Big Mountain Ski Resort Data Analysis for Business Optimization

Guided Capstone Project - 2021
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Context

- Big Mountain Resort offers spectacular views of Glacier National Park and Flathead National Forest, with access to 105 trails.
- The organization recently installed an additional chair lift, increasing their operating costs by $1.54M for a season.
- About 350,000 people ski or snowboard at Big Mountain annually.
- Big Mountain is not capitalizing on its facilities as much as it could. Basing their pricing on just the market average does not provide the business with a good sense of how important some facilities are compared to others.

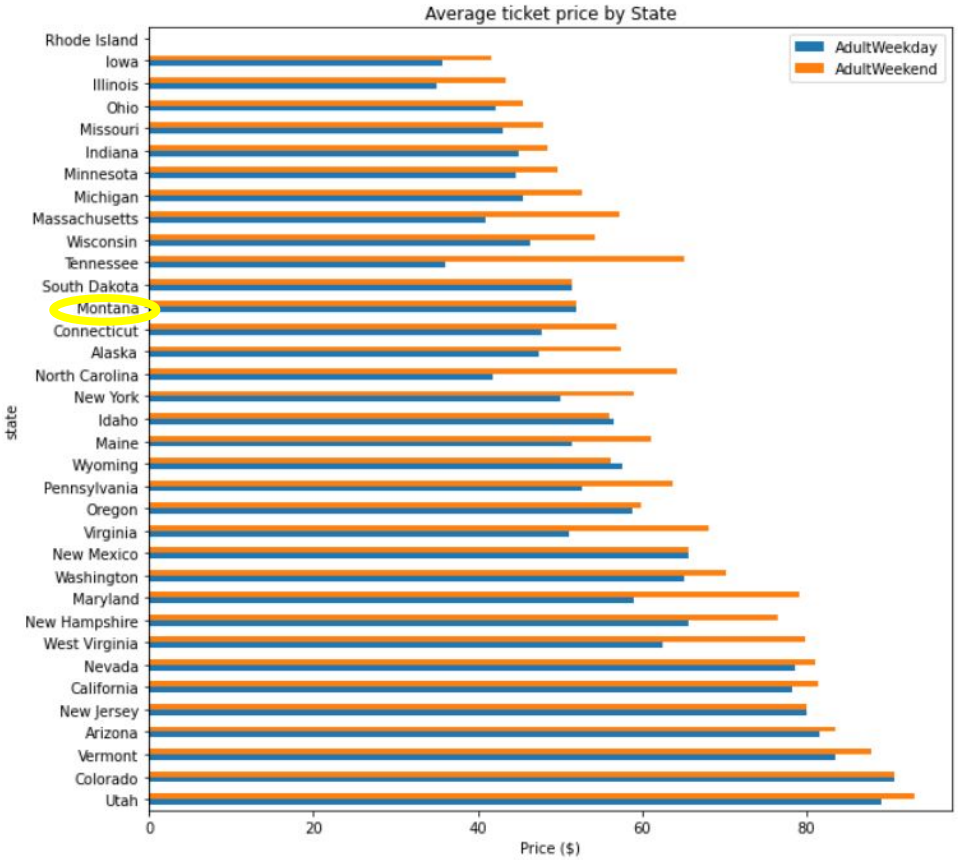
Goals

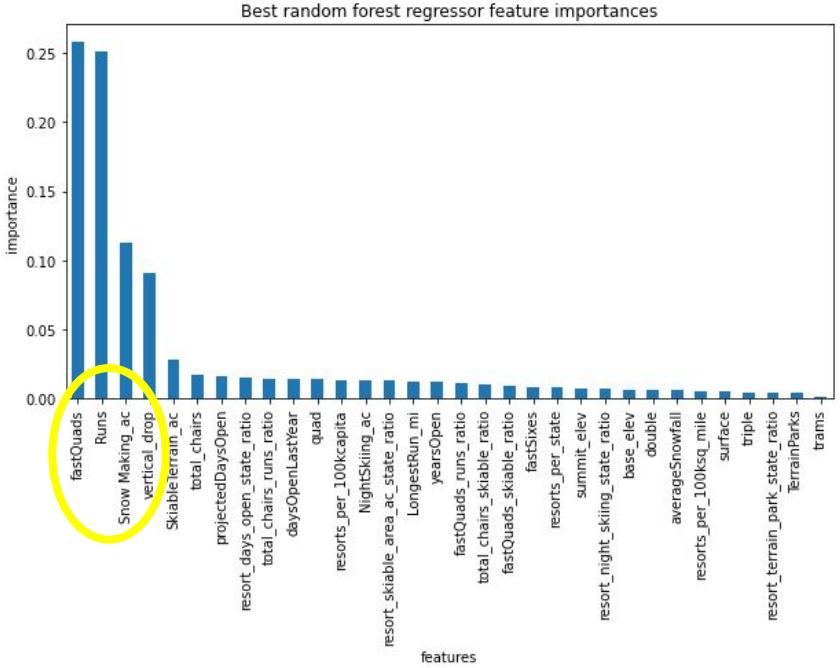
- Find which facilities if exploited bring the most revenue and increases ticket prices.
- Find the optimal ticket price basing off of competing resorts' prices.
- Find ways to offset increasing operating costs from additional chairlift if there are any.
- Create models and choose a final model to find answers to questions.

Strategies and Key Findings

- Adult weekend prices are higher than adult weekday prices sub $100 resorts.
- The key facilities at Big Mountain Resort are: number of fast quads, number of runs, maximum vertical drop, and acreage of snow.
