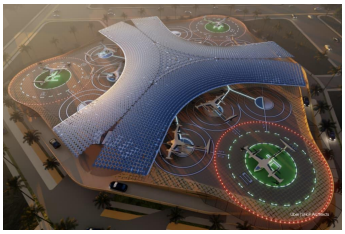
Uber Air for NYC

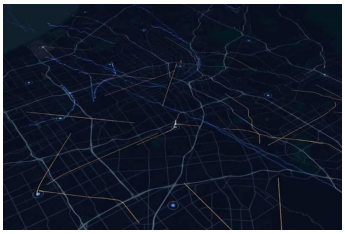
Data Analysis by Sae Huh

Background

In 2019, Uber announced that Uber Air flying taxis will take off in Dallas, Los Angeles and Melbourne in 2023. Uber Air is a shared air transporation service between suburbs and cities to start, and ultimately within cities. The company believes Urban Air Mobility(UAM) presents an opportunity to decongest road traffic, improve mobility, give back time to those trapped in daily traffic, and unlock the potential of cities worldwide.

Uber Air’s 4 Components

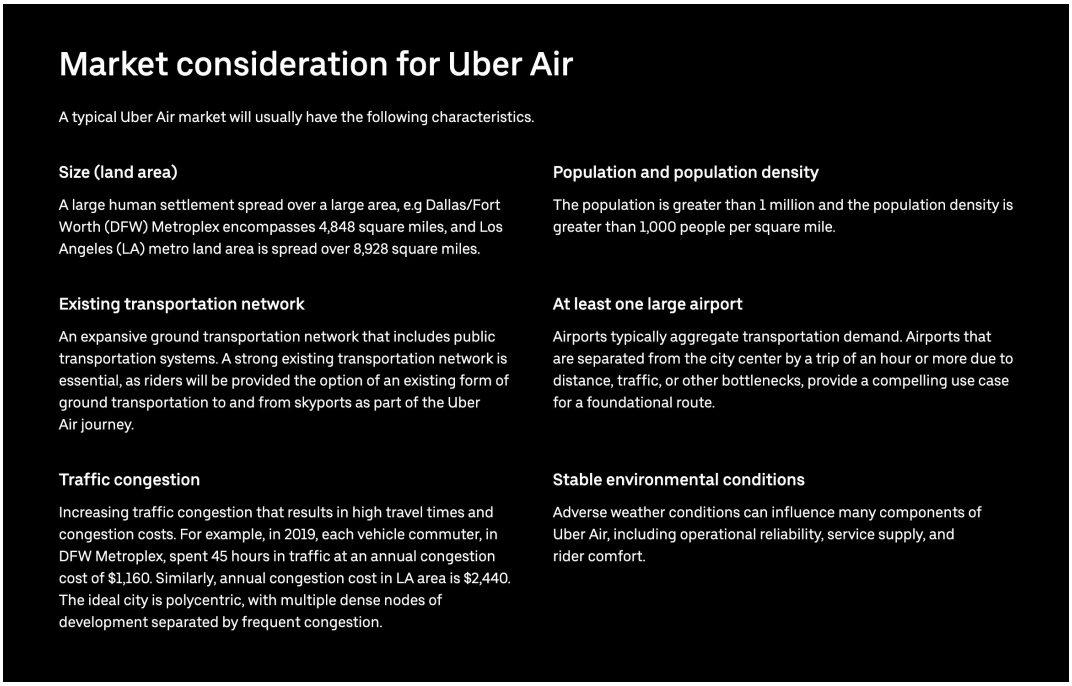




Uber Air's ecosystem consists of 4 fundamental systems, OEM partnerships for electric VTOLs(vertical take-off and landing vehicles), infrastructure partnerships for skyports, airspace management system and multimodal journey, that the Uber Elevate team and its partners are developing.

VTOLs are similar to helicopters and will carry four passengers at low altitude from skyports in each metro area and will seamlessly string a ground transportation segment to a skyport, with a pooled point-to-point flight, and a just-in-time ground transportation leg to a rider’s final destination. The short flights will start at $5 per mile, so a 20-mile trip would add up to about $100 though Uber Elevate officials anticipate that the cost will go down eventually.

Above mentioned cities have already put together elaborate plans and designs for their services and skyports, but what about New York?



NYC meets all of Uber Air's considerations.

New York City has an estimated 2019 population of 8,336,817 distributed over about 302.6 square miles (784 km2), which is not spread wide enough. However, the New York metropolitan area is the largest metropolitan area in the world by urban landmass, at 3,450.2 sq mi (8,936 km2).

The New York metropolitan area is the most populous in the United States, as defined by both the Metropolitan Statistical Area (20.3 million residents in 2017) and the Combined Statistical Area (23.7 million residents in 2016).

New York City's transportation system includes subway, bus, ferry, Taxi as well as FHV(For-hire Vehicles).

New York has three robust airports in JFK, Newark and LaGuardia.

