Predicting Hotel Booking Cancellations

By Matthew Merrill

Problem

Cancellations cause…

- Daily actualized income to drop below projections when rooms cannot be re-booked.
- Forced price reduction to fill vacancies.
- Increased distribution costs to sell those vacant rooms.

Problem

Data from 2015 to 2017 from our clients two hotels in Portugal (one city, resort) show an increase in cancellations correlated with an increase in bookings from online travel agencies.

Cancellations from OTA's increased 39% in the 3 years our data was collected.

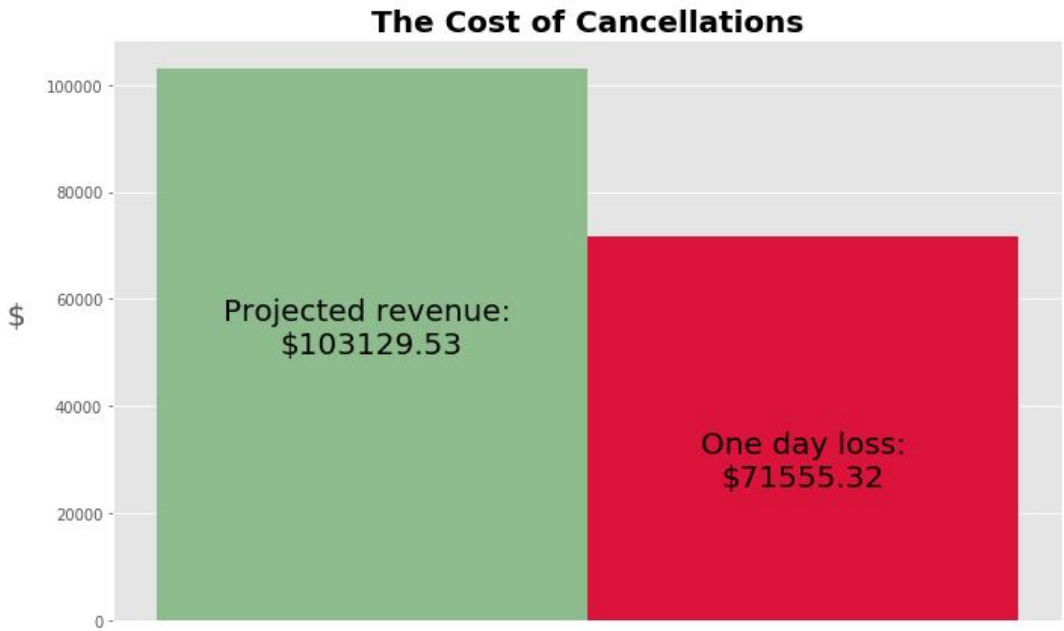
Online Travel Agencies

Cancellation rates have been on the rise since the advent of “risk free cancellations” among many online travel agencies.

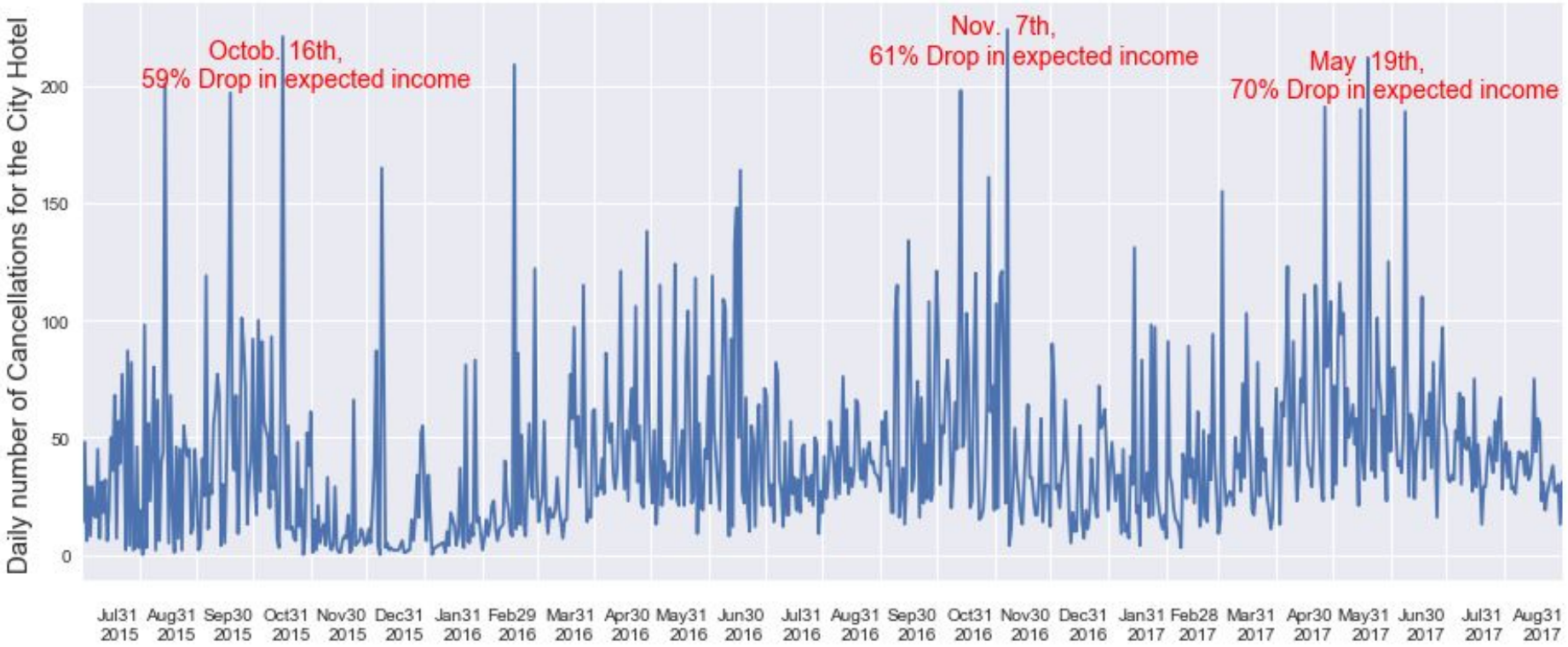
Over the same time span that online travel agencies began to dominate the booking industry (56% of bookings in 2017 were from an OTA) the rate of cancellations among hotels also increased (“Booking.com” reported a 50% cancellation rate among reservations in 2018).

