Analytics for Fare Class Purchases in Air Travel

Predicting the fare product purchased by customers and its implication for pricing strategies

30th March 2022

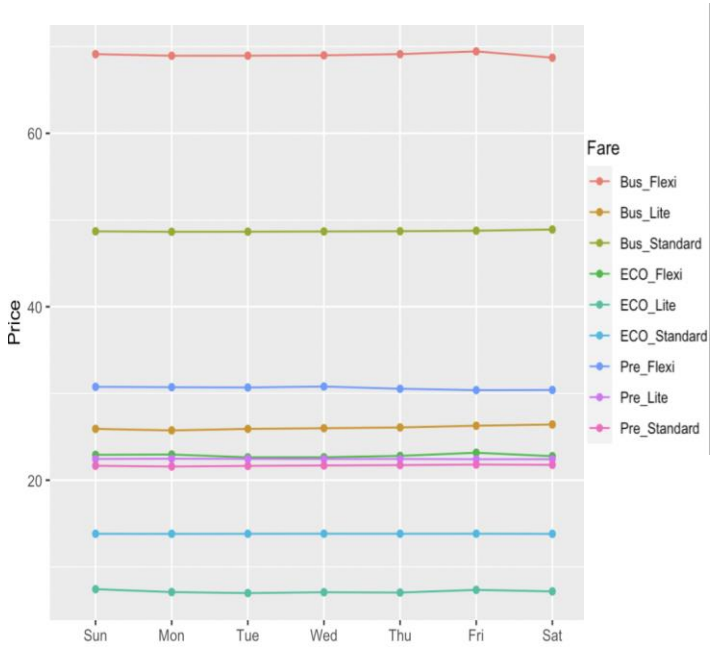
Adelyn | Xin Jie | Shannon | Jun Li | Jiadong

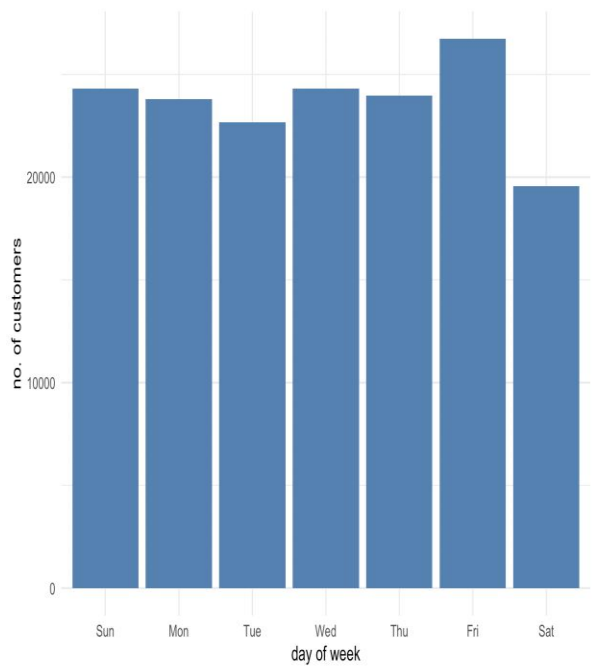
Executive Summary

Introduction & Objective	• As airline seats are limited in nature, Singapore Airlines is trying to optimize revenue by utilizing dynamic pricing to sell seats to customers with different profiles and different willingness to pay • Predict the fare product purchased by customers and its implication for pricing strategy.
EDA	• Analysing price & demand of bookings • Understanding fare class popularity • Purchase patterns for different fare class products • Proportion of Fare Product Type against Flight Length
Modelling	• Ran Random Forest with **accuracy of ~89%** • Utilized Decision Tree for each itinerary group to give additional insight into decision making process by customers
Purchasing Behaviour	• Customers are willing to pay more for having the **option to cancel** • Customers are risk averse – they are willing to pay more upfront to **for cheaper cancellation fees to insure themselves** for a potential flight cancellation.
Fare Strategy	• Use **Decoy Pricing** to monetise customer's risk averse attitudes by offering more expensive prices for customers who want the option to cancel bookings • **Rejig fare structure for Business-Flexi** such that cancellation charges is not hiked according to scarcity of seat but priced in as part of the Business-Flexi fare. • **Consider rate fencing** to allow customers to customize their own flight plans based on their own needs – individual customizations will be offered at a higher price
Limitations & Conclusions	• Airline capacity not known (affects rate fencing) • No show and cancellation data not available • Uneven distribution of fare products purchased (minimal number of rows that purchased tickets from the premium range)