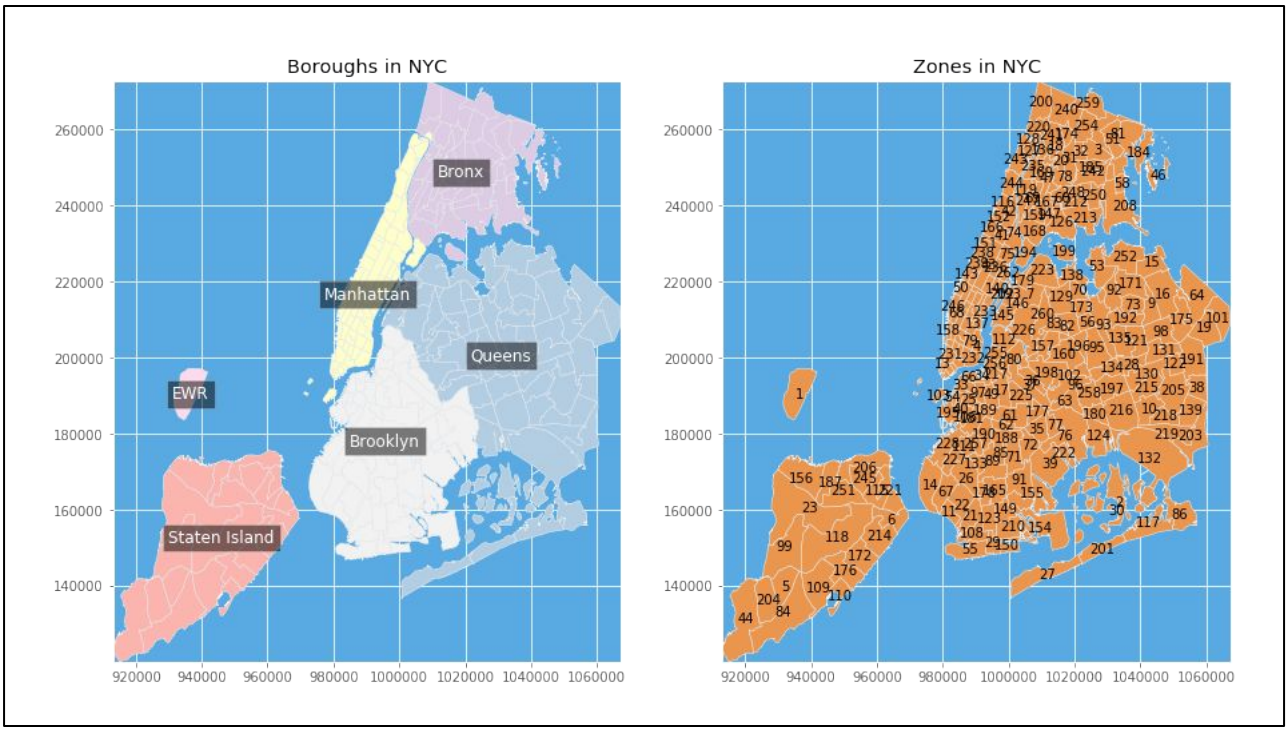
According to INRIX 2019 Traffic Scorecard Report, New York City is 4th most congested city in the US and 14th in the world with 140 hours spent in congestions.

Questions

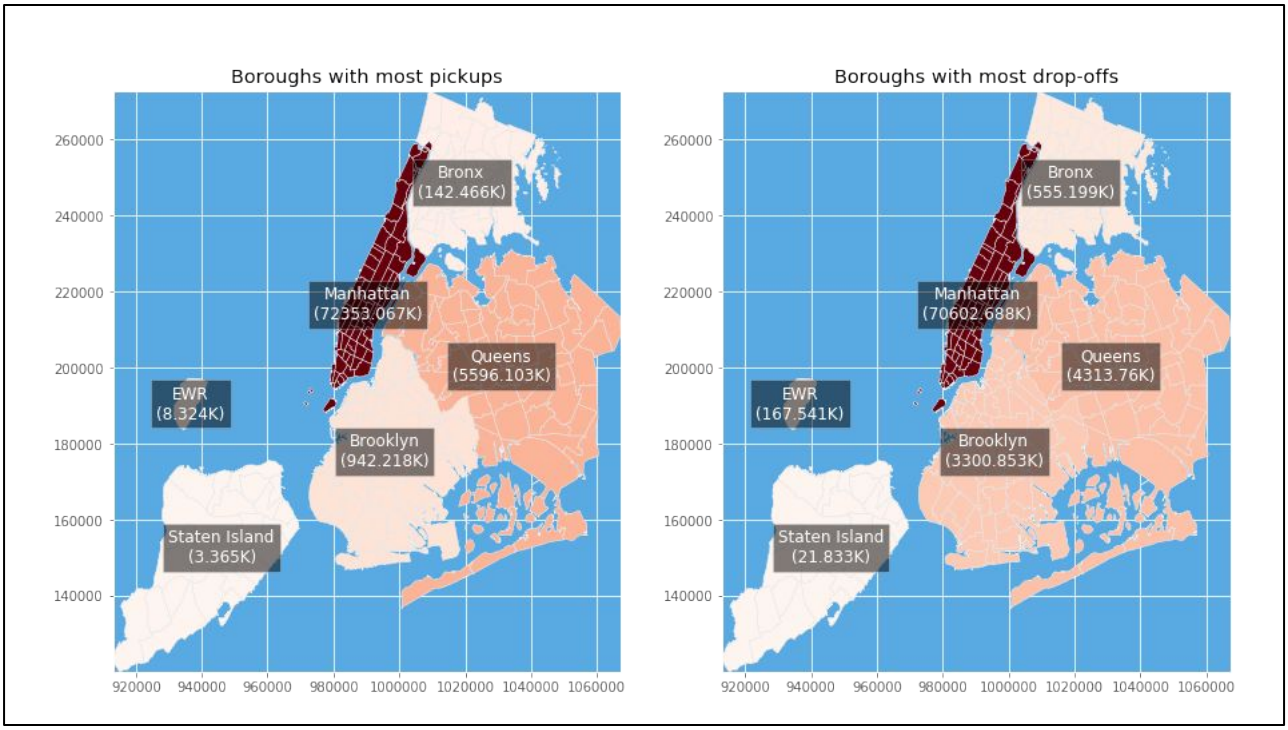
- Where in NYC should Uber Air run?
- When should it run?
- Does Uber Air’s announced rate and plan bring any value?