Case Study, May 19th, 2017

- Our clients city hotel suffered a 73% cancellation rate.
- Potential losses amounted to over 70K.
- 40% of cancellations were from OTA's



Fluctuations like this are common and difficult to anticipate



BUT … Cancellations can be predicted with machine learning

There are common traits among cancelled bookings that can be captured and explained in a machine learning model.

The fasted and most easily interpreted model for our use is Catboost.

Using our model

We could have predicted...

- 99% of cancellations on October 16th
- 94% of cancellations on November 7th
- 86% of cancellations on May 19th

from the moment the booking was logged.

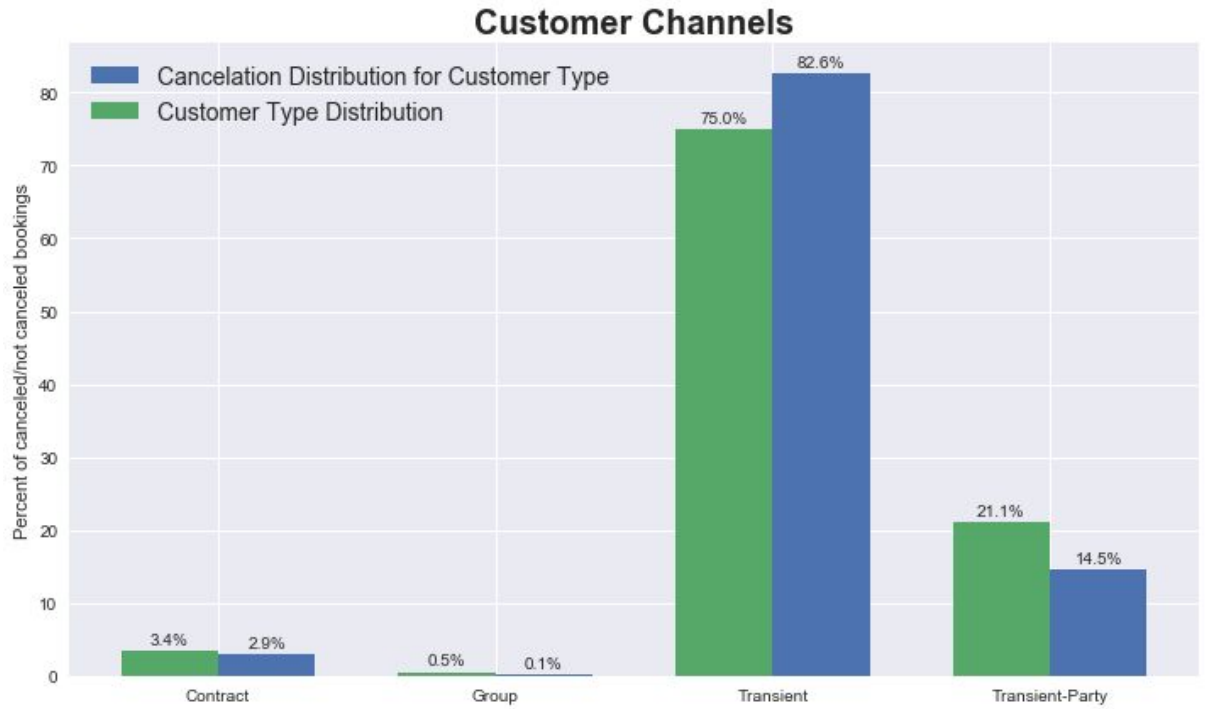
Observations from Exploratory Analysis

Lead time

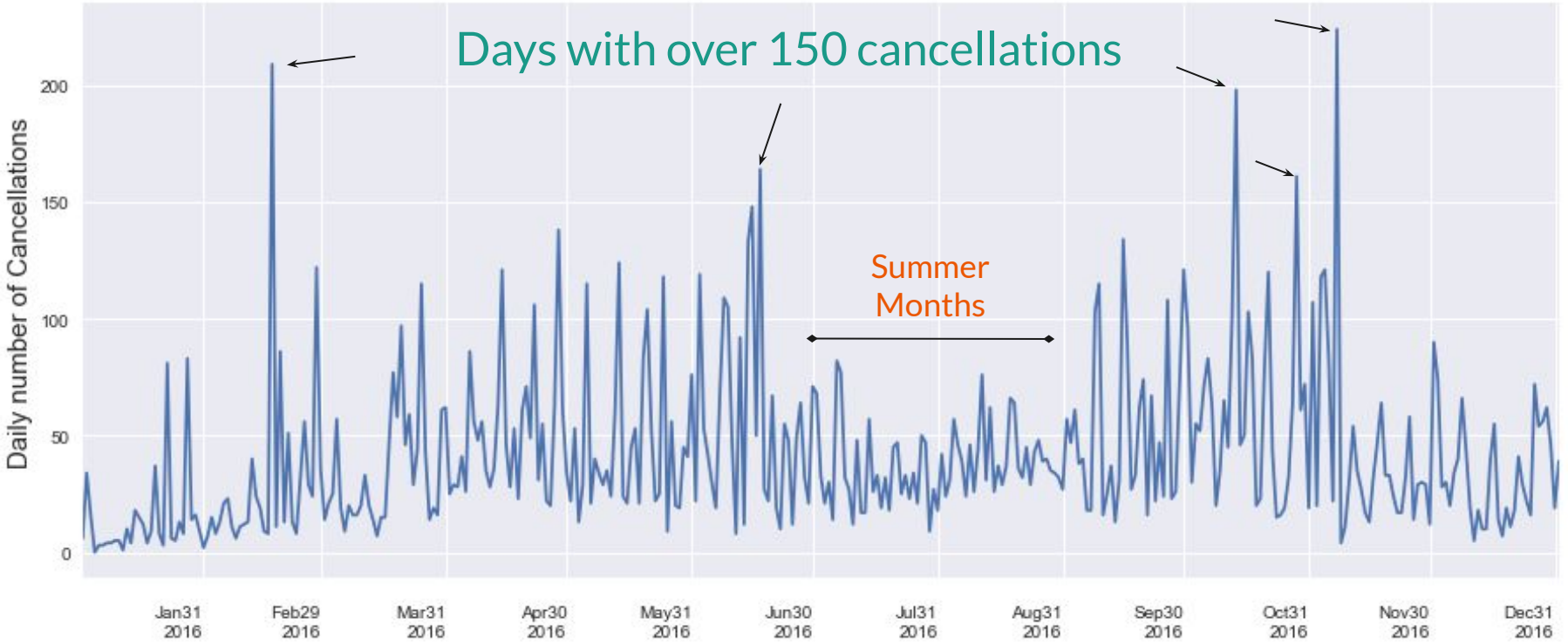
- Median lead from from canceled bookings was 145% greater than for non-canceled.

Customer type

- Transient bookings accounted for 83% of cancellations but only 75% of bookings.



