# Problem Statement Worksheet (Hypothesis Formation)

**What opportunities exist for Big Mountain Ski Resort to select a better value for their Ski passes or undertake changes that will cut costs or support a higher value for passes.**

## 1 Context

Big Mountain ski resort in Montana, has recently invested in a new chair lift increasing operational costs by $1,540,000 per season. Previously they have based their pass value on a premium above the average for resorts in their market segment. The business wants to identify a better value than their current method. They are also open to changes that will cut operational costs or improve customer experience to support a higher price.

## 2 Criteria for success

Big Mountain ski resort will use a data-driven approach to justify an increase in ticket price next season. The raise in value of tickets must cover the additional operational costs of any improvements to the resort. Furthermore they will identify operational cost cutting possibilities without lowering ticket price and any potential changes that could further increase ticket price, such as another park or more night skiing.

## 3 Scope of solution space

Identify correlation in the data of equivalent resorts between ticket price and other key variables such as area of skiable terrain per lift. That may justify a higher value than currently charged. See which other variables in the data are highly correlated with ticket price such as number of parks, area for night skiing or additional runs. Identify other adjustable variables that are highly correlated with ticket price for further investment.

## 4 Constraints within solution space

The data we have available may contain missing values and may be messy. Hard to quantify the aesthetics of other resorts. Ticket prices may vary between weekday and weekend. We have no control over some of the variables: the amount of natural snow that falls or the elevation. There may not be clear correlation between the available data and the price. We do not have information on number of visitors to other resorts,

## 5 Stakeholders to provide key insight

Jimmy Blackburn - Director of Operations
Alesha Eisen - Database Manager

## 6 Key data sources

Csv file from the Database manager containing information about 330 resorts in its market segment including Ticket price, skiable area and number and types of lifts and trams available.

# Recommendation and key findings

Additional run

Add the run which increases vertical drop by 150 feet. This requires the installation of a new chairlift but no additional snow making equipment. The model shows us that this would support an increase in ticket price by $1.99 and thus total revenue by $3474638. Hence the ticket prices should rise to $82.99 at a minimum.

Closing run(s)

In the predictions we show that closing one run would have zero decrease in ticket price. For any further closure of runs we would need to be aware of the reduction in operational costs. We could compare these to the predicted decrease in ticket price. The model predicts a decrease in total revenue of $710,144 for two closed runs. When we close three, four or five runs the decrease in total revenue is identical - it would be $1,166,666. Closing runs will mean that the other runs will be more crowded which would be potentially less attractive to visitors.

Current ticket price

Big Mountain charges $81 for both weekend and weekday tickets. The model predicts that Big Mountain could charge a ticket price of $95.87 however we should note the following: The model is based on Weekend ticket prices and in many resorts this is higher than their Weekday prices. Therefore the model may be proposing a higher value for Weekday prices. The mean difference in Weekend and Weekday ticket prices is $6.23. The Mean Absolute Error tells us how much of a error we can expect from the prediction on average which in this case is 10.39. I therefore I advise an increase of Weekend ticket price $85.48.

Weekend vs Weekday

We need to be aware of the fact that the other resorts in Montana have no increase of their Weekend ticket price as compared to their Weekday price. A large increase in Weekend ticket prices may encourage skiers to go to resorts with a cheaper option. Including the additions to the resort I recommend a Weekday ticket price of $83 justified by the additional run and a Weekend ticket price of $87.50 justified by the model and the run.

Caveats

The model is based on fair pricing from other resorts with regard to the market. There may be resorts that price themselves too high or too low. Raising Weekend prices over Weekday prices may encounter resistance from visitors. Resorts in Montana have equal weekday and weekend prices.

