Section 1: Problem Statement
What are ways that Big Mountain Resort can restructure its ticket price for next season to reflect the value of its facilities while remaining competitive within the market segment?

Section 2: Data Wrangling
To provide guidance for Big Mountain's pricing and future facility investment plans, a dataset was obtained that contained information for 330 individual ski resorts within our market segment. Figure 1 shows that the ski resorts of interest are geographically spread across the United States. There was a concern that the spatial diversity of the ski resorts could introduce regional biases that would erroneously impact the modeled prices for Big Mountain. For example, it is not desirable to have modeled ticket prices for Big Mountain (located in Montana) to be skewed by New York ski resorts. Section 3 will show that no regional biases in ticket prices were found, allowing the data from each state to be treated equivalently.

The dataset was examined for missing and erroneous values. Ultimately, the cleaned dataset contained information for 277 individual ski resorts (13 ski resorts were removed because of missing data). Figure 2 shows the distributions of the features that are contained in the cleaned dataset (with the exception of AdultWeekday). The adult weekday prices were removed in favor of the adult weekend prices, which were selected as the target values.

Section 3: Exploratory Data Analysis
Figure 3 shows the principle component analysis (PCA) joined with information about state-wide averaged ticket prices. The key takeaway from Figure 3 is that no discernable pattern or groupings are evident with respect to the quartiles of average state-wide ticket prices. Thus, as mentioned in Section 1, no regional biases in ticket prices were found, allowing the data from each state to be treated equivalently when building the pricing model.

Of the features shown in Figure 2, correlation analysis revealed that the following features are strongly correlated with ticket price: 1) vertical drop, 2) fastQuads, 3) total chairs, 4) runs, 5) snow making ability, and 6) night skiing. Figure 4 shows a positive linear relationship between the aforementioned features and ticket price, indicating that vertical drop, fastQuads, total chairs, runs, snow making ability, and night skiing are potentially good predictors of ticket price and target areas for future investment.

Section 4: Model Preprocessing
As a baseline for model comparison, the mean ticket price was used as the predictor (i.e., the overall mean ticket price is our best guess). This resulted in an R-squared value of essentially zero for our training and test data. This tells us that none of the variation in ticket prices is captured by the mean. In addition, the mean absolute error (MAE) was approximately 18-19 and the root mean square error (RMSE) was approximately 24-25. The MAE value tells us that by using the average ticket price as the predictor we would be off, on average, by roughly $18-19.

The RMSE value tells us that, on average, our predictions would be off by roughly $24-25 from the actual values.

Next, we built a linear model and it resulted in the following key findings:

1. Cross validation MSE of approximately $10.50 with a standard deviation of roughly 1.6
2. Suggested that the vertical drop is the biggest positive feature with respect to ticket price
3. Snowmaking, total chairs, fastQuads, and number of runs also have a positive influence on ticket price
4. Verifying performance on the test set produces performance consistent with the cross-validation results

Lastly, we built a random forest regressor model and it resulted in the following findings:

1. Cross validation MSE of approximately $9.60 with a standard deviation of roughly 1.4
2. Suggested that the fastQuads is the biggest positive feature with respect to ticket price
3. Number of runs, snowmaking, and vertical drop also have a positive influence on ticket price
4. Verifying performance on the test set produces performance consistent with the cross-validation result

Section 5: Winning Model & Scenario Modeling

Based on the results of the model preprocessing (Section 4), the random forest model was chosen because it has a lower cross-validation mean absolute error by almost $1.00 and exhibited less variability.

Big Mountain Resort has been reviewing potential scenarios for either cutting costs or increasing revenue (from ticket prices). The business leadership has proposed four scenarios: 1) permanently closing down up to 10 of the least used runs, 2) increase the vertical drop by adding a run to a point 150 feet lower down but requiring the installation of an additional chair lift to bring skiers back up, without additional snow making coverage, 3) same as number 2, but adding 2 acres of snow making cover, and 4) increase the longest run by 0.2 mile to boast 3.5 miles length, requiring an additional snow making coverage of 4 acres.

Each scenario was examined using the random forest model to test the sensitivity of ticket price to the proposed changes and the following results were found:

1. For scenario 1, the model showed that closing on run makes no difference in ticket price or revenus. Closing 2 and 3 successively reduces support for ticket price and so revenue. If Big Mountain closes down 3 runs, it seems they may as well close down 4 or 5 as there's no further loss in ticket price. Increasing the closures down to 6 or more leads to a large drop in ticket price and overall revenue.
2. For scenario 2, the model results support a $1.99 rise in ticket price, which would increase revenue by $3,474,638 over the course of the season.