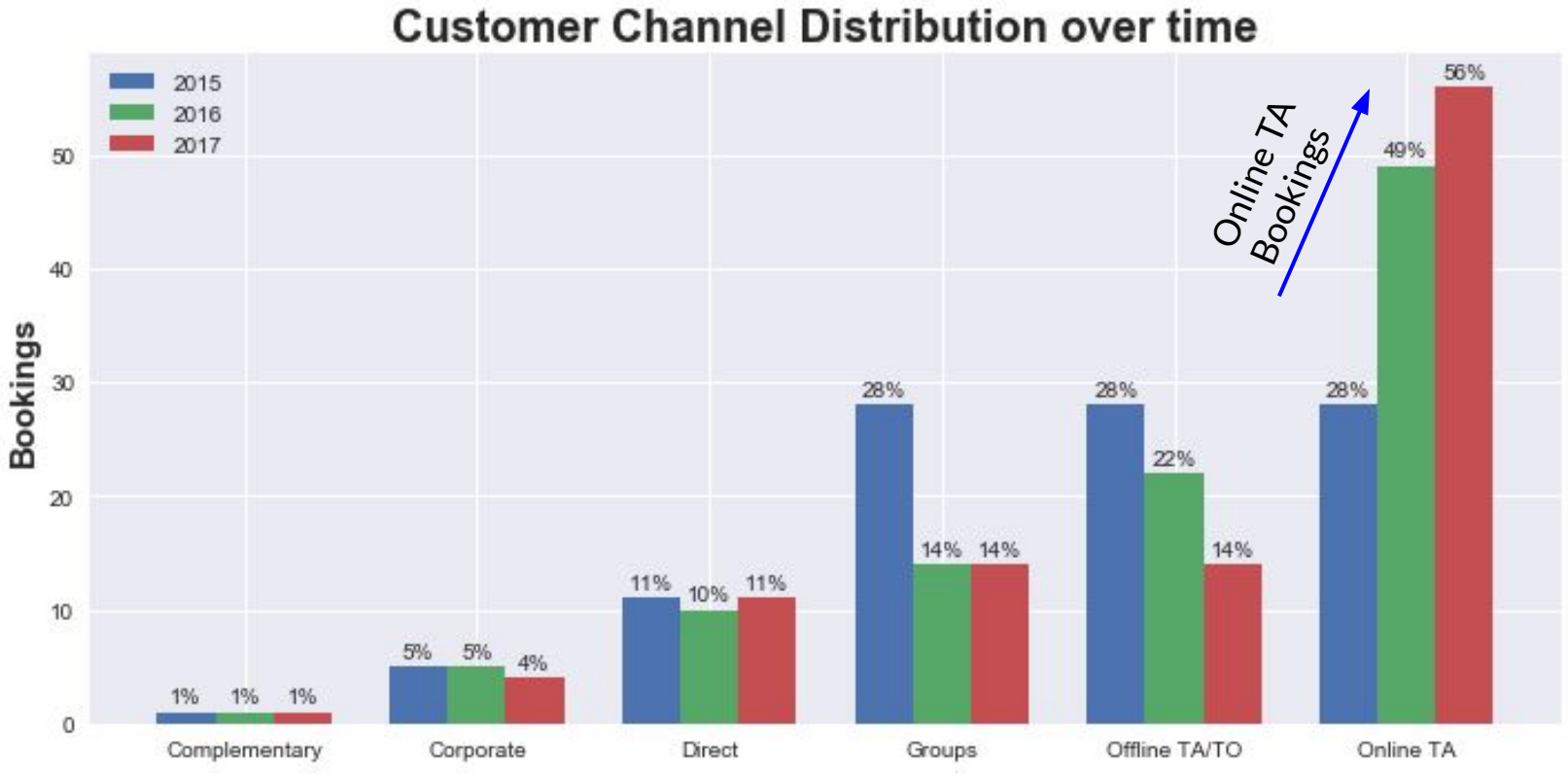
Seasonality: Summer months have lower cancellation rates