NYC Taxi Data

I decided to dive into this case using the Yellow Taxi Trip Record for its size and variety of data columns capturing time and location of pickups and dropoffs, passenger counts, trip distance, rates, and fare amount.



NYC Yellow Taxi serves 271 zones across its 6 boroughs.



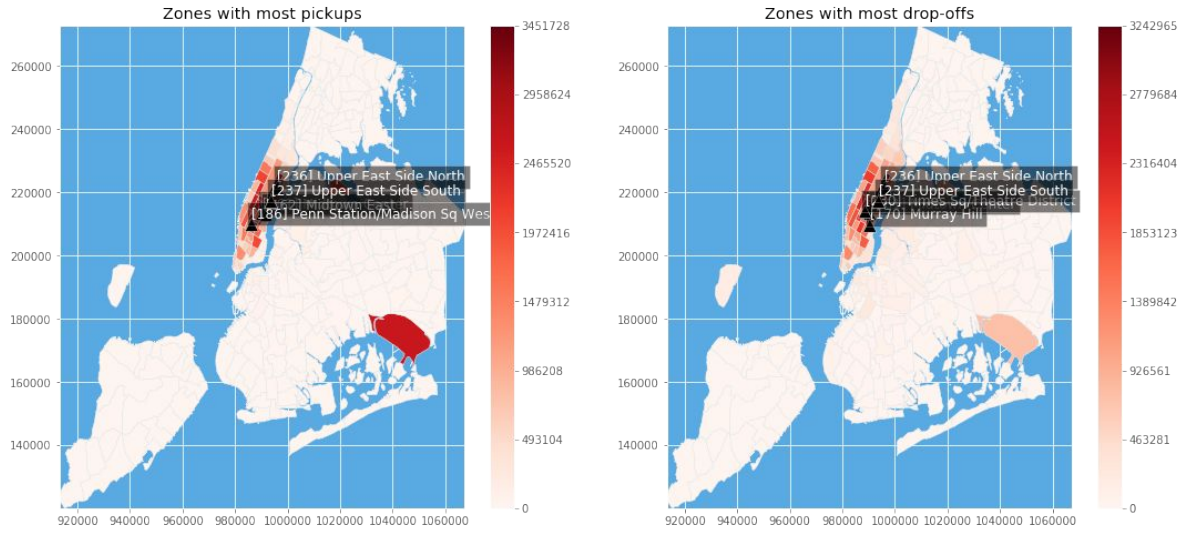
So I first looked at the count of the pickups and dropoffs in each borough to see where demands are.

Manhattan has the most number of pick ups and drop offs at 142.9 million in total. Queens at the second with 9.9 million, Brooklyn at third with 4.2 million.

However, running a service within Manhattan means requiring 2 skyports within the city and having to compete again many other public transportation means.

So I looked at zones with high demand.

Locations

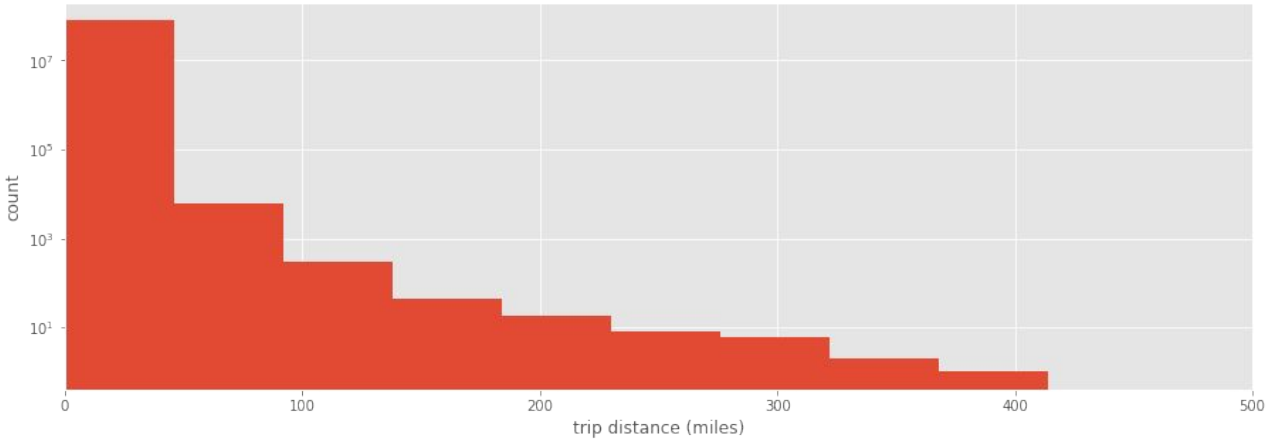


- Top 5 pickup zones are:
  - Upper East Side South
  - Midtown Center
  - Upper East Side North
  - Midtown East
  - Penn Station/Madison Square West They are all in the Upper Middle East side of Manhattan.

