Big Mountain Resort Project Report

Background: Big Mountain Resort, a Montana ski resort offers spectacular views of Glacier National Park and Flathead National Forest, with access to 105 trails, 11 lifts, 2 T-bars, and 1 magic carpet accommodating about 350,000 skiers and riders of all levels every year. The resort installed an additional chair lift recently to help increase the distribution of visitors across the mountain, which increases operating costs by $1,540,000 this season. Management is seeking guidance on a better ticket pricing strategy for the value of the facilities than basing on the market average, and changes that will either cut costs without undermining the ticket price or will support a higher ticket price.

Problem hypothesis: What can Big Mountain Resort do to buffer an additional $1,540,000 chair lift operating costs and gain at least 10% business revenue increase by the end of this ski season?

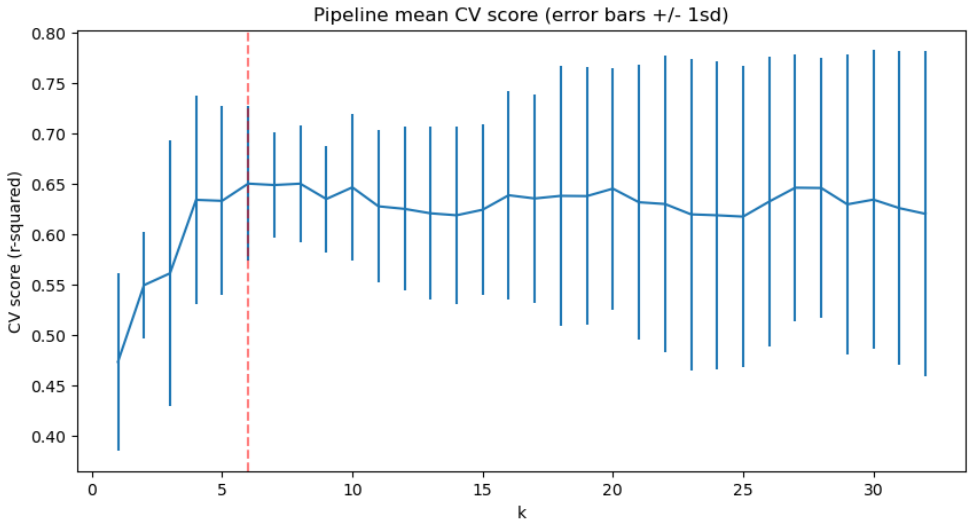
Data sources: 1. CSV file containing resorts location, elevation change, facilities, average annual snowfall inches, opening days, adult ticket price, etc. of 330 resorts (including Big Mountain Resort) in the US as part of the same market share from Database Manager Alesha Eisen; 2. US states population and area data from Wikipedia.