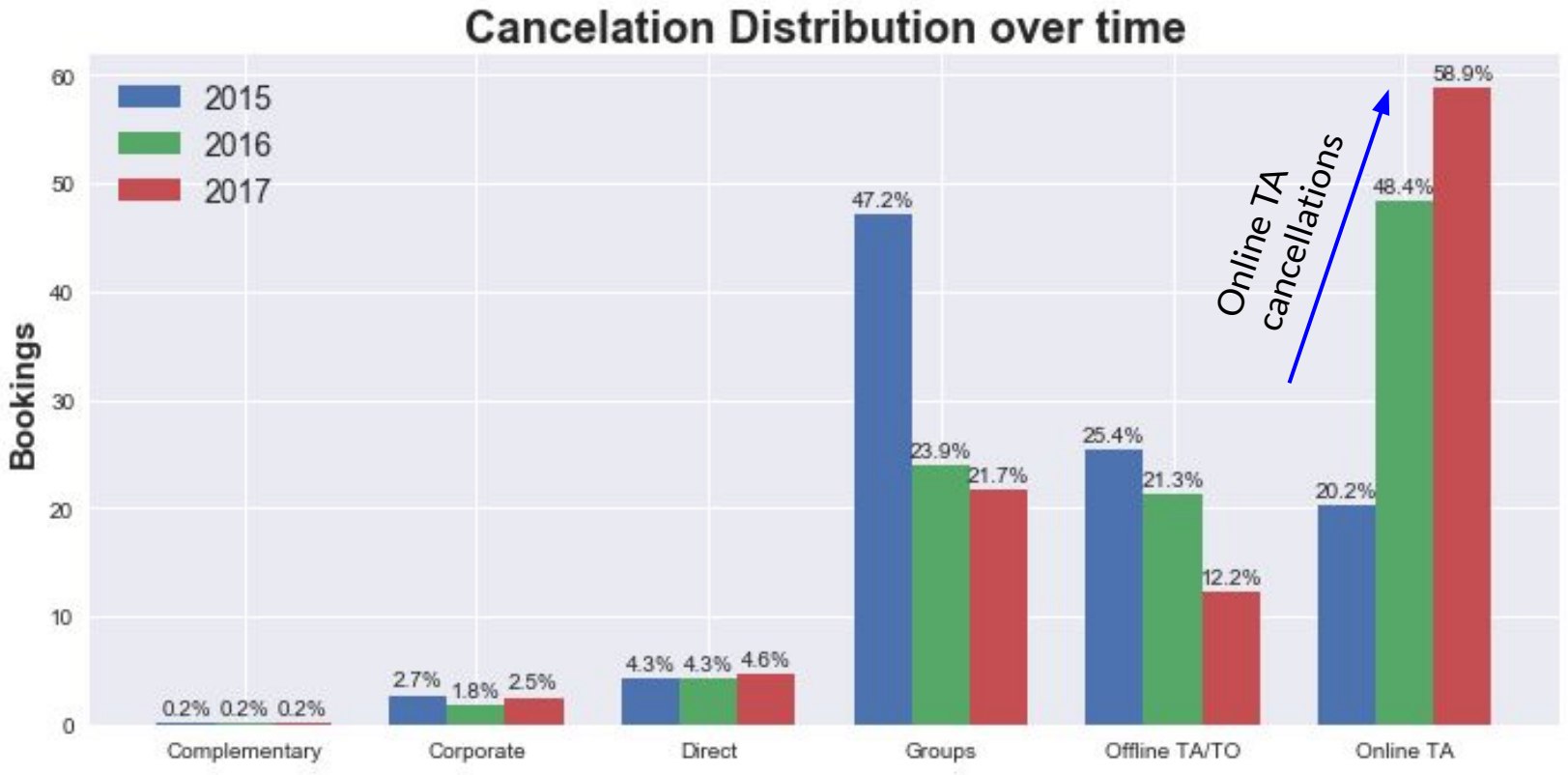
Market Segment

- Changes in the share of canceled bookings has changed over time.
  - 47% were from group bookings in 2015
  - 59% were from online travel agencies in 2017
- OTA cancellation rate in 2017 was 41%, the highest among any group.

Online TA bookings increased 28% from 2015 to 2018



Online TA's made up 59% of cancellations in 2017, up from 20% in 2015



Summary of observations