- Top 5 drop-off zones are:
  - Upper East Side North
  - Midtown Center
  - Upper East Side South
  - Murray Hill and Times Square/Theatre District They are also mostly in Upper Middle East side of Manhattan.

However, from the figures above, the zone in the lower-right corner shows quite high number of demand in Queens, where JFK and Laguardia Airport is located. JFK is ranked at 7th pick-up location and 38th drop-off location among top 50 zones. La Guardia Air port ranks at the 14th in pick-up locations and 35th in drop-off locations. Rest of top 50 zones were in Manhattan.

Trip Distance



Considering that the landmass of New York City is 302.6 square miles, the figure above should represent most trips taking place within the area.

96% of Yellow Taxi Trips have distance shorter than 15 miles

So I created subsets of the data by dividing them into two groups by distance at 15 miles.

Top 5 Zones for Pick UP & Drop Off

	pickup zone	dropoff zone	short trips
18185	Upper East Side South	Upper East Side North	508762
18282	Upper East Side North	Upper East Side South	432182
18184	Upper East Side North	Upper East Side North	426463
18283	Upper East Side South	Upper East Side South	412750
5317	Upper West Side South	Upper West Side North	223234

	pickup zone	dropoff zone	long trips
4878	JFK Airport	Times Sq/Theatre District	95909
171	JFK Airport	Clinton East	62142
1212	JFK Airport	Midtown South	58794
1336	JFK Airport	Murray Hill	54396
991	JFK Airport	Midtown Center	53391

Uber Air should operate between **Upper East Side** and **JFK Airport**

As seen in the tables below, we can see that:

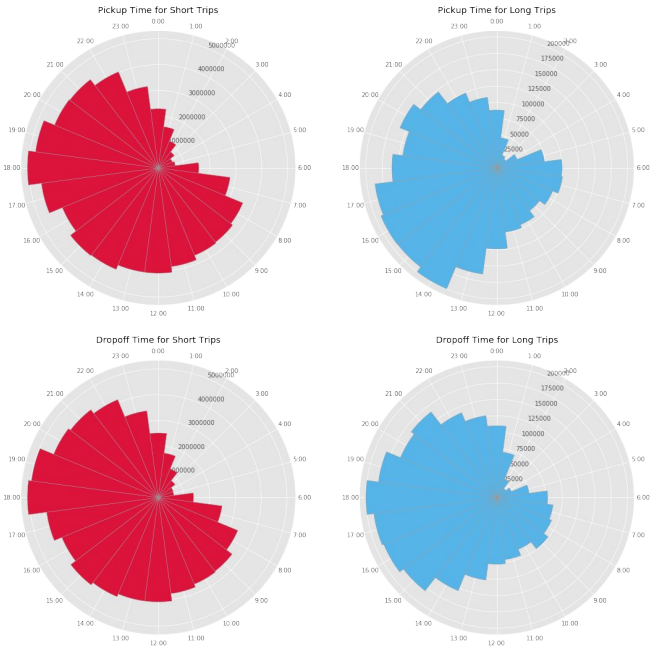
1. Top 5 zones for short trips are all in within Upper East Side.
2. Top 5 pick up zones for long trips are all JFK airport.

Hours of Operation

1. Short Trips
   - the hours of robust activity are from 9AM to 10PM
   - the peak hours are from 6PM to 7PM

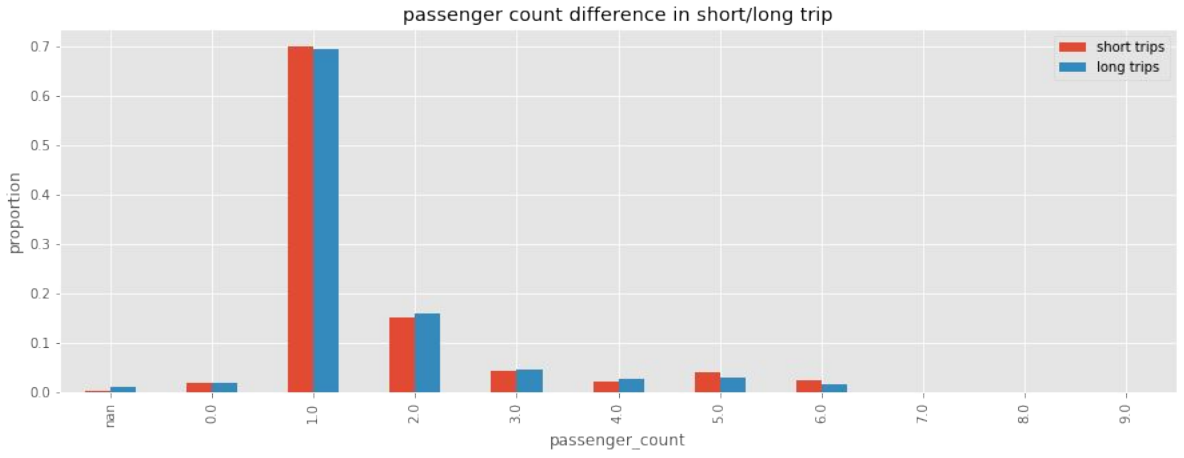
2. Long Trips
   - the hours of robust activity are from 9AM to 10PM
   - the peak hours for pickups are from 2PM to 6PM
   - the peak hours for dropoffs are from 4PM to 7PM

3. Off hours are from 11PM to 8AM



I recommend operating between 12PM to 10PM with expanded capacity for 2PM to 8PM.

