Grace Nye

Guided Capstone Project – Big Mountain Resort

Big Mountain Resort, a ski resort in Montana, is looking into potentially raising its ticket prices and investigating which of its facilities is valued most by its users. As the resort has just installed a new chair lift which is looking to increase operating costs this season, it would be valuable to increase revenue in order to counteract the new cost. Therefore, operating within the scope of the data which is available for ski resorts in the United States (adult ticket prices for various resorts, vertical drop, skiable terrain, number of chairs, etc.), we want to answer the question: how can Big Mountain Resort increase its revenue by 10% over the next season and offset the cost of the new chair lift by increasing ticket prices that are supported by the market?

In order to tackle this question, we first wrangled our data by familiarizing ourselves with each column, investigating the integrity of each entry and whether there were any missing values, and assembling it into a format that would lend itself more easily to further analysis. We did this by correcting missing and/or inaccurate values and dropping columns/rows with missing information.

Next, we performed exploratory data analysis, in order to identify overall trends and patterns in the data so we could identify which variables might be more important than others in the modelling process. First, we looked into the importance of individual states and whether or not the state label should be taken into account when modelling – we found that there was no clearly observable pattern to the data, with average ticket prices distributed with fairly broad spread, so we decided not to use these labels. Next, by looking into the relationship between ticket prices and all other variables, we identified that adult weekend ticket prices are highly correlated to features such as the vertical drop, the number of runs, the number of fast quads, and the snow making coverage, among others.

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**Figure 1 –** Scatterplots of adult weekend ticket price vs. snow making coverage, total number of chairs, vertical in feet, and total number of runs reveals a positive relationship, indicating that these features are valuable to customers.

Next, we pre-processed our data and began training the machine learning model to learn how ticket prices are determined and what features are most valuable to customers. We divided our data into 70:30 training and testing splits, then tested out several types of models to see what fit best to our data. We evaluated our models by comparing them to the expected ticket prices when simply using the average of known values, and by assessing its performance using cross-validation and evaluating performance on the test set. We found that the random forest regressor provided the best fit to the data and reduced the mean absolute error to around $10. This means that, assuming the validity of our data, the model can predict what the ticket prices of a given resort are with a range of $10 of uncertainty. The models we tested here also showed that the top four features to be considered were vertical drop, snow making coverage, total chairs, and fast quads.

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**Figure 2 –** Feature importances, as determined by the best random forest regressor.

After using our completed model to predict the ticket price of Big Mountain Resort, we found that the suggested ticket price was $95.87. The current adult weekend ticket price is $81. Even when considering the mean absolute error of $10.39, the model suggests that a $4.48 ticket price increase would be suggested by the market. This price increase is justified by the fact that Big Mountain Resort is on the upper end of all ski resorts in terms of the facilities that it can provide to customers that they care the most about, as illustrated below. By raising ticket prices, the cost of the new chair lift can also be offset. However, as Big Mountain Resort is already ranked among the most expensive ski resorts, it is worth considering whether or not additional data would be useful in making this decision – for example, we are lacking data on the number of visitors each resort receives each season as well as the operating costs of the resort, both of which would be very useful data to have. Although Big Mountain Resort is at the high end of the distribution for features that our model ranks as most valuable to visitors, we may be missing certain factors, and we are also basing our assumption on the fact that other resorts have also properly priced their tickets.

Big Mountain Resort proposed four potential courses of action: 1) closing up to ten runs; 2) adding a run, lengthening the longest run, and adding a chair lift; 3) the same as 2, but increasing snow making coverage by 2 acres; 4) increasing the length of the longest run and increasing snow making coverage by 4 acres. The model here suggests that Scenario 2 will result in the greatest increase in revenue for the business. Closing a single run is not predicted to affect ticket prices, but closing more will result in a decrease in the market supported ticket price. Scenario 2, adding a run, increasing the length of the longest run, and adding an additional chair lift will support a ticket price increase of $1.99 per adult weekend ticket, which will result in an increase of seasonal revenue by $3474638, if we assume that there are 350,000 adult visitors every season who buy on average 5 day passes. Scenario 3 is predicted to have the exact same result as scenario 2, indicating that adding 2 acres of snow making coverage will not have a significant effect on such a small scale. Scenario 4 is predicted to have no effect on ticket price at all. This is indicative of the fact that the model we are using ranks length of run as not very important.

Future scope of this work includes generating additional data about number of visitors per resort as well as seasonal operational costs to factor into the model, as they could provide additional insights into why our model predicted the ticket price to be so much higher than it currently is for Big Mountain Resort.