Brief Introduction about Capstone Project

Watershed Properties is a residential property management company. They manage several thousand properties in more than 60 different neighborhoods around the United States. They are very proud of our relationship with our property owners and our tenants, which allows us to keep our overall property occupancy rates at a very attractive 97.3%.

Like most traditional property managers, Watershed has thus far exclusively managed long-term leases that typically require tenants to live in a property for a year or more, and pay monthly rent. However, the real estate business has begun extending into a different market: short-term rentals. Short-term tenants, or "guests," pay rent by the night rather than by the month, and are located and communicated with through increasingly popular websites like Airbnb. They would like to know whether Watershed should expand into this short-term rental market.

Watershed currently has a time-sensitive opportunity to explore the short-term rental market with one of its top property owners, who has expressed interest in working with Watershed to convert some of its long-term rental properties to short-term rental properties. They require me, as their business data analyst, to:

(1) calculate how much it would cost to convert and maintain each of this client's properties as a short-term rental
(2) determine the nightly rental price that would maximize the profits from each of these properties, if they were converted to short-term rentals.

They would then like me to use this information to:

(3) calculate which properties would have increased profits as short-term rentals
(4) determine how profitable, overall, it would be if Watershed converted some of this client's properties into short-term rentals.
(5) determine how much cash Watershed would need in order to realize any potential profits from converting the properties.

I will also have to synthesize this information into a succinct business recommendation:

Should Watershed enter the short-term rental market using some of this client's property portfolio, or not? If so, which properties should be converted first?

Technical Details of Recommendation to Enter the Short-Term Rental Market

I recommend that Watershed should convert 16 of its current long-term properties to short-term rent in the 1st stage. These properties are located in Austin, TX and Miami, FL. After 2 years of operation, Watershed can then re-evaluate the industry and consider 2 options of expansion: (1) continue to capture more share in Austin and Miami or (2) enter short-term market in other cities, e.g. San Diego and New York

The analysis that serves as the basis of my recommendation indicates that Watershed and its client would benefit from $824,566 of increased profits during the first year, and yearly profits of $728,566 every year thereafter if my recommendation is enacted. The initial capital investment needed to implement my recommendation would be $480,000.

Though there are properties in cities such as New York that have slightly better profit than some in Austin and/or Miami, I recommend focusing on the latter 2 places to build up stronger image and more easily direct marketing effort. Investing in scattered regions with only a few houses in each place might not yield expected outcome.

This analysis is based on financial assumptions that were confirmed by company and industry experts, but sensitivity analyses indicate that Watershed should enter the short-term rental market with their client, even if these initial assumptions need to be revised. Below, I describe the analyses I used to arrive at my conclusion, and report the results of my sensitivity analysis that assesses how expected profits and needed capital expenditure would change if my assumptions are modified.

Analysis Summary

I modeled the relationship between nightly rental price and occupancy rate for short-term rental properties using data from current short-term rentals managed by other companies and owners. I used this model to predict the short-term rental price that would maximize profits from each of Watershed's client's properties if it were managed as a short-term rental property. The metrics I report are based on the sum of the forecasted profits that would be gained and the forecasted capital investment that would be needed if my recommendation is followed, after the following are taken into account: (1) initial furnishing costs, (2) upkeep costs, (3) internet service fees, (4) regulatory fees, (5) hospitality charges (including key service and cleaning), (6) typical duration of stay, and (7) utilities. The details of the assumptions I used are provided below (Table 1), followed by a description of the results of my sensitivity analysis.

Analysis Assumptions and Sensitivity Analysis Ranges

Table 1

Consideration	Assumed Value	Source of Original Assumed Value	Minimum Value Tested [*Entry Set 5*]	Maximum Value Tested [*Entry Set 6*]	Rationale for Range of Values Tested [*Entry Set 7*]
Additional profit needed for a property to be considered "more profitable as a short-term rental"	$6,000	Watershed Financial Department	$6,000	$6,000	Since I use another Ranking Score to decide selected properties. This range does not matter much
Cost to convert property to short-term rental (includes furnishing and decorating)	$30,000	Watershed Marketing Department	$27,000	$30,000	10% interval from most possible amount
Years to depreciate capital expenditures	5	Watershed Financial Department	5	5	
Yearly upkeep	$6,000	Watershed Marketing Department	$6,600	$5,400	10% interval from the most possible amount
Service fees to short-term stay website (e.g. Airbnb)	20%	Watershed Marketing Department	18%	22%	Own assumption
Regulatory fees (taxes and potential legal fees)	10%	Watershed Financial Department	8%	12%	Own assumption
Hospitality charges (key service, cleaning, re-stocking)	$100	Watershed Financial Department	$90	$110	10% interval from most possible amount
Typical stay duration (days)	3	Watershed Marketing Department	2	5	Stays may range from 2 (business trip) to 5 (tourism trip)
Monthly utilities per property	$300	Watershed Financial Department	$270	$330	10% interval from most possible amount