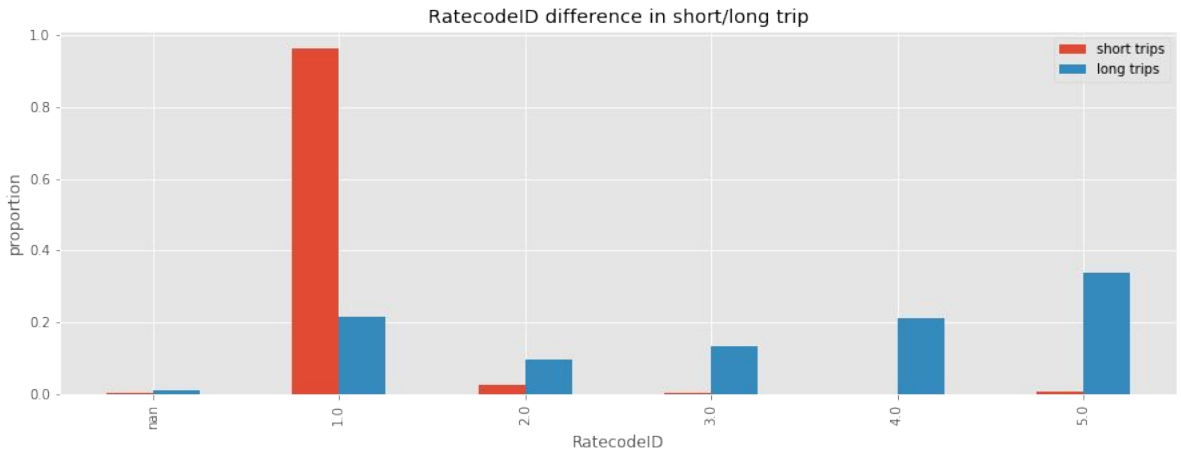
Passengers



Most of the Yellow Taxi trips regardless of its distance transport a single passenger.

Uber Air is a shared ride system for 4 passenger VTOLs.
It means 1 VTOL can replace 4 Yellow Taxi trips to JFK.

Rates



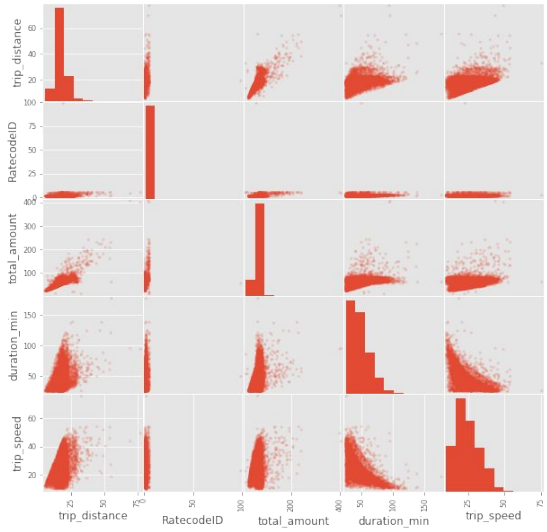
Rates

1. Standard rate
2. JFK
3. Newark
4. Nassau or Westchester
5. Negotiated fare
6. Group ride

Here is a problem. There is a flat rate offer for JFK at $52 to $58 depending on traffic surcharge. You can see in long distance trips that the flat rates for Airports become more common.

This is an issue we have to investigate because Uber Air won't be able to undercut the price.

Deeper Exploration



Thinking about the difference in cost and duration for the trip to JFK,
I began to ask following questions.

1. How do we evaluate the cost of our transportation?
2. Money and Efficiency. How do we measure efficiency?
3. Ultimately what does introduction of Uber Air mean as a new public transportation system? Is it any meaningful? Is there future? Where is the future?(range of distance, fare, demand, benefit?)

Trips to/from JFK(sample)

```
df_jfk.describe()
```

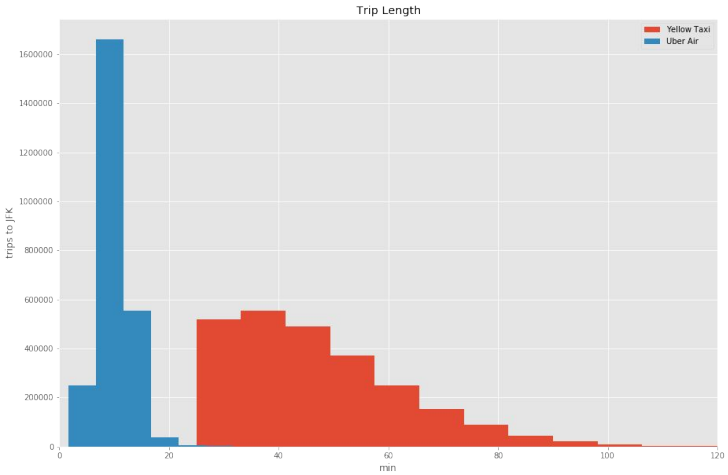
	passenger_count	trip_distance	RatecodeID	PULocationID	DOLocationID	total_amount	trip_duration
count	2.512294e+06	2.512576e+06	2.512294e+06	2.512576e+06	2.512576e+06	2.512576e+06	2512576
mean	1.622064e+00	1.781621e+01	1.767932e+00	1.390771e+02	1.452416e+02	6.533778e+01	0 days 00:47:03.851017
std	1.226027e+00	4.026216e+00	6.909373e-01	3.348037e+01	6.623380e+01	1.722468e+01	0 days 00:15:51.565783
min	0.000000e+00	4.200000e+00	1.000000e+00	1.000000e+00	1.000000e+00	1.030000e+01	0 days 00:25:01
25%	1.000000e+00	1.650000e+01	1.000000e+00	1.320000e+02	1.070000e+02	5.892000e+01	0 days 00:34:43
50%	1.000000e+00	1.785000e+01	2.000000e+00	1.320000e+02	1.320000e+02	6.636000e+01	0 days 00:44:06
75%	2.000000e+00	1.928000e+01	2.000000e+00	1.320000e+02	1.880000e+02	7.367000e+01	0 days 00:56:10
max	9.000000e+00	5.430900e+02	9.900000e+01	2.650000e+02	2.650000e+02	4.993000e+02	0 days 07:11:11

