1.290000e+00 3.080000e+00 4.107000e+01 **security_deposit** 126258.0 3.419327e+02 6.260590e+02 0.000000 0.000000e+00 1.500000e+02 5.000000e+02 5.000000e+03 **weekly_price** 20939.0 1.297547e+03 9.815052e+02 7.500000e+02 1.000000e+03 **zipcode** 126258.0 9.411478e+04 1.315900e+01 94013.000000 9.410900e+04 9.411400e+04 9.412100e+04 9.496500e+04 4. Impact of COVID 19 on Gross Rental Revenue 4.1 Methodology Due to the relatively new impact of COVID-19 shutdown, there is not enough data to accurately model an accurate time series forecast. To circumvent this, I calculated the average daily percentage loss based on the data we presently have concerning the lockdown (March 19/2020 – 6/6/2020) and then extrapolated out that loss against our previous 2019 data for Q2, Q3, and Q4 of 2020. It is safe to assume that 2020 would have resulted in similar(if not slightly greater) revenue than 2019, so this extrapolation will serve as a worst-case scenario. 4.2 Results **Losses Due to Initial Shutdown** The loss due to COVID-19 shutdown for the data we have concerning 2020 is below, data ranges from 3/19/2020 - 6/7/2020 Out[16]: Daily Gross Renatal Income Comparing 2020 Shutdown to 2019 Statistics --- 2020 Gross -- 2019 Gross \$80,000 -\$60,000 \$40,000 \$20,000 Net Daily Income 2020 during Shutdown(3/19/2020 - 6/7/2020) Total Loss: \$-2426995.0 Percent Loss:-88.21% \$-20,000 \$-40,000 \$-60,000 \$-80,000 Forecasting losses through Q2, Q3, and Q4 in 2020. Out[24]: Daily Rental Income 2019 Q2 Vs 2020 Q2 Projections \$120,000 -— Q2 2019 Gross — Q2 2020 Projection \$100,000 -\$80,000 \$60,000 \$40,000 Total Projected Loss for Q2: \$-2,692,339.16 \$-40,000 \$-60,000 \$-80,000 \$-100,000 -2020 Q2 Projected Income 2020 Q2 Projected Loss Daily Rental Income 2019 Q3 Vs 2020 Q3 Projections \$120,000 -— Q3 2019 Gross — Q3 2020 Projection \$100,000 -\$80,000 \$20,000 Total Projected Loss for Q3: \$-3,402,457.29 \$-40,000 \$-60,000 \$-80,000 -\$-100,000 -2020 Q3 Projected Loss Daily Rental Income 2019 Q4 Vs 2020 Q4 Projections — Q4 2019 Gross — Q4 2020 Projection \$500,000 \$400,000 \$300,000 \$200,000 Total Projected Loss for Q4: \$-4,097,722.34 \$-100,000 -\$-200,000 \$-300,000 \$-400,000 2020 Q4 Projected Income \$-500,000 2020 Q4 Projected Loss **4.3 Decision Recommendations** San Francisco Daily Gross Income Analysis Results: Q2 Projected Loss: \$2,692,339.16 Q3 Projected Loss: \$3,402,457.29 Q4 Projected Loss: \$4,097,722.34 Projected Net 2020 Losses: \$10,192,518.79 Looking at the results, things do not look great should the lockdown remain in place as currently constructed for the rest of 2020 in San Francisco. Due to concerns from COVID 19, it would be a wise decision to only offer listings where the full-property is rented to a single-person/family. No single rooms should be permitted. Airbnb does already require cleaning to be done after each rental is completed (which is included in the price), so consumers will feel more at ease should we make this mandate. Somethings to consider for Airbnb as well is moving into the long-term rental market. The most profitable/popular listings on the platform belong to long-term rental companies who provide fully furnish dwellings in San Francisco. A potential strategy to ensure secured revenue would be to work with local apartments in SF and use our platform/advertising as a means to attempt to book empty dwellings. Airbnb thus could then capture either a commission or a percentage of the monthly rent in long-term deals. **5. Airbnb Rental Prices in San Francisco 5.1 Methodology 5.2 Base Model Decision Tree** Out[18]: Base Tree Regressor Model Error Evaluation Root Mean Squared Error:48.86 Prediction vs Actual Fit Prediction Error Distribution 17,500 \$400 15,000 12,500 \$300 ± 10,000 Pred \$200 7,500 5,000 2,500 \$-300 \$-200 \$-100 \$0 \$100 \$200 \$300 \$100 \$300 Error Actual **5.3 Tuned XGBRegressor Price Predictor** Out[19]: Tuned XGBRegressor Error Evaluation Root Mean Squared Error:15.67 Prediction Error Distribution Prediction vs Actual Fit 70,000 \$400 60,000 \$300 50,000 ¥ 40,000 30,000 20,000 10,000 \$-200 \$-100 \$100 Error Actual Out[20]: Tuned XGBRegressor Error Evaluation Root Mean Squared Error:27.05 Prediction Error Distribution Prediction vs Actual Fit 16,000 \$400 14,000 12,000 \$300 10,000 Prediction 2005 Š 8,000 6,000 \$100 4,000 2,000

max

property_type_In-law property_type_Bus property_type_Dome house property_type_Boat 0.00 0.02

\$-300 \$-200 \$-100

property_type_Boutique hotel

property_type_Condominium

property_type_Aparthotel

property_type_Hotel bed_type_Real Bed property_type_House security_deposit -

> bed_type_Futon guests_included -

> > deaning_fee -

bed_type_Airbed room_type_Hotel room -

amenities_count property_type_Bungalow =

property_type_Cabin property_type_Earth house property_type_Castle property_type_Treehouse property_type_Farm stay

property_type_Camper/RV property_type_Tiny house -

room_type_Private room property_type_Townhouse property_type_Apartment -

property_type_Guesthouse property_type_Hostel accommodates -

property_type_Guest suite property_type_Bed and breakfast -

property_type_Serviced apartment -

property_type_Cycladic house (Greece) -

neighbourhood_cleansed_encoded

room_type_Shared room property_type_Resort room_type_Entire home/apt

> property_type_Villa property_type_Loft bed_type_Couch property_type_Other property_type_Hut

Out[21]:

\$0

Error

\$100

\$200 \$300

Tuned XGBRegressor Feature Importances

\$100

\$0

0.10

0.14

0.16

\$200

Actual

\$400

6. Conclusion

5.4 Decision Recommendations

6.1 Takeaways 6.2 Future Research