As agreed upon at the beginning of the project, some issues were NOT incorporated into the analysis, but could be incorporated in the future to help optimize short-term rental rates or to further refine projected profits (Table 2):

Table 2

Factor not included in analysis	Reason for exclusion from analysis
Weekly or seasonal changes in rental prices/occupancy rates	Instructions from Project Manager
Promotions, coupons, or special events	Instructions from Project Manager
Loss in rental income while property is converted	Instructions from Project Manager
Differences in utility rates across properties	Instructions from Watershed Financial Department

I have created a dashboard that illustrates the effects of changing these assumptions on predicted profits and required capital investment that is available to anybody on the team by request. **The minimum additional profits Watershed could earn after conversion when the assumptions were modified within the ranges described above was $689,993** if all the properties that are "more profitable" as a short-term rental are converted. **The maximum additional profits Watershed could earn when the assumptions were modified within the ranges described above was $1,919,912** if all the properties that are "more profitable" as a short-term rental are converted. The modified set of parameters associated with this minimum and maximum value are provided below (Table 3). Overall, the parameter that affected profits most was Service Fee and Regulatory Fee

Table 3

Consideration	Value in Assumption Set that led to Minimum Profits [*Entry Set 11*]	Value in Assumption Set that led to Maximum Profits [*Entry Set 12*]
Additional profit needed for a property to be considered "more profitable as a short-term rental"	$6,000	$6,000
Cost to convert property to short-term rental (includes furnishing and decorating)	$33,000	$27,000
Years to depreciate capital expenditures	5	5
Yearly upkeep	$6,600	$5,400
Service fees to short-term stay website (e.g. Airbnb)	22%	18%
Regulatory fees (taxes and potential legal fees)	12%	8%
Hospitality charges (key service, cleaning, re-stocking)	$90	$110
Typical stay duration (days)	2	5
Monthly utilities	$330	$270

Ranking Score

Since Watershed can only finance the conversion project with $500,000 cash in the first year, I apply a Ranking Score to decide which properties among the "profitable" group that we should prioritize.

Ranking Score is calculated using the below formula;
Net Profit 2 year + Net Cash Flow 2 Year – Range of Net Profit in 2 year, Normal vs. Worst Case – Range of Net Cash Flow in 2 years, Normal vs. Worst Case

The last 2 components are used to capture uncertainty in profitability and cash flow. Considering 2 properties having the same financial outcome, the one with lower volatility in profit/cash flow should be favored.

Predictive Modeling Details

I was provided with four types of information about short-term rentals of the same type (number of bedrooms, apartment or house, kitchen availability, unshared property) and in the same location as Watershed's client's 244 properties: a typical short-term nightly rental rate, the corresponding occupancy rate for the property with that rental rate, the 10th percentile nightly rental rate, and the 90th percentile nightly rental rate.

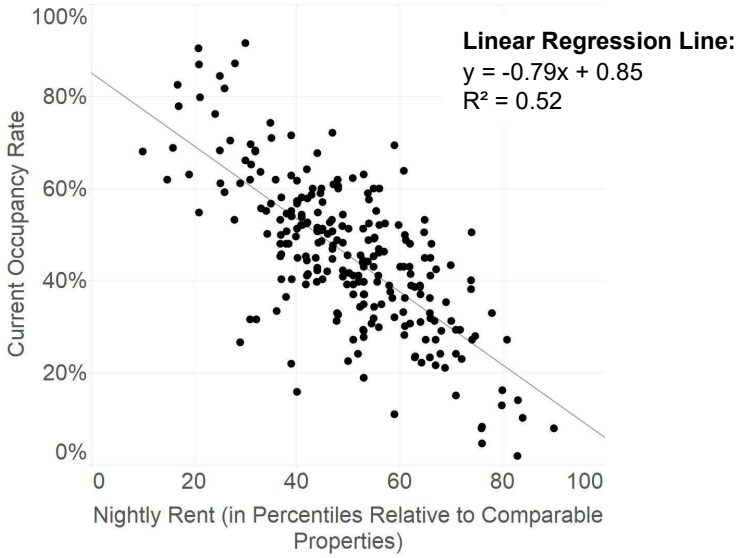

Figure 1: Scatter map of nightly rent (in percentiles relative properties within same region) and actual occupancy rate