Preliminary EDA

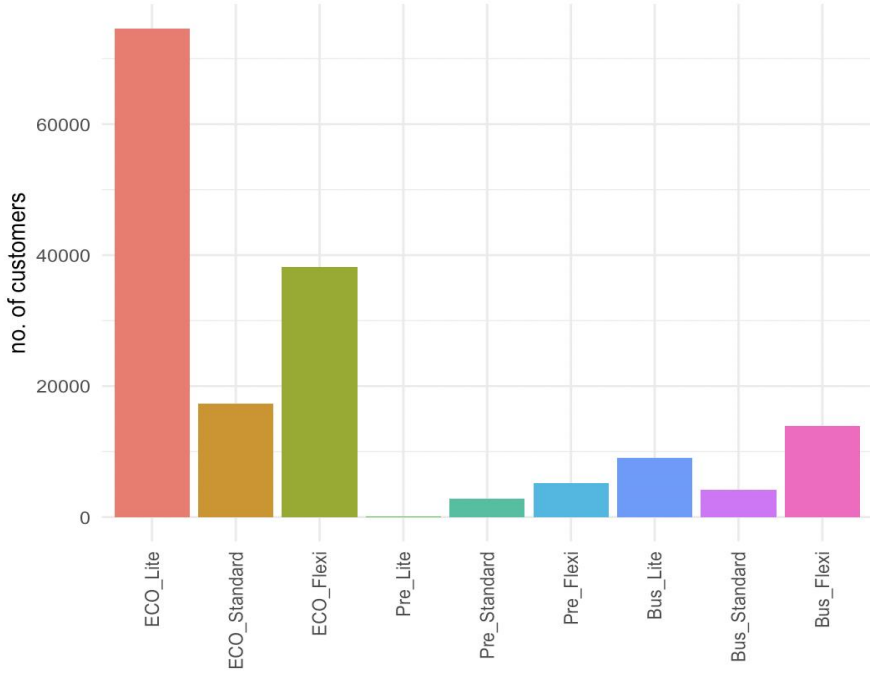
Price and Demand for Airline Tickets





- Price of economy flexi is generally around the same or slightly higher than premium lite and premium standard
- Demand is generally consistent throughout all days of the week with a slight decrease in demand on Saturday
- Demand and prices are relatively constant throughout the different days of the week which suggests the airline adopts a demand-based pricing strategy

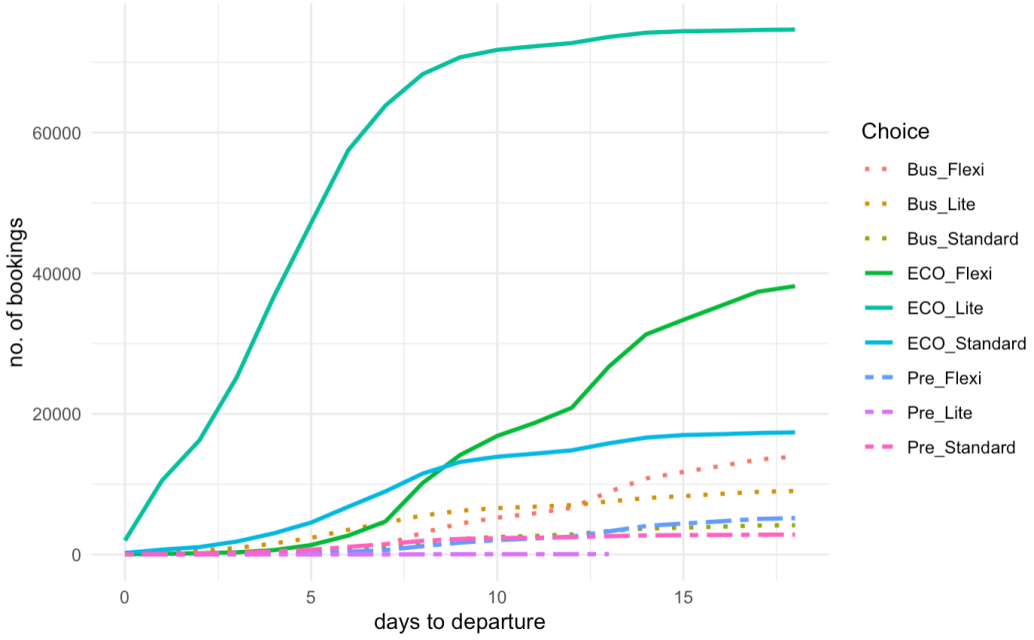
Looking at Fare Classes



- The most popular class is economy class, followed by business class and premium classes.
- For Economy and Premium classes, Lite fares are the most popular while Flexi is the most popular in business class. Business class travellers tend to be less price sensitive as companies usually pay for business travellers and leisure travellers could be part frequent fliers seeking to maximise mileage and upgrading benefits.
- Most people who choose Economy Lite are more price sensitive customers and more likely leisure travellers