Df_jfk is a subset of data filtered by DO or PU location set to JFK zone.

Mean cost: $65 with STD $17
Mean duration: 47 min with STD $15 min
Mean distance: 18 miles with STD 4 Miles

Where does Uber Air fit?

- Fare: $90
- Duration: 7 - 15 min
- Speed: 74 - 150 mph



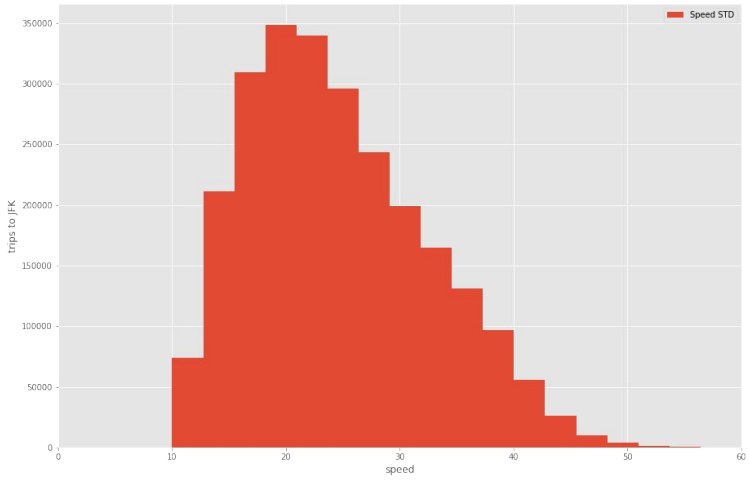
Uber Air can get to JFK in 7 min 12 sec at 150mph (if 74mph, 14min 36sec) and cost you $90.
There is $25 gap.

How do you tell if this $25 is worth it?

Stand Deviations

Yellow Taxi's STDs:

- Fare: $17.2
- Duration: 15 min
- Distance: 4 miles
- Speed: 7.9 mph



One of the reasons for spending extra $25 is to avoid the standard deviations attached to Taxi ride.
There are traffic, road construction, accidents that we cannot account for.

We don't know about the Uber Air's STDs yet but we can assume that there won't be much trouble with traffic.

We always try to get to the airport early because we don't want to be late.
Why? Because flights are expensive.

That got me wondering about the value of transportation.
How we evaluate and choose them.

Let’s calculate the value

Yellow Taxi	Uber Air
Distance: 18 miles	Distance: 18 miles
Duration: 47 min	Duration: 10 min
Cost: $65	Cost: $90
Dollar/min: $1.38/min	Dollar/min: $9/min

Is saving 37 minutes worth spending 25 dollars more?

- By taking Uber Air, Jamie didn’t spend 37 minutes in transit but spent 25 more dollars.

- Cost of being on Yellow Taxi for 37 minutes: 1.38 dollar/min * 37 min = $51.059

- $51 - $25 = $26

- Time Saved = (trip_duration_taxi) - (trip_duration_air) = 47 min - 10 min = 37 min
- Money Spent = (total_amount_air) - (total_amount) = $90 - $65 = $25
- Money Saved = (dollar/min_slower_transportation)*(Time Saved) - (Money Spent)
- Value = Money Saved/Time Saved = $51 - $25 = $26
- $26 saved for 37 minutes you earned = You are saving $0.7/min when you are on Uber Air instead of Yellow Taxi.

This is where speed becomes important.

Extra:

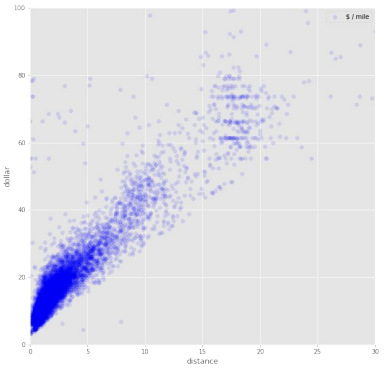
I can take subway to JFK which cost me $2.75 and 68 minutes.
By taking Uber Air, I spend $90 and save (68-10 = 58 minutes)

This doesn’t work subway fare doesn’t get affected by duration or distance.

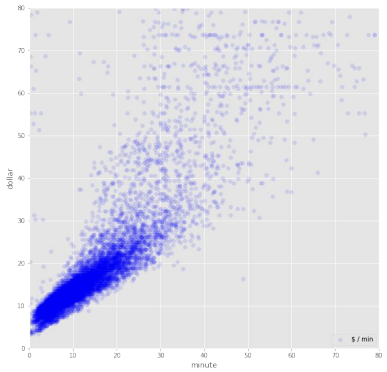
What if I decided to walk and not spend a dime?