3. For scenario 3, the model results, like for scenario 2, support a $1.99 rise in ticket price, which would increase revenue by $3,474,638 over the course of the season. The small increase in the snow making area makes no difference.
4. For scenario 4, the model results show that the proposed changes make no difference whatsoever.

Based on the sensitivity analysis, we recommend scenario 2 for further consideration.

Section 6: Pricing Recommendation

Big Mountain Resort currently charges $81.00 per adult ticket. The modeled price for Big Mountain Resort is $95.87 per adult ticket with a mean absolute error (MAE) of $10.39. The modeled results suggest that there is room for an increase in ticket price. However, this result should be viewed with some caution because the validity of our model lies in the assumption that other resorts accurately set their prices according to what the market supports (i.e., the ticket price accurately represents the value of their facilities). If Big Mountain Resort's ticket price is actually underpriced, then it is reasonable to expect that others may be either underpriced or overpriced. Conversely, if the pricing strategies for other resorts are accurate, then our modeled results could imply that our model is lacking some key data (e.g., information about operating costs).

The addition of a new chair lift has increased Big Mountain Resort's operating costs by $1,540,00.00 this season. To strictly cover the increase in operating costs, Big Mountain Resort would need to raise their ticket price to $82.00 (an increase of $1.00 over last year's price). This calculation is based on the fact that every year about 350,000 people visit Big Mountain and, on average, ski for five days.

Section 7: Conclusion

Based on Big Mountain Resort's facilities, the model showed that an increase in ticket price is warranted. It appears that Big Mountain's current ticket price of $81.00 is undervaluing its facilities compared to other resorts in the same market. To strictly cover the increase in operating costs of the new chair lift, Big Mountain Resort would need to raise the ticket price to $82.00. However, to set a price that reflects the value of Big Mountain's facilities will need further work (see Section 8).

Regarding future investments, the sensitivity analysis showed that scenario 2 of the business leadership team's proposals is the best option for increasing revenue through ticket prices and should be considered further. Overall, increasing the vertical drop has the potential to increase revenue by $3,474,638 over the course of the season (through a $1.99 increase in ticket price).

Section 8: Future Scope of Work

Overall, it appears that Big Mountain's current ticket price is undervaluing its facilities compared to other resorts in the same market. However, compared to other Montana ski resorts, Big

Mountain is on the upper end of ticket prices. Thus, there is the risk of pricing Big Mountain out of the local market with a price increase and losing visitors to our regional competitors.

At this point, two additional pieces of information would be useful for determining Big Mountain's ticket price: 1) operating cost of resorts and 2) place of origin for visitors (i.e., where are visitors traveling from?). More facilities should come with a greater operating cost. It would be useful to see how Big Mountain's operating costs compare to other resorts in our market, to see how operating costs are related to ticket prices, and to see how operating costs are geographically distributed (perhaps east coast operating costs are greater than the mountain west due to different regulations, taxes, etc.). If a strong relationship is evident between operating costs and ticket prices, then perhaps operating costs may need to be included in our model.

It would also be insightful to see where Big Mountain's visitors are coming/traveling from. If its visitors are predominantly from the local area (i.e., Montana residents or residents of nearby areas), then pricing itself out of the local market with a price increase is a real risk. However, if Big Mountain’s visitors are predominantly from remote locations, then the risk of pricing itself out of the local market is reduced as the visitors are primarily coming to Big Mountain Resort because of its facilities and not local convenience.