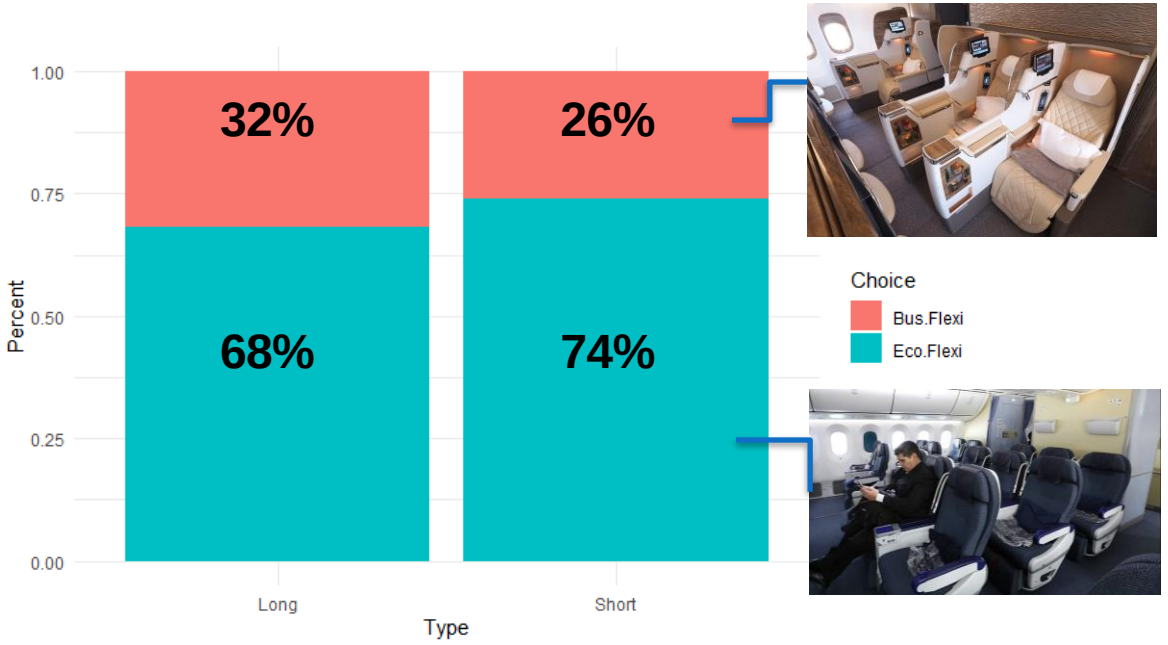
Preliminary EDA

Purchase patterns for different fare product types



- The bookings for **business classes generally start picking up closer to departure date**
- Businesses are generally willing to pay more to book last-minute and non-stop flight options but rarely allow premium-section seats for rank and file employees.
- Bookings for **economic classes generally start picking up early on when booking open** as most leisure travellers plan for trips in advance

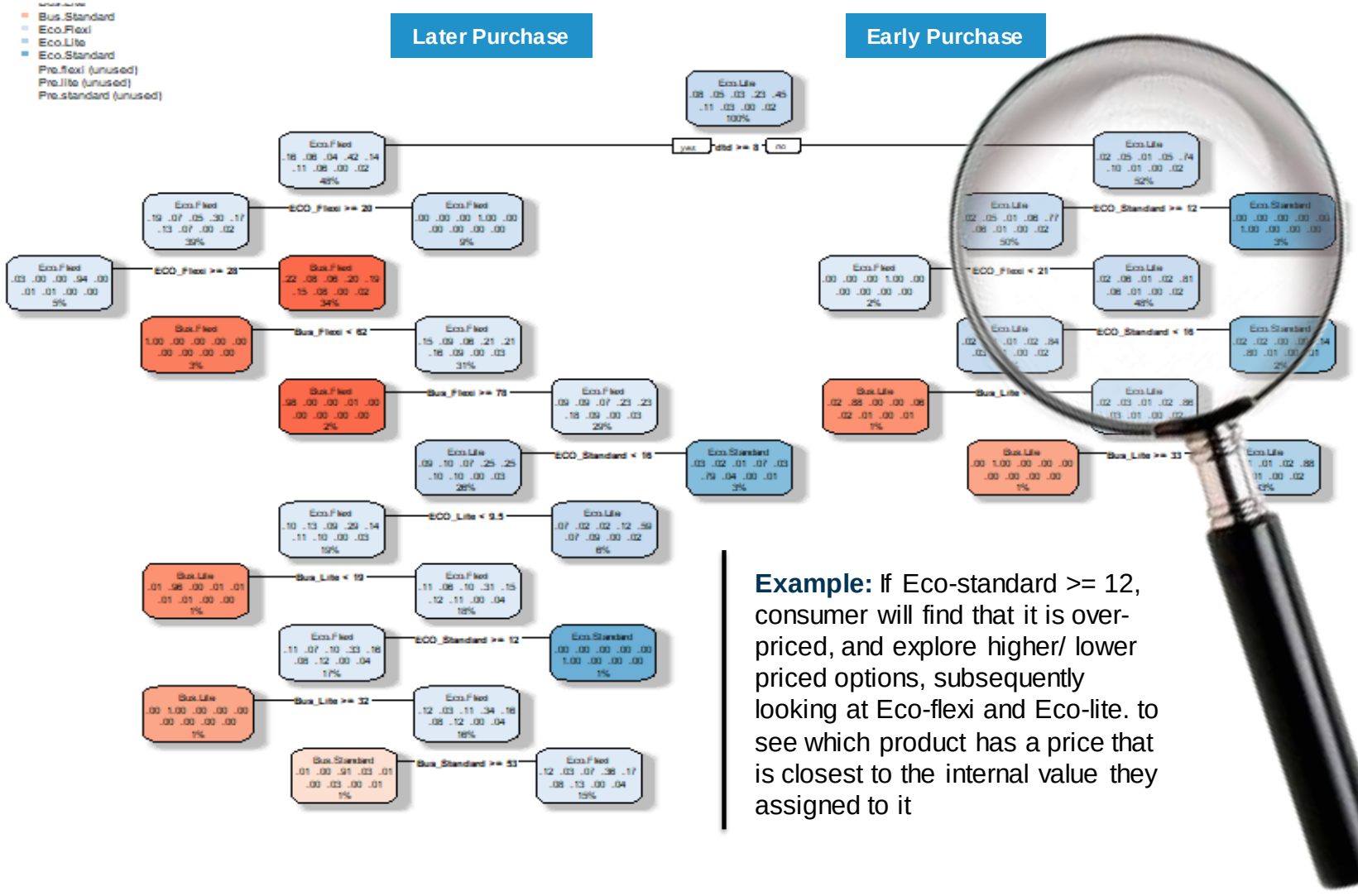
Proportion of Fare Product Type against Flight Length



- Assuming that length of itinerary name is correlated with flight duration
- **People on longer-haul flights prefer better seats:** Business-flexi purchases as a % of total Eco-flexi and Business-flexi is larger on long haul flights

Achieving Greater Clarity as to how features influence customer choice

Utilizing a decision Tree to illustrate the potential road map for consumer fare choice