Fare Amount

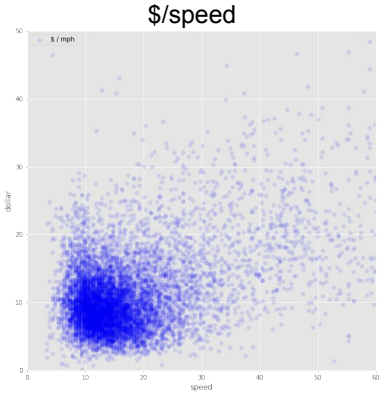
$/mile



$/min



$/speed

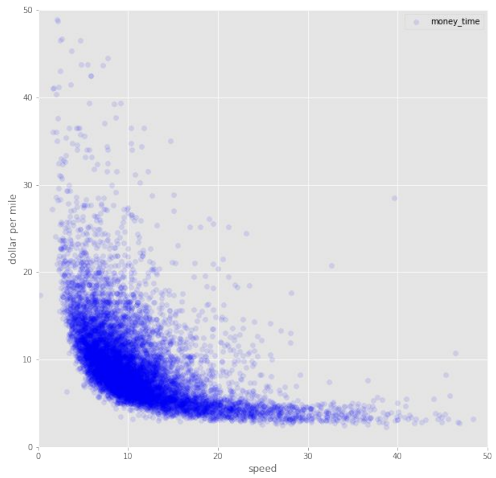


Here we compare the fare amount to trip distance, duration and speed in Yellow Taxi trip records data.

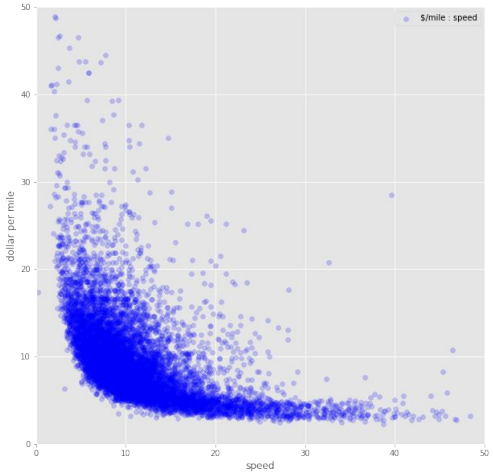
We can see strong correlation between fare amount and trip distance and duration, Where longer the distance and duration is higher the fare amount is.
The fare amount goes up as trip speed increases as well but the correlation seems weaker.

Speed

Dollar per Minute VS Speed



Dollar per Mile vs Speed



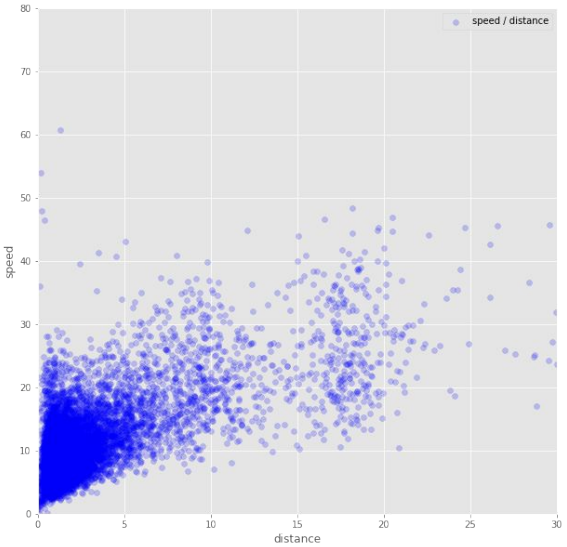
Now, we're looking at the correlations of speed to two different measures of efficiency: Dollar per minute and Dollar per mile.

We can see that they are both on negative logarithmic curves.
Notice how both dollar per minute and mile goes down as speed increases,
Which means that the trip actually gets cheaper as it gets faster.

Speed per Distance

The longer the distance is faster the speed gets.

Do Yellow Taxi get faster beyond the distance of 30 miles and speed of 50 mph?



In the Yellow Taxi dataset, we can see that speed increases as the distance increases for the trip.
However, the speed only increases upto 50 mph or so.
Also, another thing we have to point out is how the data points get more scarce as distance increases.

Yellow Taxi trips don't really go further than 25 miles
and there is a limitation to how fast it can go even if there are no congestions.

This explains why the correlation between fare and speed is weaker as we saw earlier.

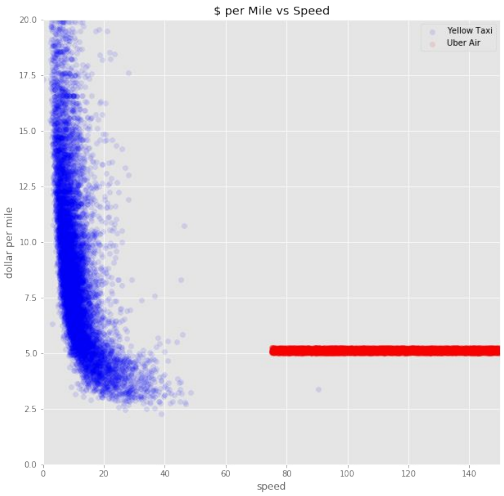
Yellow Taxi(Cars) vs Uber Air

Yellow Taxi cannot further reduce $/mile:

1. Legal Speed Limit
2. Extra Fees
3. Flat Rate
4. Limitation of Vehicles

Uber Air:

- $5/mile
- 74 to 150 mph



This is where Uber air comes in.