Cancelled bookings share the following common traits:

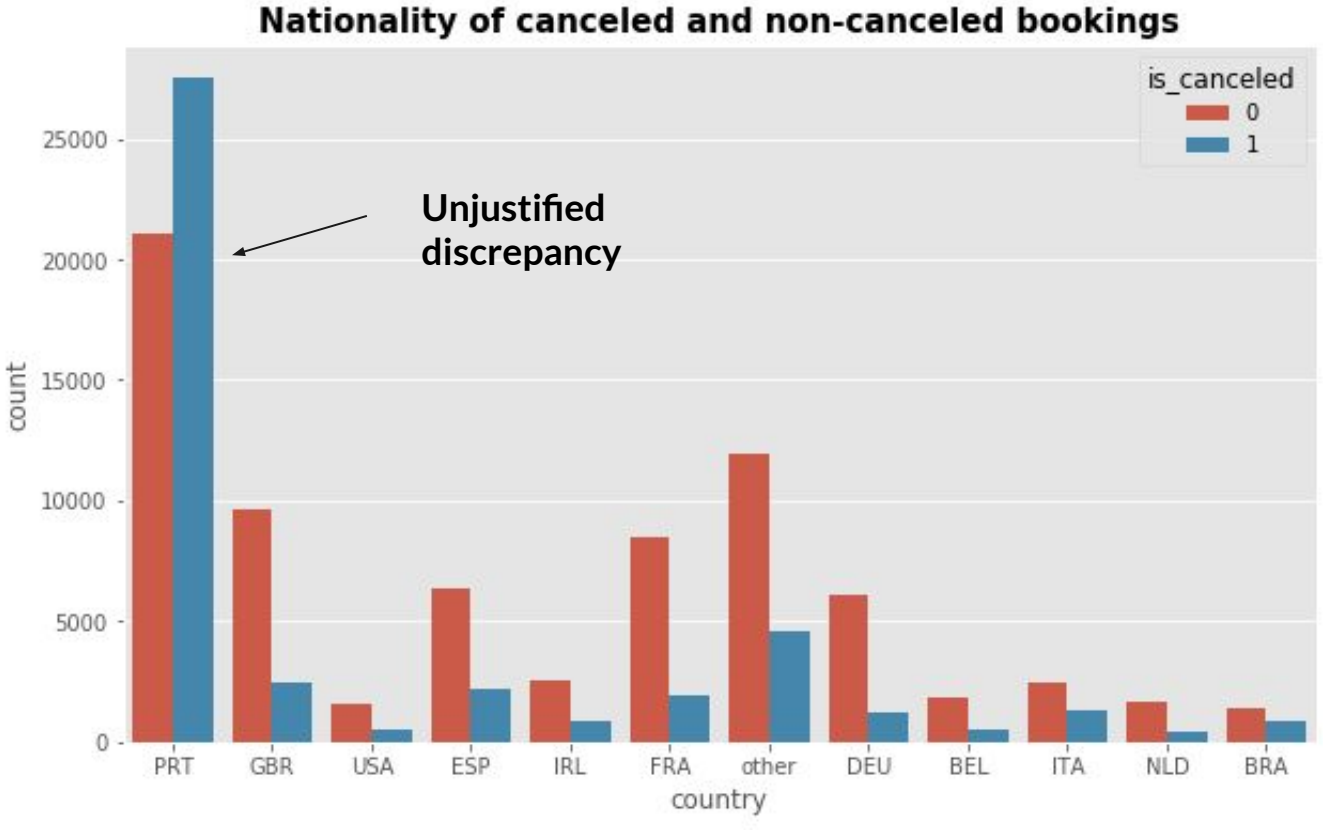
- Lead times are typically greater
- They have slightly higher average daily rates
- OTA and Group bookings have some of the highest cancellation rates.
- Cancellations are shifting towards OTA's and away from groups.
- Some rare but telling traits:
    - If a guest has previous cancellations or booked through 'agent 9', they are considered a high risk cancellation.