Example: If Eco-standard >= 12, consumer will find that it is over-priced, and explore higher/ lower priced options, subsequently looking at Eco-flexi and Eco-lite. to see which product has a price that is closest to the internal value they assigned to it

Key Insights

Fare product purchase decisions driven predominantly by pricing:

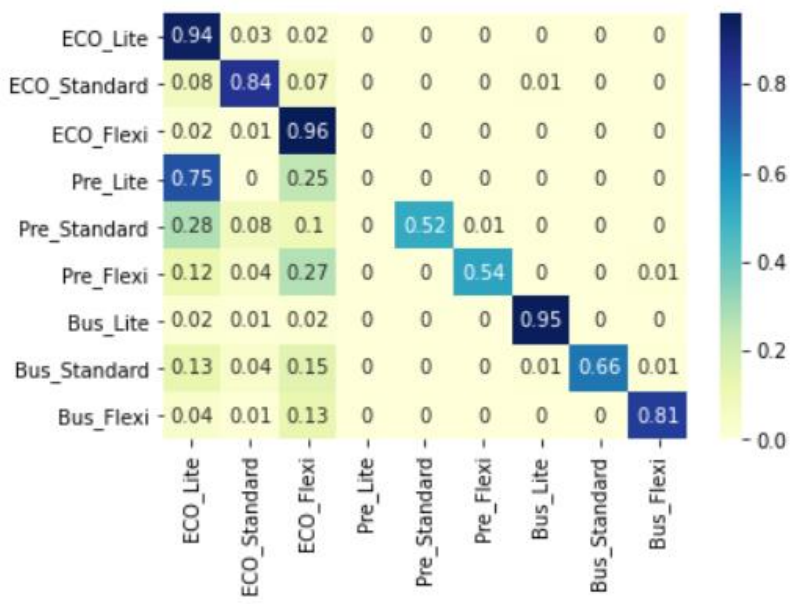
Unsurprisingly, flight number, week, and group are not used in the decision tree – we believe that product purchase would not be affected by which week or which day the consumer decides to fly

Multi-step Comparison-based Decision Making Process:

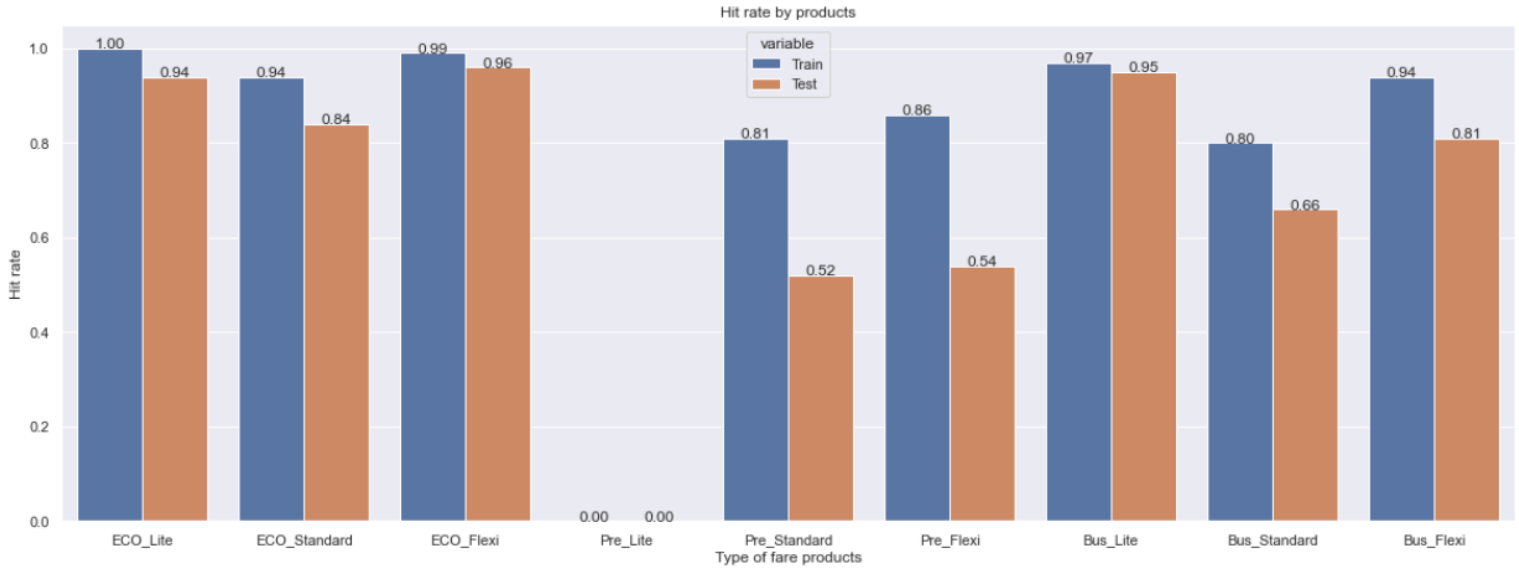
- The bulk of consumers utilize pair-wise comparison in deciding which product to buy
- Consumers assign utilities to each product – i.e. how much they value each product
- If product A's price exceeds their value allocated to them by the consumer, consumers will prefer to get a more premium product as they will feel that since product A is overpriced, the more premium product will seem "cheaper" relative to product A, hence more worth it and vice versa