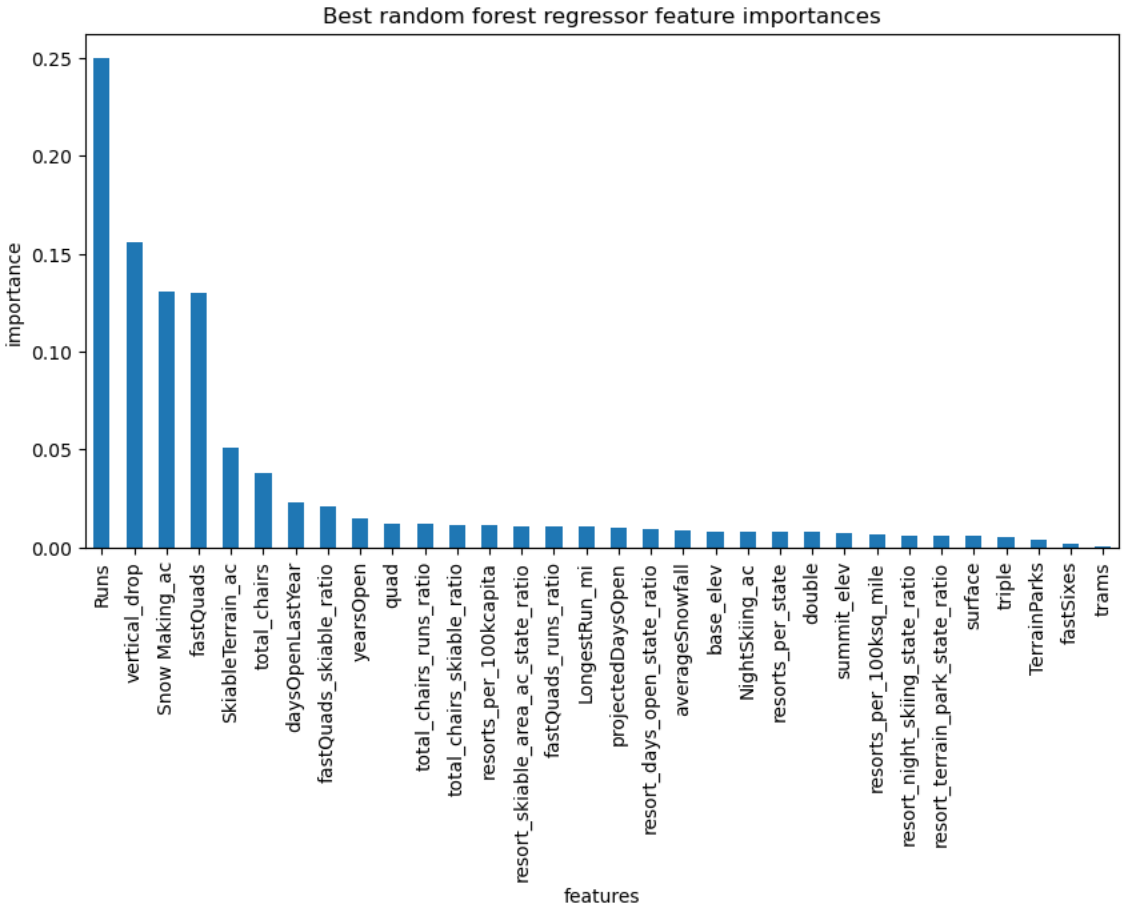
Brief procedures: After primary data wrangling, resorts with outlier uncertain open year and price missing records and columns were removed, 'AdultWeekday' was selected as study target, 278 resort rows left for study.

During exploratory analysis and visualization, PCA analysis of in state_summary features and state average 'AdultWeekday' price and price quantile categorical feature plot showed no clear patterns of relationship between state and ticket price, so each resort facility to state total ratio features are added to resorts dataset. Numeric features heatmap and each feature against 'AdultWeekday' price visualization showed 'vertical_drop', 'trams', 'fastQuads', 'Runs', 'total_chairs', 'LongestRun_mi', 'Snow Making_ac', 'daysOpenLastYear', and 'projectedDaysOpen' features were positively related to price.