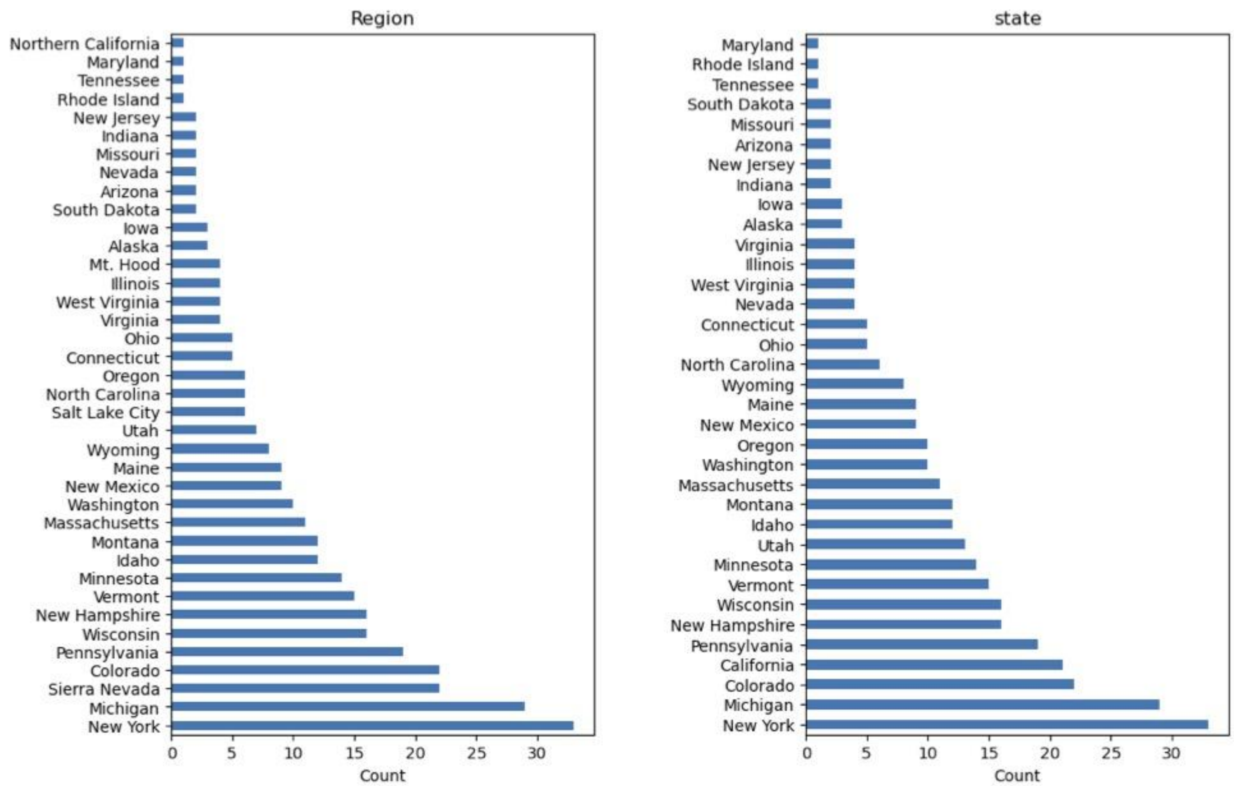

Figure 1. Distribution of ski resorts within market segment by region (left) and state (right).