Individual Hit Rate

Hit Rate Heatmap



Train vs Test Hit Rate

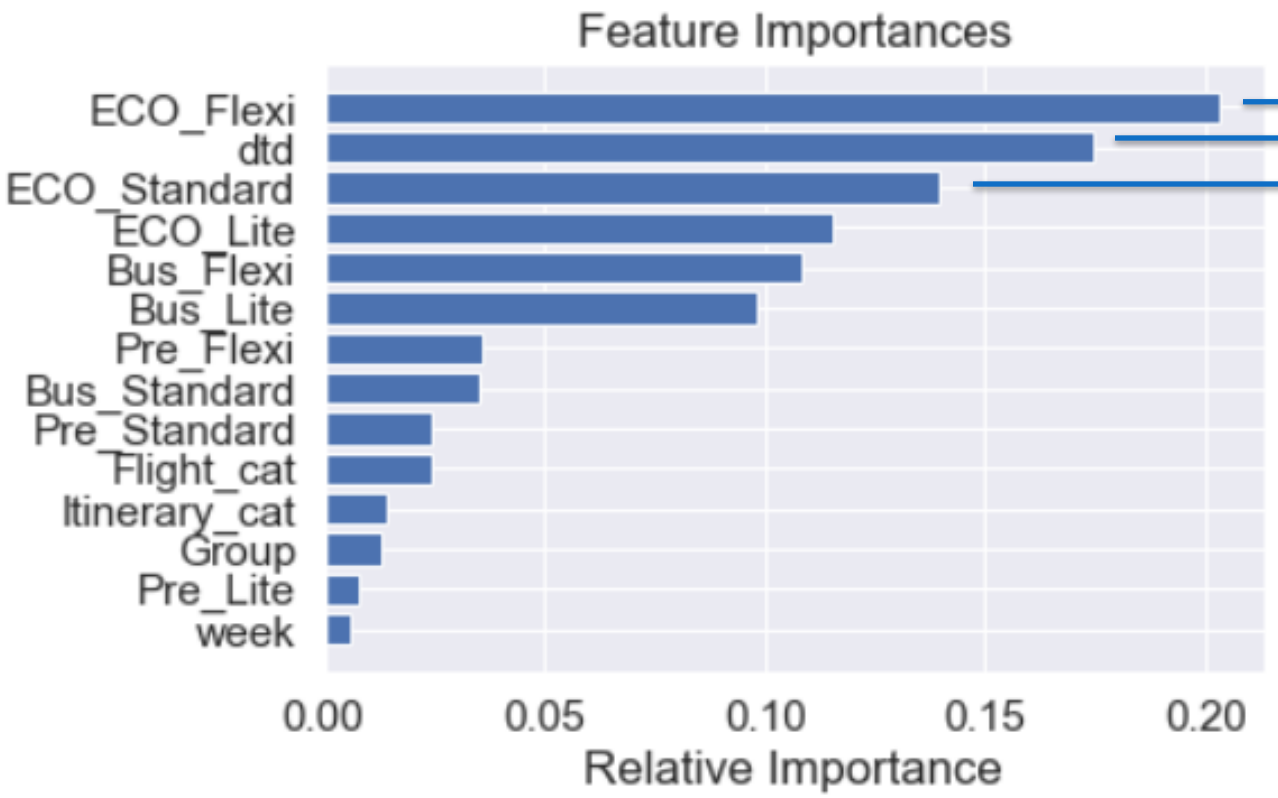


- ECO_Lite, ECO_Flexi and BUS_Lite are among the fare products with the highest hit rate

- Random forest model has a high accuracy of **0.89**
- Minimal difference between the train and test set hit rates, except for Pre-Standard and Pre-Flexi
- The purchase of Pre-Standard and Pre-Flexi products might be dependent on income as well as purpose of travel, which are information that are unavailable

Feature Importance: Which are the most pertinent features in flight purchasing

Random Forest Feature Importance Plot



Within our Random Forest model, the top 3 most important features in explaining which fare product selected are: 1) Eco Flexi Flight Price, 2) Days to Departure and 3) Eco Standard Flight Price

1 A flexible baseline for comparison: Eco Flexi Flight Prices

As Eco Flexi, is the highest-tier economy class option, one can assume that Eco-Flexi is the base-line that most corporate travellers that require flexi flights use to compare flight prices to.