Machine Learning

Data Leakage

- The goal is to predict cancellations at the moment the bookings is made.
- Special requests, meal options, car parking requests, assigned room type and any booking changes had to be dropped as these are often chosen after the booking is made and do not accurately represent information known at booking.

Country of origin is assigned to Portugal if the booking is canceled or a no show



Model results

- Our goal is to predict cancellations, but accuracy is not the most important metric, AUROC is.
- The AUROC will tell us how well the model can distinguish between classes (canceled vs non-canceled)
- We also care much more about reducing false negatives than false positives.

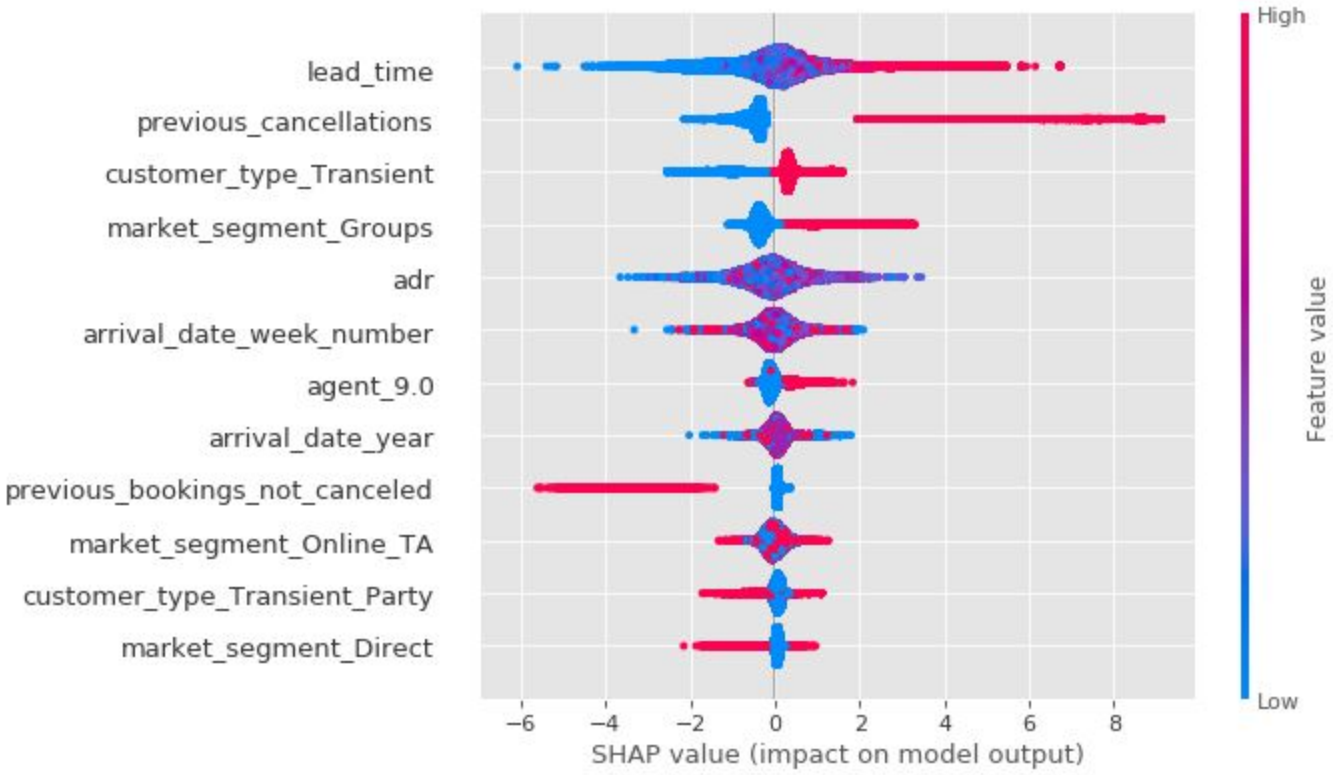
Model results

- Logistic Regression: 77% AUROC
- Random Forests: 90% AUROC
- Catboost: 89% AUROC

Model of choice: Catboost

It handles categorical features extremely well, makes fast predictions and is interpretable.