# Creating the model

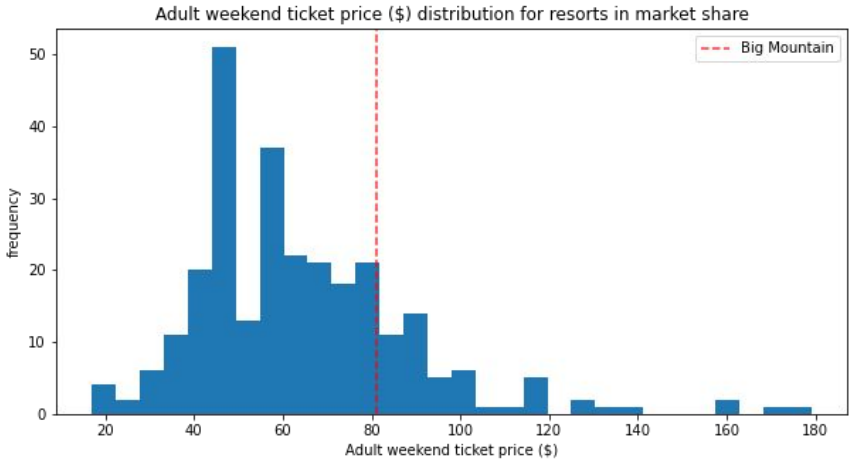
The first baseline model I constructed was predicting the price with the mean. The Mean Absolute Error (MAE) tells us how much absolute error we can expect on average from the predictions made. For the baseline model the MAE was 19 therefore the prediction we make with this model should be on average within $19 dollars of the actual price. The second model was a Linear Regression model. The MAE for this model was $9 which is superior to the baseline model.

The best model constructed was a Random Forest model. Imputing the missing values with the median and using Gridsearch cv to find the best value for k in select k best. We aslo scale to mean zero and unit S.D. The Random Forest model was competing with the Linear regression model and a 'model' predicting the price with the mean. Testing the mean 'model', the Linear Regression model and the Random Forest model with cross validation mean absolute error we find that the Random Forest Model is superior.

We then make an analysis of the amount of data we have access to. To do this we use the learning curve function. We plot the output of the learning curve function with different training set sizes and compute the Cross validation score. It shows that an improvement in scores until a sample set size of about 50 where it is consistent. Therefore we do have enough data to model the ticket price.

## Big Mountain Resort in Market context

We compare big mountain resort within market context. It shows us that its high in market context in the following areas: Skiable area, Longest run, Total number of runs, Fast Quads, Total number of chairs, area covered by snow makers, vertical drop. In terms of ticket price we see that Big Mountain is highest in Montana and relatively high overall.



# Modelling scenarios

Predicting the current ticket price

The Random Forest model predicts a ticket price for Big Mountain resort of $95.87. This model has a Mean Absolute Error of 10.39. Therefore our prediction should be on average within $10.39 of the actual value. This implies that Big Mountain could charge 95.87 - 10.39 = $85.48 per ticket. However it's important to note that this model is using weekend prices from other resorts to predict the price. Weekend prices in many resorts are higher than Weekday prices particularly when tickets are below $100. The mean difference between Weekend and Weekday ticket price is $6.8. Hence without further improvement to the resort we should be wary of increasing Weekday ticket prices based on this model. Therefore without any additions to the resort I would recommend increasing the Weekend price to $85.48 at a minimum. However I would not recommend increasing the Weekday price without further support from improvements to Big Mountain.

Modelling scenario: Adding a run

This run would be one that increases vertical drop by 150 feet and requires the addition of a new chairlift. The model shows that this will increase support for a new ticket price by $1.99 leading to an increase in total revenue of $3474638. We model the same scenario but with an increase in snow making by two acres. This makes no further increase in predicted ticket price. Therefore I would recommend creating the new run with extra vertical drop, installing the new chairlift but not adding extra snow making.

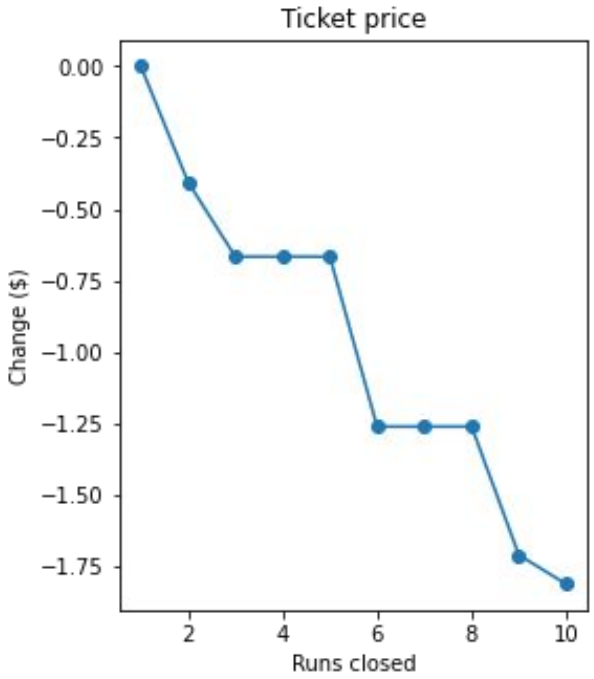
Modelling scenario: Increase longest run

