NYC Yellow Taxi Usage and Profitability

Purpose of the Study

The study's main objective is to understand some of the characteristics of the yellow cab industry and how some variables such as distance, speed or traffic affect profitability.

Overview

During 2019, NYC Yellow Taxi industry will have revenue of about $1.6 billion ($4.5 million per day) and will transport more than 140 million passengers (~400 k/day). Profits are estimated to be around $300 million (~$900k/day).

The total amount of distance traveled (with and without passengers) in a day is ~1.2 million miles. To put distance in

Estimated 2019

REVENUE $ 1,631,365,946	PROFIT 331,506,250	PROFIT 20.3 %
PASSENGERS 140,326,083	TAX: TOLL/MTA/IMP… $ 102,637,325	TRIPS 88,206,941
DISTANCE (AVG) 2.98 mi	SPEED 12.56 mph	DURATION (AVG) 14 mins

perspective, it would take a single person about 20 years to travel it.

Characteristics of Yellow Taxi Usage

We can characterize the usage of NYC taxi as a small distance and mid fare service. About 80% of the trips have a distance of 5 miles or less and has a fare of $18 or less.

For example, trips with longer distances such as Manhattan to and from JFK Airport only represent a small percentage of the total.
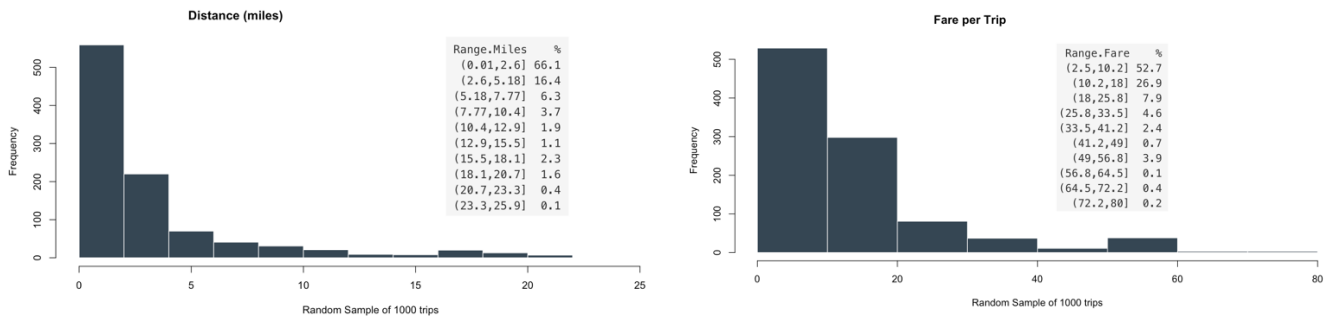

Fig. 1 Concentration of trips by Distance and Fare (random sample)

Purpose of Trips

Even though we don't have much information regarding the purpose of the trips, we can make some assumptions by looking at the most traveled routes and cross check it with the hour of the day. In the following heatmap we can identify how the demand is concentrated in particular hours of the day.
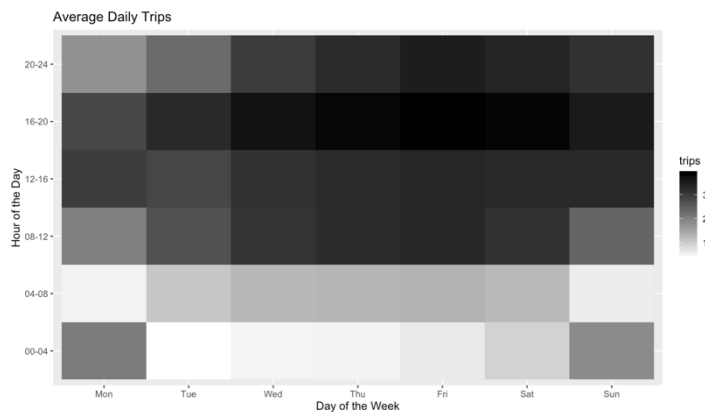
Fig. 2 Heatmap of trips by day and hour

Takeaway 1: People use taxis when tired, especially after a long day at work

From the previous graph we can see that most of the trips are generated between 4 and 8pm. Even though there is slighter more demand from Thursday to Saturday, we see that in general the demand is still high at that particular time of the day any day of the week.

Now, by looking at the routes with more trips, we can tell that much of the traffic is generated within the Upper East Side.

Typical Fare Composition vs Operating Costs

In average, a NYC trip costs the users $17.30 but only $14 goes directly to pay for the direct costs. At the end, the taxi's profit per trip is near to $4.