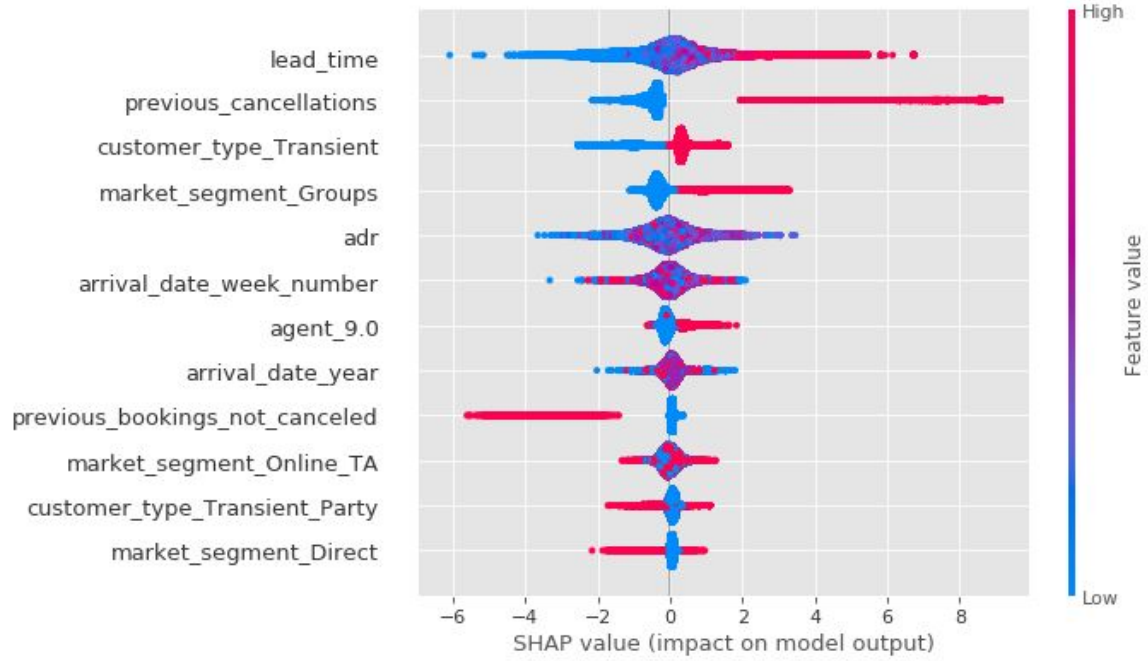
Catboost Summary plot



Feature importance can be understood with a summary plot.

The most important appear on top.

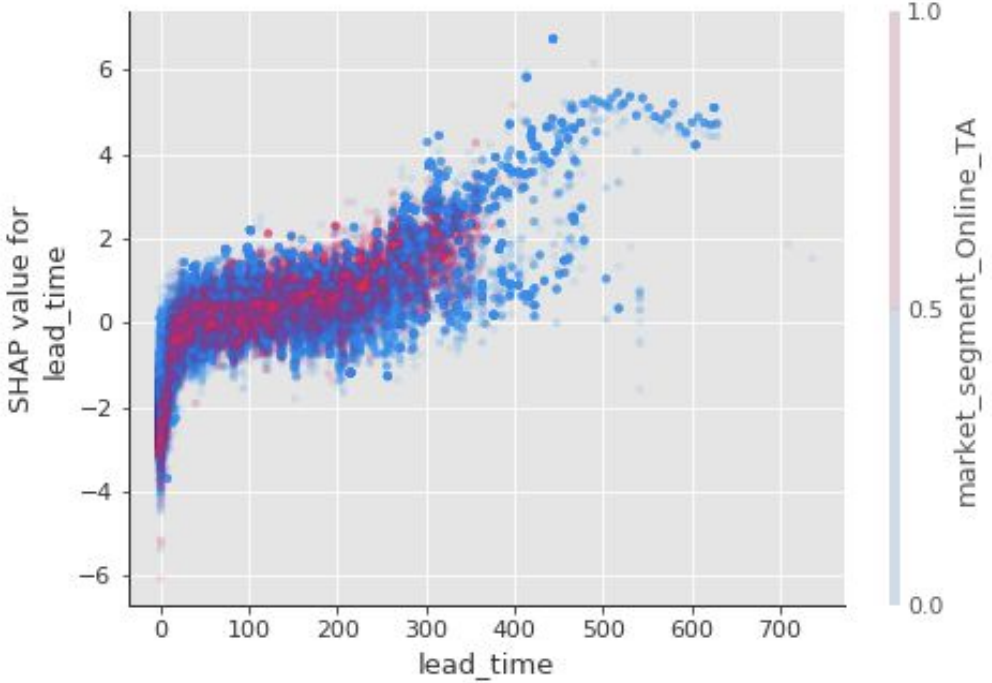
Catboost Summary plot



ADR and arrival week need to be investigated further.

Lead time, previous cancellations, transient bookings and group bookings are clear indicators of high cancellation risk.