When the typical rental prices were expressed in terms of percentiles relative to properties of the same type and in the same location—but not when they were analyzed as raw dollar values—they correlated linearly with occupancy rates.

I have tried including other variables such as number of bedrooms and whether this is a house or apartment property to run multivariate model. However, only sample_price_percentile feature is statistically significant, and Adjusted R-square does not vary much between 2 models. Hence, at this stage, relying on a univariate model is more appropriate.

```
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              8.573e-03  3.410e-04  25.141   <2e-16 ***
sample_price_percentile -7.943e-03  4.926e-04 -16.126   <2e-16 ***
num_bedrooms            -9.187e-05  1.460e-04  -0.629    0.530
apt_househouse           1.726e-04  1.461e-04   1.182    0.238
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.00114 on 240 degrees of freedom
Multiple R-squared:  0.5215,    Adjusted R-squared:  0.5155
F-statistic: 87.18 on 3 and 240 DF,  p-value: < 2.2e-16
```

Figure 2: Regression result of multivariate model

```
Coefficients:
                         Estimate Std. Error t value Pr(>|t|)
(Intercept)               0.85075    0.02562   33.21   <2e-16 ***
sample_price_percentile -0.79175    0.04926  -16.07   <2e-16 ***
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1141 on 242 degrees of freedom