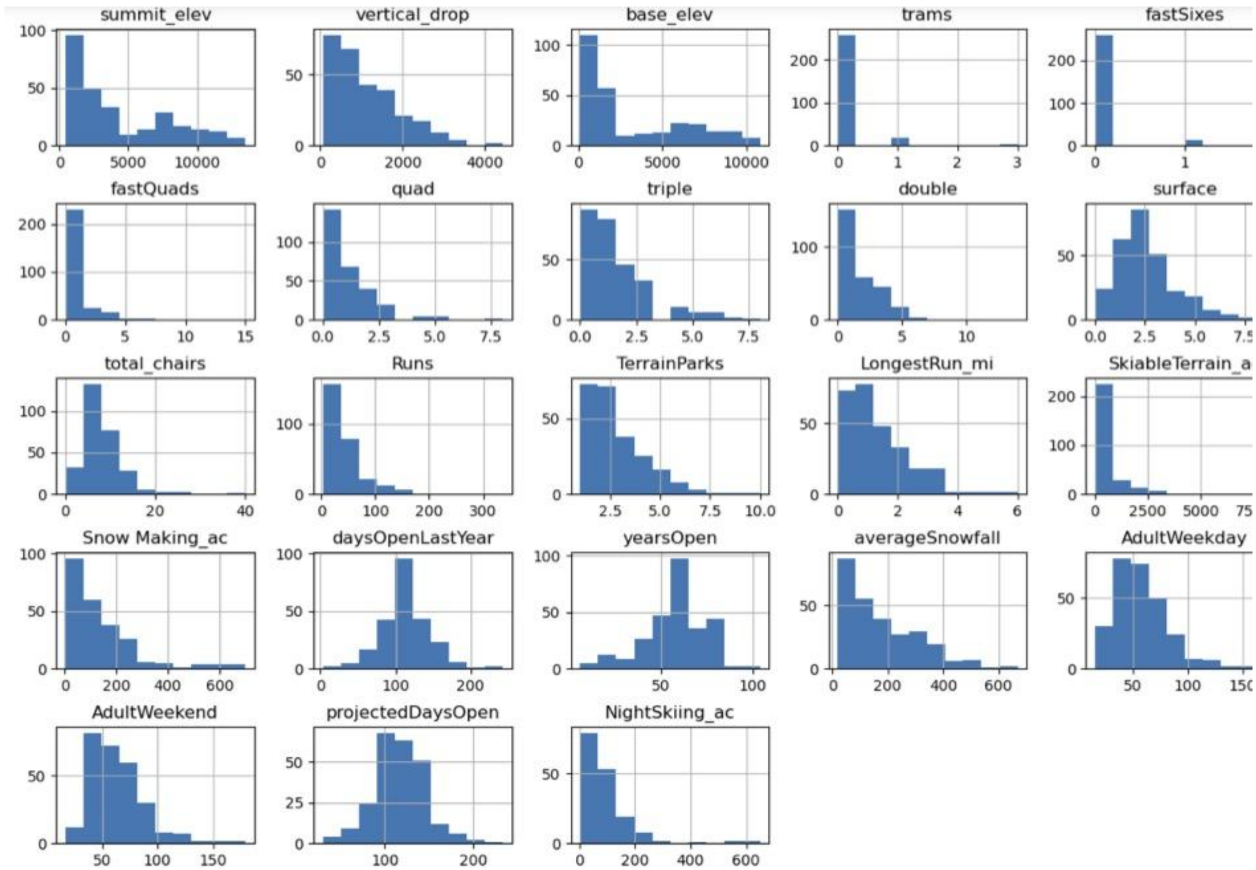

Figure 2. Histograms of the numeric features associated with the ski resorts that are included in the pricing model

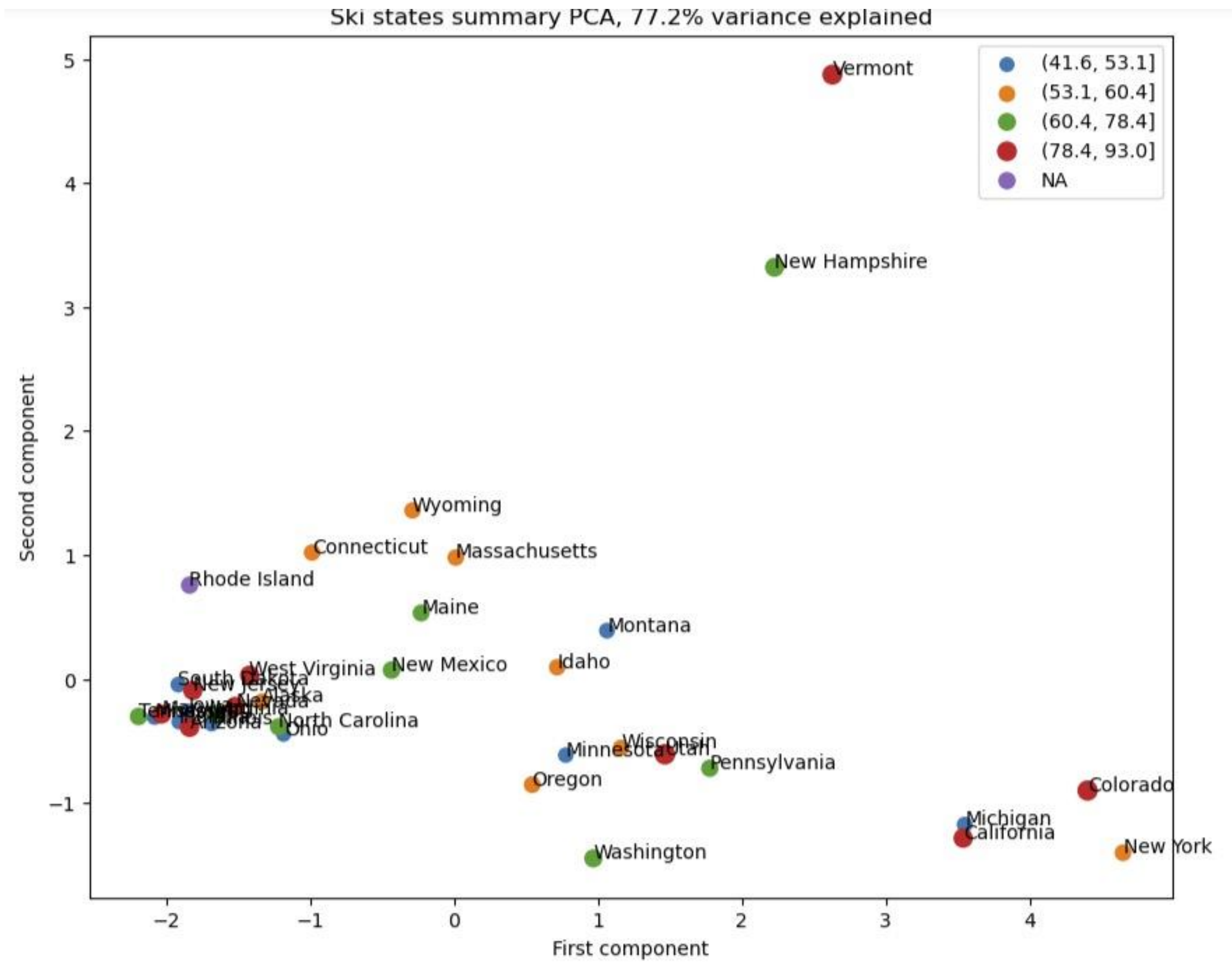

Figure 3. Principal component analysis of features joined with state-averaged ticket prices. The colored circles represent the quartiles of the averaged ticket prices.