Catboost Dependency Plot: lead time

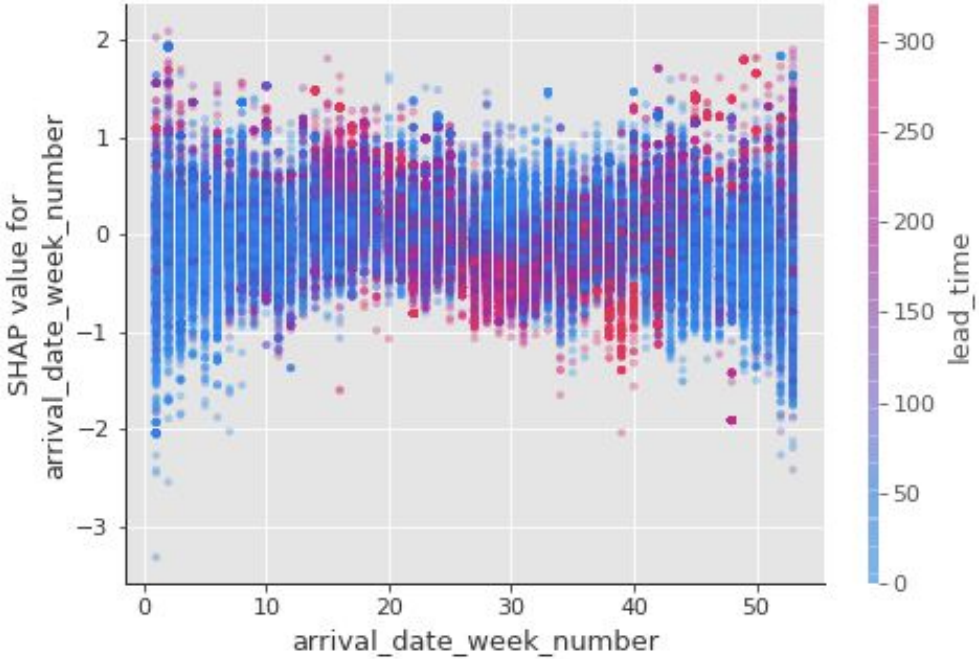


Lead time is our strongest indicator.

Bookings with lead times greater than 200 are considered high risk.

Last minute bookings are typically followed through.

Catboost Dependency Plot: arrival week

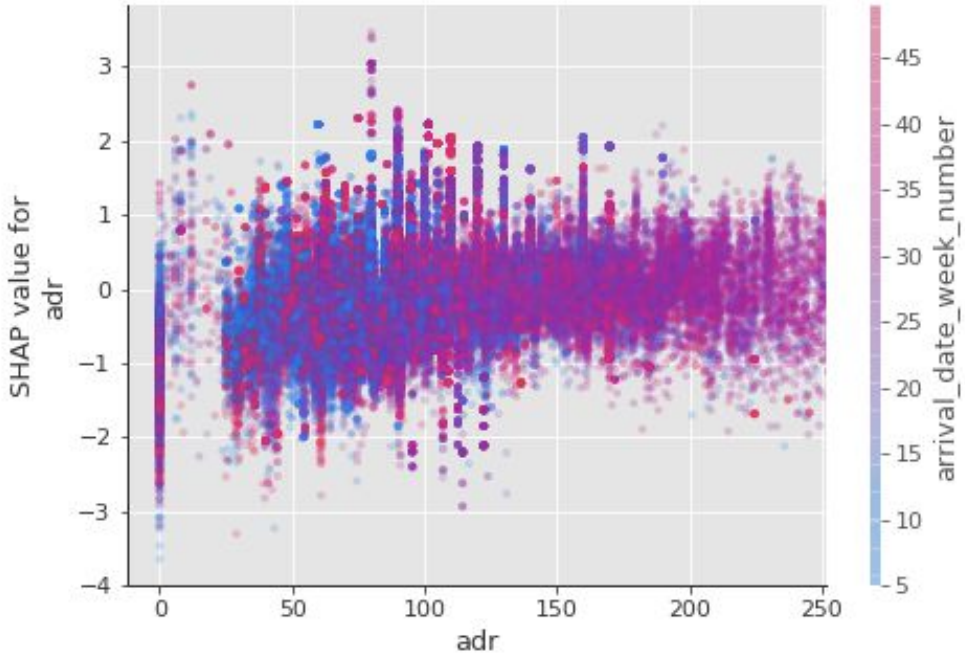


Greater lead times are marked with a red hue.

Points below the horizontal 0 line are less likely to cancel.

Lead times are good indicators of cancellations, except during the summer months when they imply the opposite.

Catboost Dependency Plot: ADR



There's a slight increase in risk for higher room rates.

Higher room rates occur in summer (seen by points with a purple hue) when cancellations are less erratic.

Free bookings are extremely low risk.

Potential uses for model

The implications of this work bring a myriad of options to lower overall cancellation rate, increase actualized income and improve customer experience for hotels.

With the ability to distinguish between possible cancellations early on, hotels can create a focused effort towards preventing canceled bookings.

Potential uses for model

- Improve the accuracy of projections for daily actualized income
- Reach out to high risk bookings with discounted packages, perks and early options to customize their experience.
- Use projected cancellation rates to optimize the distribution of customer channels.

Model Deployment

Using the Rshiny package in Rstudio, a web application was created to display the results and interact with the catboost model.

Please email me to check out the web app.

matt.merrill94@gmail.com

Personal Profile links

Sources

1. Hertzfeld, Esther. Study: Cancellation Rate at 40% as OTAs Push Free Change Policy. Hotel Management, 23 Apr. 2019, www.hotelmanagement.net/tech/study-cancelation-rate-at-40-as-otas-push-free-change-policy.
2. Funnell, Rob. “The Real Cost of ‘Free’ Cancellations for Hotels.” Triptease, Triptease - Attract. Convert. Compete., 13 May 2019, www.triptease.com/blog/the-real-cost-of-free-cancellations/?utm_source=MediaPartner\&utm_medium=HotelSpeak.