Multiple R-squared:  0.5164,    Adjusted R-squared:  0.5144
F-statistic: 258.4 on 1 and 242 DF,  p-value: < 2.2e-16
```
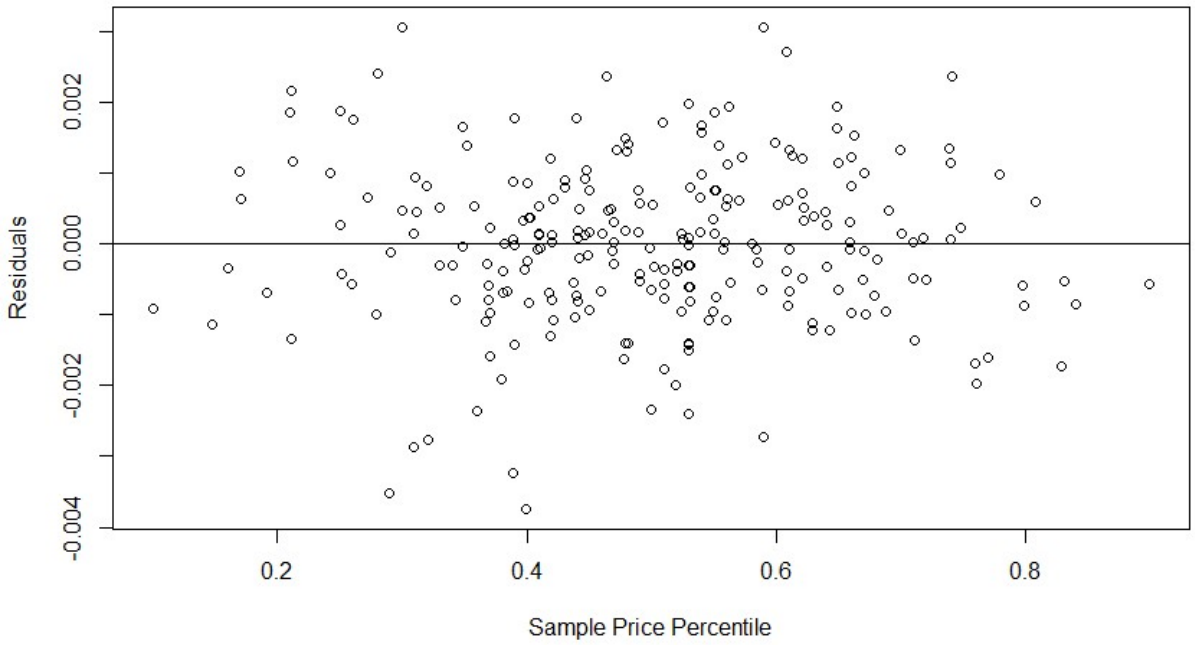
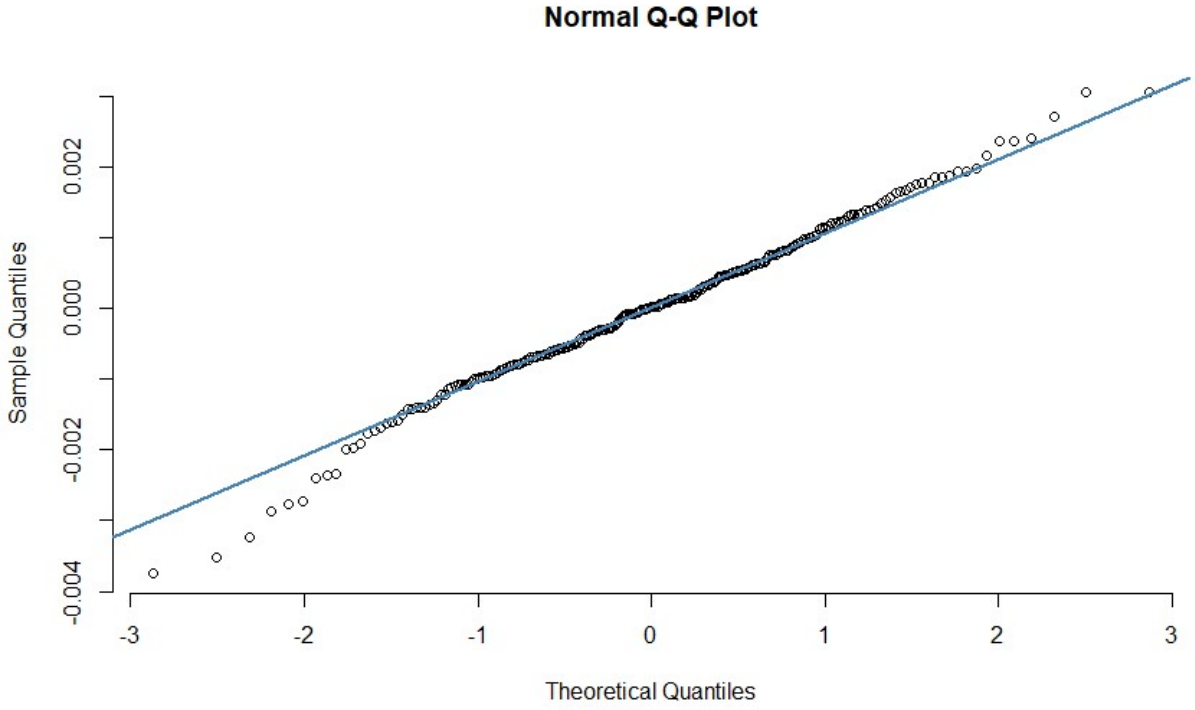

Figure 3: Regression result of univariate model

Though the predictive model is still somewhat simple, the residual errors satisfy the assumption of linear regression, centering around 0 with little signal of change in variance. The QQ Plot also confirms the normal distribution of residual errors, which solidify our trust in this model for prediction.


Residuals
0.002
0.000
-0.002
-0.004
0.2
0.4
0.6
0.8
Sample Price Percentile


Normal Q-Q Plot
Sample Quantiles
0.002
0.000
-0.002
-0.004
-3
-2
-1
0
1
2
3
Theoretical Quantiles

I used the parameters of the regression line and optim function in R to find the rental price and occupancy rate that would maximize the profits expected from each of Watershed's client's 244 properties. Any optimized price below the 10th percentile rate was replaced with the 10th percentile rate, and any optimized price above the 90th percentile rate was replaced with the 90th percentile rate, in order to account for lack of data outside of these ranges in the linear model.

These optimized rental rates were entered into a financial cash flow and profit model that computed the expected revenue from each property based on its projected occupancy rate, and the expected costs according to the financial assumptions described above.