- Scenarios for business optimization are:

1. Increase up to 150ft vertical drop and required additional chairlift without additional snow making.
2. Same as #2 but with additional 2 acres of snow making cover.


Average ticket price by State
AdultWeekday
AdultWeekend
Rhode Island
Iowa
Illinois
Ohio
Missouri
Indiana
Minnesota
Michigan
Massachusetts
Wisconsin
Tennessee
South Dakota
Montana
Connecticut
Alaska
North Carolina
New York
Idaho
Maine
Wyoming
Pennsylvania
Oregon
Virginia
New Mexico
Washington
Maryland
New Hampshire
West Virginia
Nevada
California
New Jersey
Arizona
Vermont
Colorado
Utah
state
0
20
40
60
80
Price ($)


Best random forest regressor feature importances
importance
0.25
0.20
0.15
0.10
0.05
0.00
fastQuads
Runs
Snow Making_ac
vertical_drop
Skiable_terrain_ac
total_chairs
projectedDaysOpen
resort_days_open_state_ratio
total_chairs_runs_ratio
daysOpenLastYear
quad
resorts_per_100kcapita
NightSkiing_ac
resort_skiable_area_ac_state_ratio
LongestRun_mi
yearsOpen
fastQuads_runs_ratio
total_chairs_skiable_ratio
fastQuads_skiable_ratio
fastSixes
resorts_per_state
summit_elev
resort_night_skiing_state_ratio
base_elev
double
averageSnowfall
resorts_per_100ksq_mile
surface
triple
resort_terrain_park_state_ratio
TerrainParks
trams
features