2 A measure of urgency: Days to Departure:

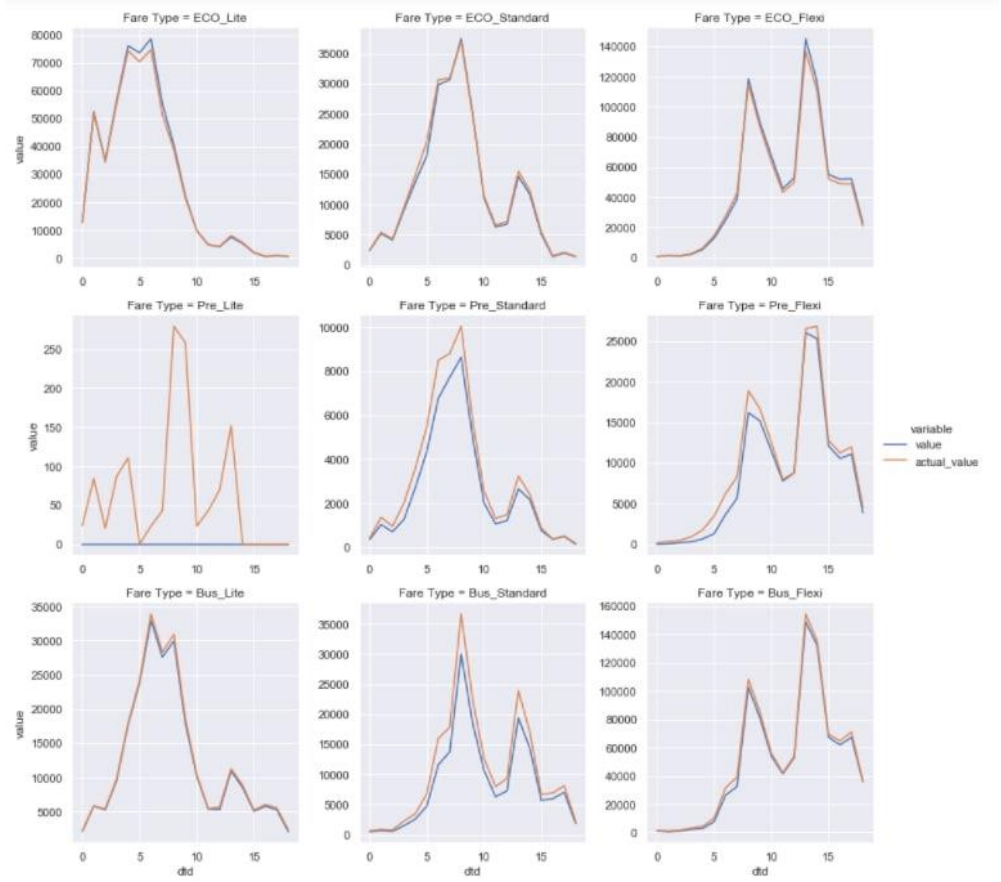
Leisure passengers will typically book seats in advance – as early as possible i.e. when the booking system opens, but corporate passengers may tend to book seats last minute, and may be willing to purchase higher fare products to get a seat.

3 A fixed baseline for comparison: Eco-Standard

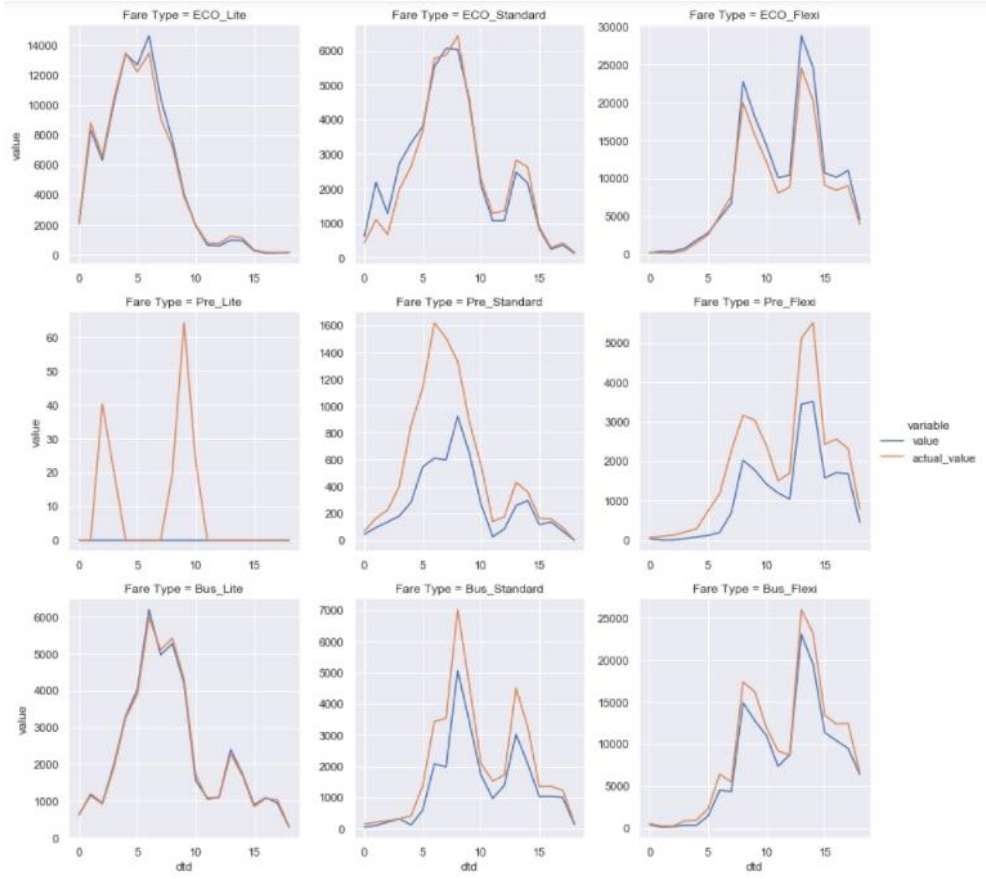
Eco-standard is the "default" option for the masses, hence it would provide a baseline comparison for fixed flight tickets.