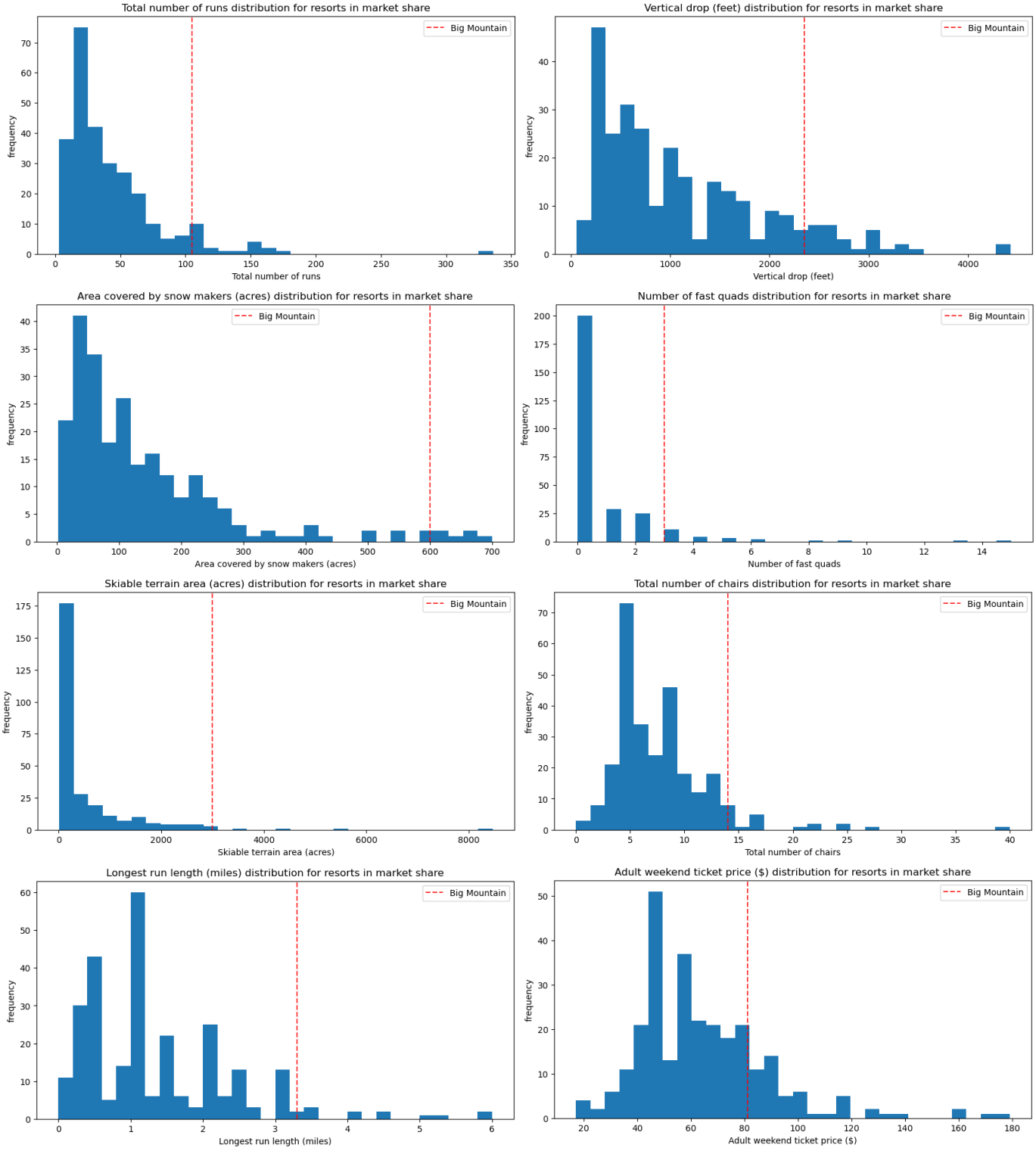
For preprocessing and training, study target 'big_mountain' was split out, the rest dataset was split into X features part and y 'AdultWeekday' part, both also 70/30 split into _train and _test parts, to reduce over fitting chances. Numeric features were used for prediction and modeling. R-squared score (R^2, coefficient of determination), and Mean Absolute Error were set as prediction performance metrics. Before modeling, 'Big Mountain's previous strategy market mean method was used as the predictor to set the metrics baseline (R^2 -0.001536 for y_test and y test prediction, and close to $19 mean absolute error). Then, Linear Regression modeling and random forest modeling methods were used for targeting useful features contributing to y pricing and better prediction. Median and mean value of each numeric feature were tried to fill missing values. With data scaling, regression, cross-validation, and GridSearchCV methods, we got consistent prediction performance metrics in both modeling. And both modeling methods suggest 'vertical_drop', 'fastQuads', 'total_chairs', 'Runs', 'SkiableTerrain_ac', and 'Snow

Making_ac' are 6 key features contributing to price and prediction. While random forest modeling performed a little better, with higher mean best R^2 0.691, lower 0.074 STD, and lower mean absolute error of $9.70 with its best_estimator, also tree method doesn't necessarily need numeric data scaling. Random forest regression modeling and its best estimator parameters was selected as the final predictor model.





For the final prediction, saved random forest regression model was refit on all the other resorts dataset except for Big Mountain. Modeling predicted price for Big Mountain is $92.41, versus current price of $81.00. The expected mean absolute error is $10.41. This suggests room for price increase. Positioning visualization of Big Mountain on those key features distribution in market share also shows Big Mountain has 7 above average or high features/facilities to offer in the market share, while its current price is closer to the mean of market share. Four proposed future improvements scenarios were also modeled and evaluated.



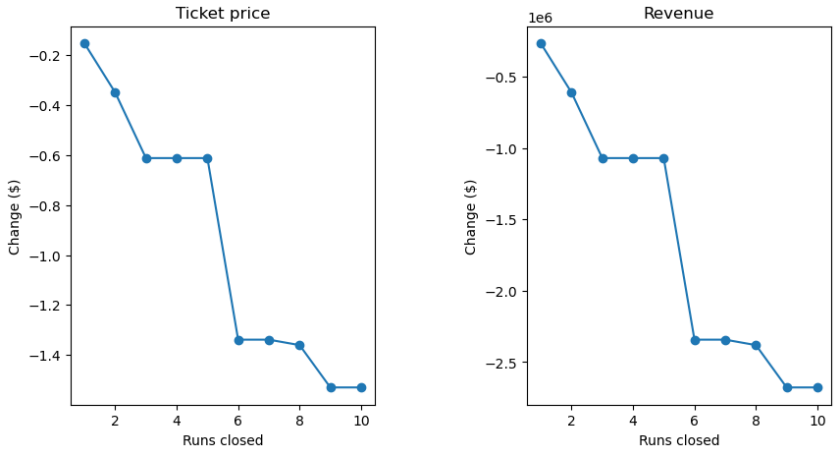
Recommendations:

1. The modelling lies in the assumption that other resorts accurately set their prices according to what the market (the ticket-buying public) supports. Based on current available date, the predicted the expected 'AdultWeekday' price for Big Mountain is $92.41, versus its current price of $81.00. With the expected mean absolute error $10.41, modeled price could be in the range between [$82 - $102.82]. The dataset doesn't include visitor data of each resorts. If we can add get visitor number and staying days etc. data, we can improve the modeling better.

2. To balance the additional $1,540,000 cost for the new chair lift, if the expected number of visitors over the season is 350,000 and each will buy 5-day tickets on average, price increase of $0.88 would cover that. While the predicted increase space is much more than that, at least 10% revenue increase is also quite positive by the end of this season. Of course, we would need to learn about business costs on other aspects and overall as well, for a better estimation.

3. Big Mountain has 7 above average or high facilities/ features to offer among the market share, including its market share ranking/positioning in 'vertical_drop', 'fastQuads', 'total_chairs', 'Runs', 'SkiableTerrain_ac', 'Snow Making_ac', and 'LongestRun_mi'. These mostly match the key features found in modeling that contributes to pricing (except for 'LongestRun_mi'). So, these are among the resort's key marketing points and pricing factors. Also, these are the prioritized factors/directions when considering future improvements.

4. For proposed future improvements, based on the scenarios modeling, (1) to increase the vertical drop by adding a run to a point 150 feet lower down without additional snow making coverage could increase ticket price by $0.40. That would require an additional chair lift to bring skiers back up, so the one-time installation cost and longtime operational cost could also be taken into consideration for better estimation. (2) Adding 2 acres of snow making to the added run and vertical drop won't support price increase. (3) Increase the longest run by 0.2 miles and guaranteeing its snow coverage by adding 4 acres of snow making capability doesn't help with price increase either. (4) Closing down 1 to 5 of the least used runs would support price decrease of $0.15 to $0.61, again, we need to know the operational cost of those runs for better calculation to suggest, but probably no more than 5 runs, as the price drop would be much more, as plotted in the chart. I would suggest to try to close 1 or 2 least used runs to see the operational cost saving and the balance first, then have a better estimation to see if it's good to close more runs.



5. The reason that the current price seems much lower than the predicted, although Big Mountain was already fairly high on some of the league charts of facilities offered, I think it's probably related to the management's previous pricing strategy of following marketing average, also as an affordable resort it has quite some visitors already. To find out, I suggest the resort may perform some small tests like offering different price (current vs. increased price) for different access packages, with different chairs, or other access or accommodation convenience, etc. Collect people's experience and feedbacks, if people would accept increased price for better access and accommodations, then the new price tested fine. Also, the closing of least used runs could also be tested from 1-2 runs and see the operating cost saving and feedbacks. We can help then with testing results and further information for prediction and suggestions.

Limitations and future work: Current dataset used for modeling was mainly on facilities. We don't have visitor numbers and average staying time of each resort for better prediction. Other data such as weather information such as temperature, geographic latitude, etc., may also relates to snowing and maintaining conditions. Also, transportation convenience, such as numbers of airports nearby and distance in between, and accommodations like hotels and restaurants numbers on site might affect population and visitor numbers. And, operational costs, for sure is very important to ticket price and revenues as well. We may not be able to get operational cost of other resorts for modeling, at least within Big Mountain, costs information will be helpful with further assessments of business improvements for sure.

Besides the operating cost of the new lift (that actually includes installation cost and annual operating cost), other costs such as previous lifts and all types of old chairs/lifts operating and maintenance cost, snow making and runs maintaining cost, TerrainParks maintaining cost, employees counting and cost, other energy and operating and marketing cost, etc., could be useful for better estimation for business improvement.

To make it more convenient for the business analyst and management teams, in future, we can write some functions with the model, so they can try and input different parameters and see the results as visualized plots, maybe on web pages or some dash board.

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