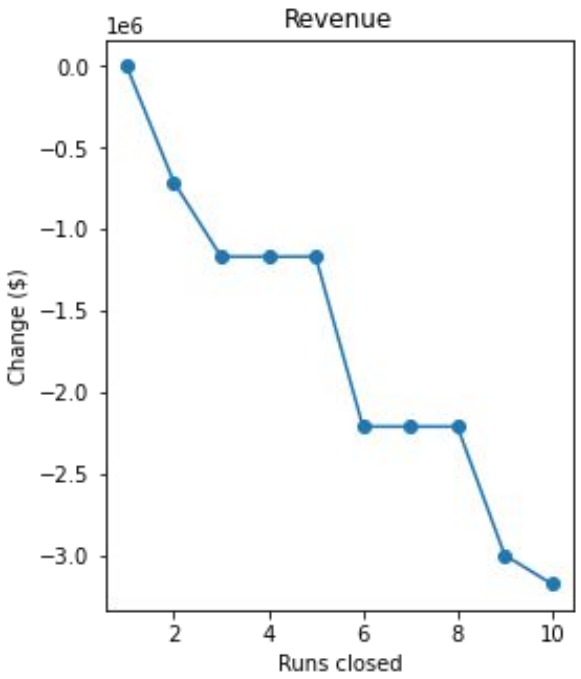
Increasing the length of the longest run by 0.2 miles and adding four acres of snow making on it. The model predicts no increase in ticket price. We should note that the Random Forest does not show longest run to be of great importance. Discount this idea.

# Modelling scenarios

Closing run(s)

We created a function that models the impact on ticket price and total revenue with the predicted change that Big Mountain could undertake. Using it to model closing up to ten runs we find the following. Closing one run has no predicted impact in ticket price. Closing two runs would have a decrease in ticket price of $0.41. Closing three four and five runs are equivalent in the model for negative impact of ticket price all $0.67. Closing six or more runs would have a negative impact on total revenue of $1.26. We must be aware that closing more than one run would decrease predicted price. Therefore the reduction in operational costs must be compared to the predicted decrease in revenue.



# Summary and conclusion

Initial increase in ticket price

The model predicts a ticket price of $95.87 without any additions to the resort. The model has an MAE of 10.39 meaning on average the prediction would be out by this much. Hence we could predict a price of $95.87 - 10.39 = $85.48 on average. Equally the model is based on Weekend prices which are often higher than Weekday prices. The mean difference between Weekday and Weekend ticket price is $6.8. I would therefore not suggest an increase in Weekday ticket price without additions to the resort that support it. The model does demonstrate that we can increase Weekend prices by $4.48 wihout additions to the resort.

Close one of the least appealing runs

This will save operational costs which could be diverted elsewhere. The model demonstrates that this will have zero impact on prices. For any further run closures it we would need to compare reduction in operational costs to the predicted decrease in revenue.

Adding a run

I recommend creating the new run that requires the installation of a new chairlift and increases the vertical drop by 150 feet. The model demonstrates that this supports an increase in all ticket prices of $1.99. With this addition to the resort I recommend Big Mountain charge $82.99 for Weekday and $87.47 for Weekend prices. Ticket prices are conventionally round numbers therefore Weekend price would be $87.50 and Weekday price would be $83.

Operational costs vs Revenue

Assuming the average number of visitors remains consistent at 3,500,000 and they continue on average to buy five day passes we can calculate the revenue increase in the following way: 5 * 350,000* ticket price increase. The ticket price increase for all tickets would be $2 and a further $3.50 for the weekend tickets. Across the week the additional weekend increase amounts to 2*3.5/7 = $1 dollar a day. Therefore the total increase in ticket price on average is $3 per day. Which gives an increase in predicted total revenue of $5,250,000. We must take into account the increase in operational costs from a new chairlift. The one previously increased costs by $1,540,00 hence if this is similar the total increase in revenue would be $3,710,000.