Actual vs Predicted Sales across All Fare Products by Days Prior to Departure

Train Set



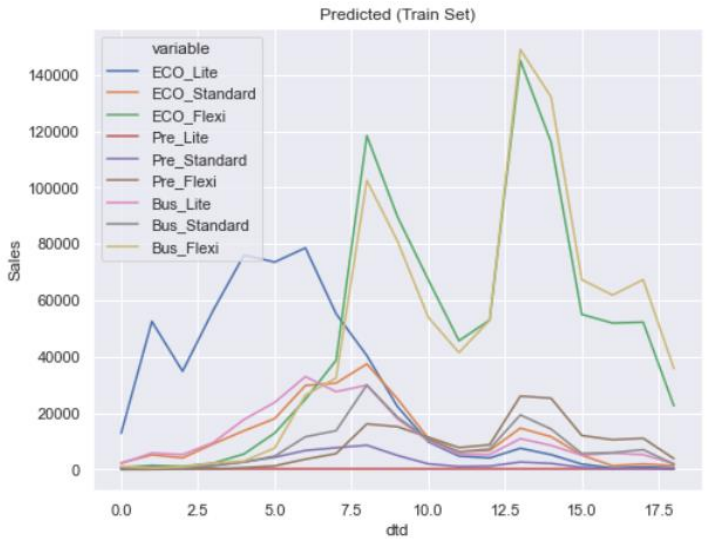
Test Set

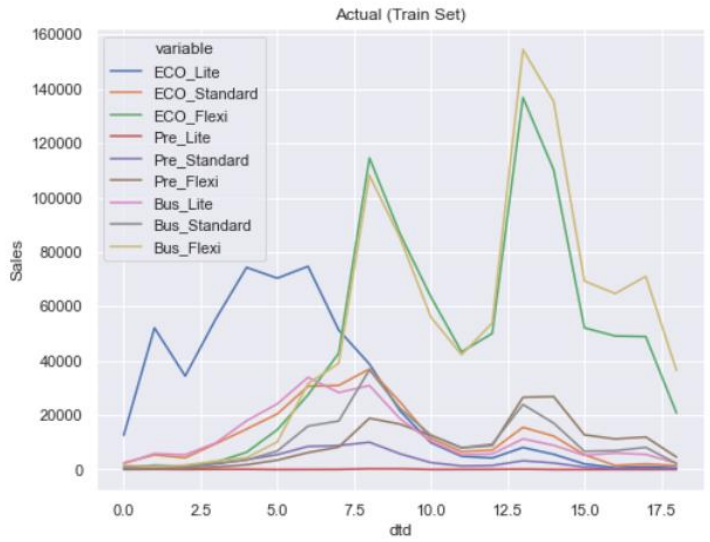


- **Predicted is largely in line with actual** for majority of the fare classes
- Model **encounters difficulty in predicting pre-lite** fare class, often predicting close to 0 sales for pre-lite, which is much lower than actual
- **Pre-lite sales are often close to 0, with sudden spikes at dtd ~10;** could possibly be when the algorithm discounts pre-lite sales prices

Actual vs Predicted Sales across All Fare Products by Days Prior to Departure

Train Set

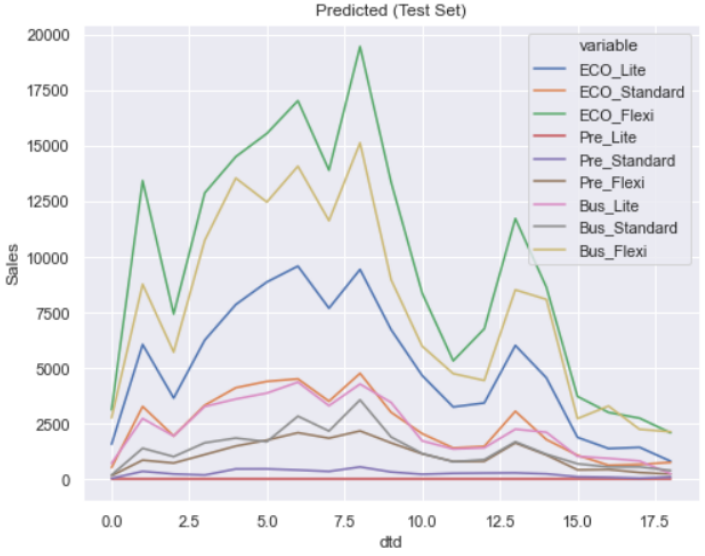


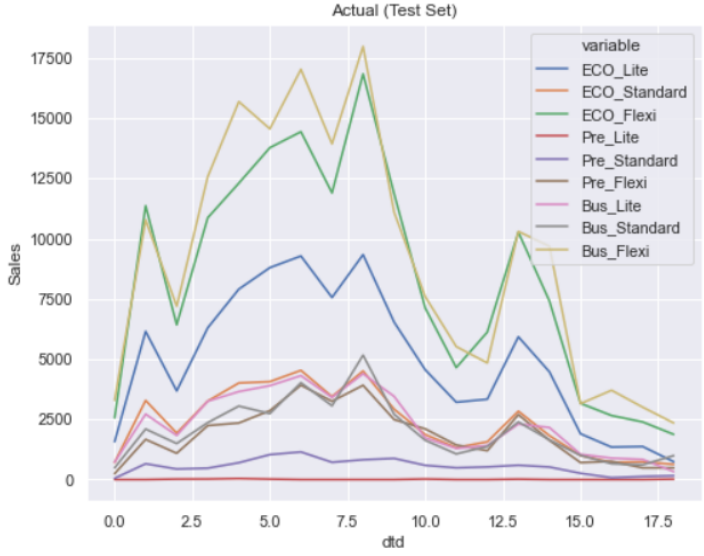


Same trend between predicted & actual sales

- Bus_Flexi's predicted sales slightly lower than actual

Test Set





Same trend between predicted & actual sales

- Bus_Flexi's predicted sales slightly lower than actual
- ECO_Flexi's predicted sales slightly higher than actual