Fig. 3 Average Revenue and Profit per trip

Since the 2 main factors that affect cost depend on time or distance, the costs can be classified according to how they are incurred in the following way:
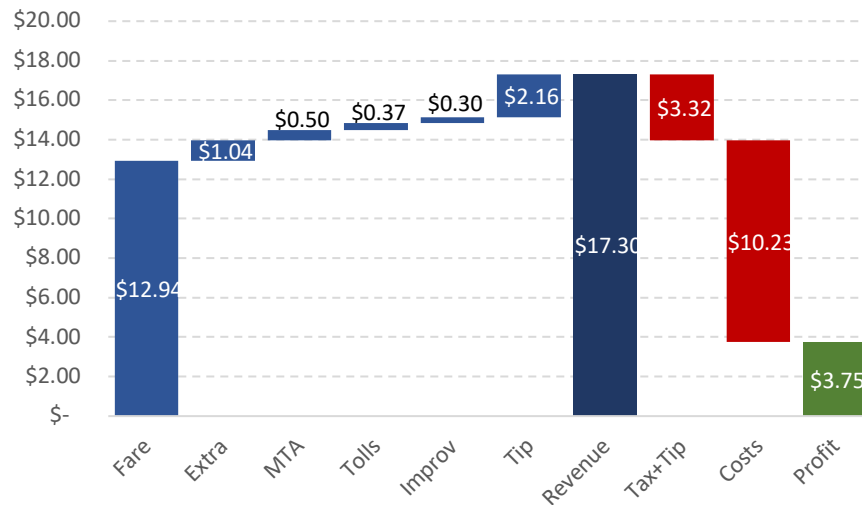
- *Time related*: costs that fluctuate with distance
  - Variable: labor (driver's salary)

- *Distance related*: Costs that depend directly by miles traveled
  - Variable: gas and maintenance (tires, oil, breaks and other preventive maintenance)
  - Fixed and Semifixed: car depreciation, replacement car cost and insurance.

Sensibility Analysis: if we increase each of the main costs independently (keeping the rest of the variables constant) by 10% we can identify how sensible is each cost in the total profit.

Cost Variable	Increase	Profit/trip	Cost Increase	Profit	
Insurance	10%	$ 3.73	$ 0.02	27%	From 3,500 to $$3,850/yr
Gas Price	10%	$ 3.67	$ 0.09	26%	From 3.5 to $3.85/gallon
Car Cost	10%	$ 3.64	$ 0.12	26%	From 20k to $27.5k per car
Labor	10%	$ 2.98	$ 0.78	21%	From 20 to $22/hr

From the previous table we can see that labor cost is one of the main factors that influences profit of the taxi business. To show this with more detail, lets look at the following example:

Origin: Upper East Side South   Destination: JFK Airport

Distance: 18 miles   Fare: $52

	Time of Day	Minutes	Cost	Profit	Profit %
Average Time	All Hours / Add Days	49	$ 42	$ 10	19%
Fastest	Thursday 12pm-4am	26	$ 29	$ 23	44%
Slowest	Friday between pm4-8pm	70	$ 54	($ 2)	-3%

Takeaway 2: Speed is the most important factor in determining profit because costs associated with time (such as labor) have the biggest impact in cost

As seen in the previous example, just by decreasing speed by having more traffic (early morning vs peak hour) a profitable route can become very unproductive. It is because basically the driver is wasting time moving so slow while it can be doing more trips (generating more revenue).

Conclusions

So, with all this information can we determine which is the best shift or the best time to work as a taxi driver? It is not that easy. Since drivers are not allowed to reject customers based on their destination, it is very difficult for the driver to control where his next trip is going to end up.

Same happens with demand. If taxis want to operate only when the average speed is greater (maybe from 10pm to 6am) there is not necessarily demand out there because the number of trips that are demanded at that time are low.

If you see the information from a regulation or traffic perspective, it can help NYC regulate the amount of taxis that can be at service at a particular time of the day or see if there are bus routes that need to be created, at the long run this perspective can help the city reduce carbon monoxide emissions.

Costing Model

The costing model is available online (https://mavaladezt.shinyapps.io/taxis/) and can be modified in order to make simulations and understand how different variables might affect the profitability of the taxi business.

About the Data

Data of Jan-Jun 2019 trips was obtained from NYC Taxi and Limousine Commission (https://www1.nyc.gov/site/tlc/about/tlc-trip-record-data.page). Only transactions paid with credit card or cash were used and it was assumed that 1 passenger was traveling when the driver was not able to introduce the number of passengers when the trip started.