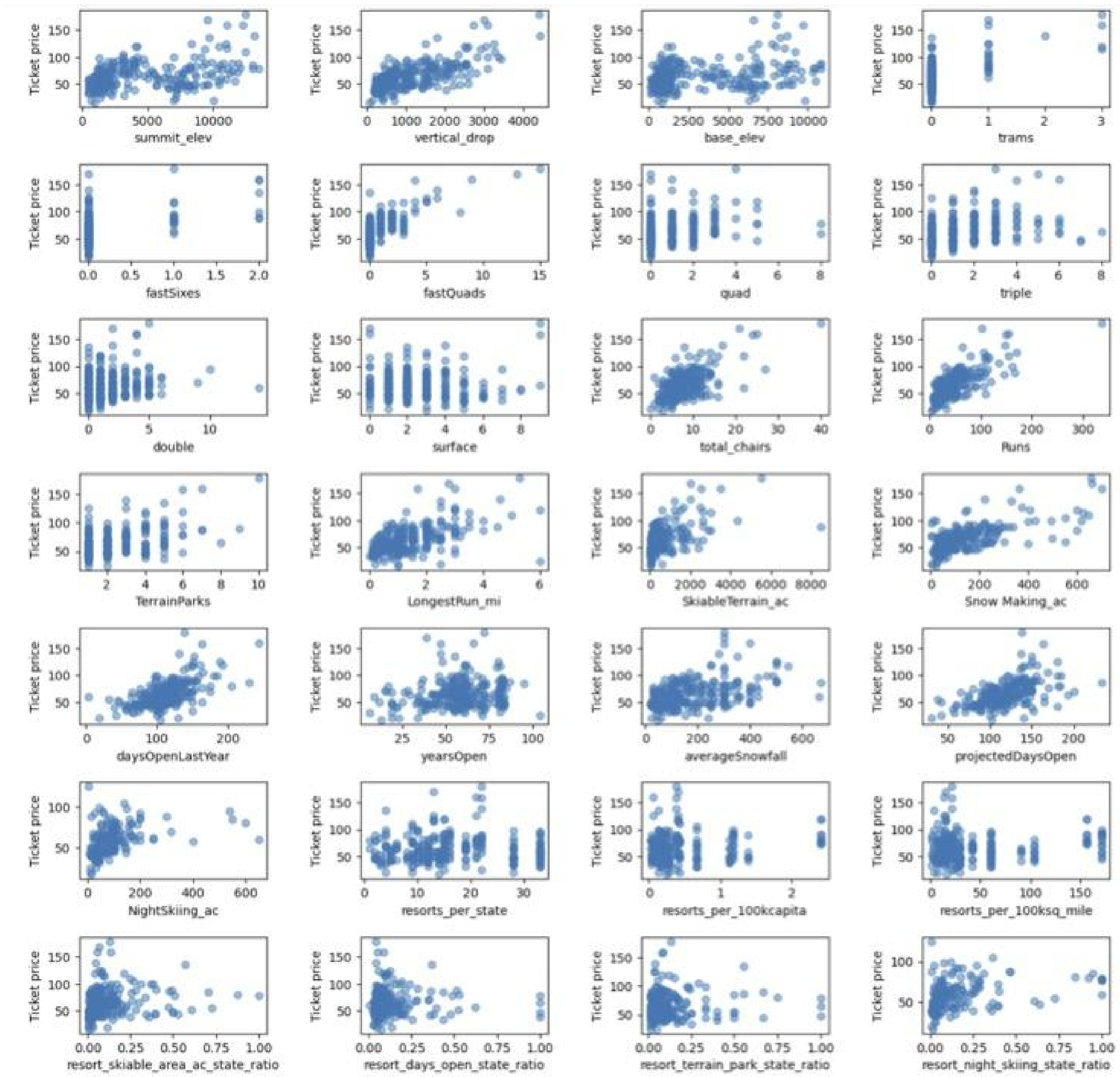

Figure 4. Scatterplots of ticket price vs features for all the resorts included in the pricing model.