By Fare Type – Understanding how important features influence customer choice

Itinerary	BBBAAABBB	BBBAAA	AAABBB	AAABBBAAA	BBBPVG###AAABBB	BBBAAA###PVGBBB	BBBDAN###AAABBB	BBBAAA###DANBBB
Importance 1:	Eco Flexi	Eco Flexi	Eco Flexi	Eco Flexi	Bus Flexi	Eco Flexi	DTD	Eco Flexi
Importance 2:	DTD	Eco Standard	Eco Standard	Eco Lite	Eco Flexi	DTD	Eco Flexi	DTD
Importance 3:	Eco Standard	Bus Flexi	Eco Lite	Bus Flexi	Eco Standard	Bus Flexi	Eco Standard	Eco Standard

Our assumption: *Based on IATA code convention, 1 airport represents every 3 letters in the itinerary. The longer the itinerary name, the longer the travel.*

Additional Observations	Analysing the specific plans	Customer Purchasing Behaviour
1 Across all itineraries, all consumers prioritise Flexi / Standard over Lite. However, customers may still choose Eco Lite for short-haul flights	The key difference between Flexi / Standard vs. Lite is the **option to cancel**.	Customers are **willing to pay more** for having the **optionality to cancel**
2 Eco Standard always ranks below Eco Flexi.	Eco Flexi charges customers **less on cancellation fees**, and **offers more baggage allowances** and **miles** than Eco Standard	Customers are **risk averse** – they are **willing to pay more upfront to for cheaper cancellation fees to insure themselves** for a potential flight cancellation.
3 There is only one scenario in which Business Flexi is more important than Eco Flexi. Business Flexi appears in top 3 importance for both long haul and short haul flights.	Bus Flexi **offers higher mile, advanced seat selection and more baggage allowances** but **charges a higher cancellation fee** than Eco Flexi.	We would **expect customers to pay more for Bus Flexi during long haul flights for comfort**. However, **this is not the case**, and could be attributed to the **higher cancellation fee**.

Caveat: Swimmers' Body Illusion – This analysis assumes that customers have the free ability to choose between different fare types given an itinerary. However, there could be a possibility that it is precisely because of the itinerary that the fare types available are limited.

Fare Strategy – Use Decoy Strategy and Repackaging of Prices to appeal to customers' need for security in terms of flight cancellation and refunds

	What is done right?	What can be improved?
Persona & Behaviour	**"The Risk-Averse"** Customers that are willing to pay more to be able to have the **option of cancelling the flight** Customers that are willing to pay more to be able to **retrieve a higher refund in case of flight cancellation**	**"The Pay-More-For-Longer-Travel"** Customers that are willing to pay more for comfort on long-haul flights
What was (not) done?	✓ Differentiate ***Lite*** by not offering option to cancel the flight ✓ Makes the other ***non-Lite*** plans more appealing ✓ Differentiate ***Flexi*** by offering a more refunds upon cancellation ✓ Makes the ***Standard*** plans less appealing for the risk-averse	✗ **Inflexible** - Charged customers higher cancellation fee for Bus-Flexi than Eco-Flexi ✓ Business class seats **are rarer, higher penalty on cancellation**
What (else) can be done?	***Decoy Pricing***  **Print - $59** 16%  **Digital - $125** 0%  **Both - $125** 84% ***Pool demand to Flexi by:*** **Lite**: Do not offer option to cancel flight — **$30**[1] **Standard**: Do not offer option to cancel flight, but better miles, baggage allowance — **$100** **Flexi**: Offer option to cancel flight and better miles, baggage allowance — **$100**	✓ For Bus-Flexi, **assign same / lower penalty fees** as Eco-Flexi ✓ However, **charge higher price for the entire fare package as a whole** for Bus-Flexi than Eco-Flexi
Why will it work?	Pricing strategy taps on **customers' need for safety and insurance** and decoy pricing **creates an illusion about the differentials** to earn a wider margin.	Pricing strategy involves **appeal to customer's needs for security** but **charges higher prices from the onset for that need**

Source(s): The Economist; Notes: 1. Indicative Price Figures

Priority level

Fare Strategy – Revenue Management

Employing Revenue Management Strategies

Rate Fencing

Rate fences are rules or restrictions that allow customers to segment themselves into appropriate rate categories based on their needs, behavior, or willingness to pay.

Product Line Rate Fencing

Using product line rate fences (Eco, Bus, Pre) and further segmenting each product line with Lite, Standard and Flexi allow different price tiering and differentiated offerings like cancellation fines.

Benefits

Many benefits offered within a fare product are **not costly to SIA** but are valuable to customers and **allow SIA to charge at a substantial premium**

Reduces drop-off from potential customers and creates a feeling of **fairness** – where customers purchases a "benefit" for a lower costs based on their own needs which could instill brand loyalty.

Physical Rate Fencing

Customers pay higher prices for better seats in economy, premium or business classes

Further limitations on Pricing strategy

Limitations	How it affects our pricing strategy
No show and cancellation data not available	Empty seats are unprofitable so we should aim to maximise seats sold. Having no show data will allow the airline to adopt an overbooking policy where they can oversell tickets. This can help airlines to determine how many tickets to oversell to maximise their revenue .
Group Booking Data not available	Airlines should consider group bookings separately from individual bookings. Usually, group bookings are offered at a discount rate so managers will need to decide on as the minimum rate to offer and whether to accept group bookings.
Lack of customer data	Analysing customer data can allow the airline to help in customer profiling to assess pricing strategy from the lenses of their end customers.
Lack of itinerary data	Flight locations and layover information were not provided which would affect ability to segment customers and rate fencing. For example, with itinerary data, the airline could accertain whether to charge higher prices for better seats if the flight is longer than a certain duration.