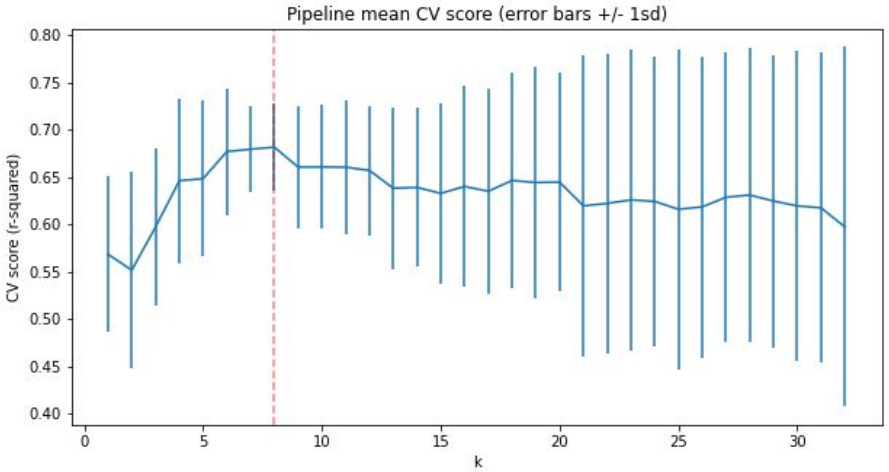
	Scenarios	Description	Price	Delta rel to pred Price	Revenue ($mil)</th><th>RevenueDiffromModeledPrice($ Mio)	
0	Predicted Price	Predicted Price	95.87	0.00	167.772	0.00
1	Current Price	Current Price	81.00	-14.87	141.750	-26.02
2	Scenario 1.1	Closing 1 run	95.87	0.00	167.772	0.00
3	Scenario 1.2	Closing 2 run	95.46	-0.41	167.055	-0.72
4	Scenario 1.3	Closing 3-5 runs	95.20	-0.67	166.600	-1.17
5	Scenario 1.4	Closing 6-8 runs	94.61	-1.26	165.568	-2.20
6	Scenario 1.5	Closing 10 runs	94.06	-1.81	164.605	-3.17
7	Scenario 2.1	add 1 chair and 150ft vertical drop	97.85	1.99	171.238	3.48
8	Scenario 3.1	add 2 acres of snow making	97.85	1.99	171.238	3.48
9	Scenario 4.1	extend longest run (0.2mi) & add 4 ac snow making	95.87	0.00	167.772	0.00

Modeling (Cross-Validation)

Linear Regression Model

- Early stage of model building, hyperparameter tuning yielded 8 parameters/features resulted in lowest error rate.
- Adding more parameters suggests overfitting will occur and cross-validation score reduction.
- Imputing missing data with mean vs. median produced better scores.
- Mean absolute cross-validation error (MAE) of the model = 10.5
- Standard deviation = 1.62
- MAE for ticket price prediction = 11.79
- Top features to look for:

1. fastQuads
2. Runs
3. Total number of chairs
4. Acreage of snow
5. Maximum vertical drop



Modeling (Cross-Validation)

Random Forest Model

- Missing data imputed using median and no scaling of features resulted in better scores and a better model.
- Mean absolute cross-validation error (MAE) of model = 9.64.
- Standard deviation = 1.35
- MAE for ticket price prediction = 9.54
- Top features to look out for:

1. fastQuads
2. Runs
3. Acreage of snow
4. Maximum vertical drop

- CV score shows that as training set size increases, it levels off to approximately sample size of 50.

Limitations

- Not every resort held a valid ticket price value.
- Lack of data on operation and maintenance costs.
- A valid number of average visitors for each season for each resort.

Conclusion

- When excluding Big Mountain Resort data when training the model to predict ticket price, we get a MAE of 10.39 and standard deviation of 1.47 (this had less bias). In this model, suggested optimal ticket price was $95.87.
- Seeing where this resort lies in ticket prices among other resorts in the market, it currently charges less than the amenities it offers (current ticket price is $81).
- Random forest model was the better model overall, with lower variation on the test set data, lower MAE and lower standard deviation.
- The key features that were at the top were consistent throughout each model, gives confidence in results.
- There are multiple limitations that hinder a solid business optimization plan, hence finding answers to these would be a good idea.
- Recommended strategies to increase ticket price and revenue include scenario of increasing vertical drop by 150ft, go forward with addition of chairlift, and increase snow making. Closing a run per season would help reduce maintenance costs.

What's Next?