The graph you see is $ per mile vs speed.
Taxi's $ per mile is in blue. Yellow Taxi can get efficient up to around distance of 40 mph between $2.50 to $5.00/min but it doesn't get much faster afterwards.

As you can see, Uber Air enters the zone in which no Yellow Taxi(or any cars) can cover.

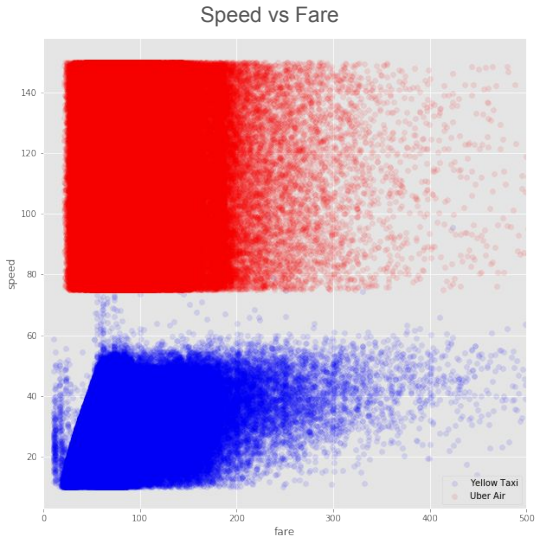
Where Yellow taxi cannot reduce its dollar/mile in faster speed because of

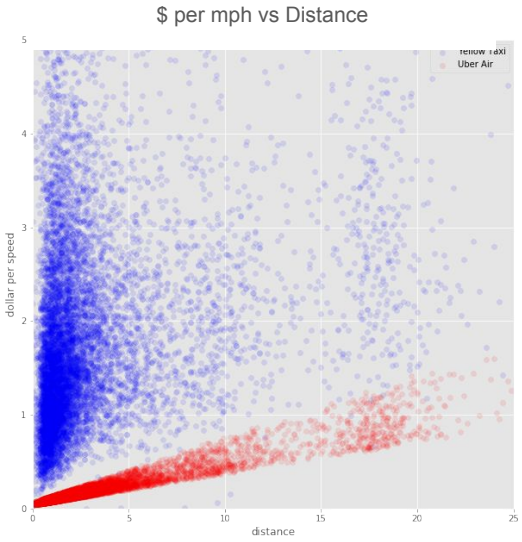
1. Legal Speed Limit
2. Extra fees such as Tolls
3. Flat Rate(If there are no traffic, it may be cheaper to go on a standard rate)
4. Limitation of Vehicles

Also, notice at much slower speed, dollar per mile for Taxi tends to be even more expensive. It reaches $5/mile efficiency when the speed is 10 mph.

Uber Air is introducing much faster public transportation at a price point that's quite often way more at much slower speed at $5 per mile between the speed of 74 to 150 mph,

Uber Air's Game





Here's Uber Air's Game.

Uber Air makes money on speed.
In terms of speed, VTOLs are in a different class from Yellow Taxi or any cars as you can tell from the left graph.
There are other affordable ways to get to JFK like driving, subway, biking or even walking.
But none of them are faster than Uber Air's VTOL.

Is it really that expensive?

From the right graph, you can see
As trip distance increases, the dollar per speed increases.
Yet, it still undercuts the dollar per speed value of Taxi.
Beyond 20 mile distance, the competition becomes scarce.

For that range between 20 miles to a couple of thousand miles,
I feel like VTOLs will have absolute advantage over any other transportation means.

The tri-state area or New York metropolitan area encompasses 3,450.2 sq mi
and is the most populous metropolitan area in the US with 20.3 million residents.

After the initial launch of Upper East Side to JFK route, I'd recommend connecting the suburbs.

Summary

- Uber Air should launch between Upper East Side Manhattan and JFK Airport
- Uber Ais should operate between 12PM to 10PM with expanded capacity for 2PM to 8PM.
- Uber Air would transport passengers at $90 in 10 minutes(with 3 min STD).
- Uber Air's launch would save 37 minutes at extra $25 than getting a Yellow Taxi

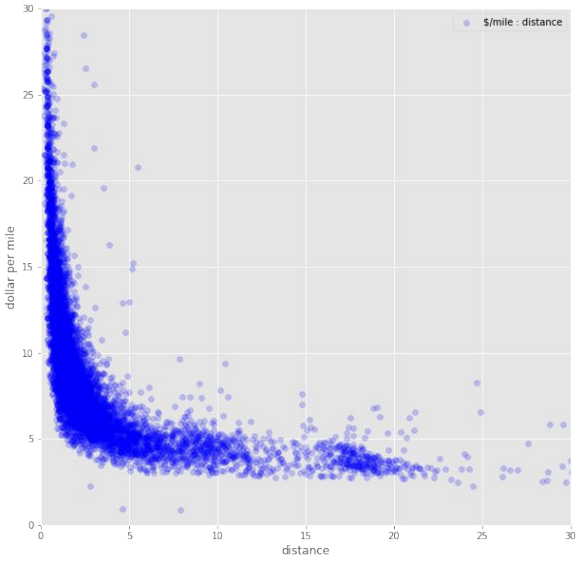
Future Analysis

- What is the optimal scale of operation for its initial launch to justify the cost?
- At what point will Uber Air become profitable?
- If Uber Air can reduce the number of long distance trips either from or to Manhattan, what impact will it have in terms of relieving inner city traffic congestion?
- If carsi were able to get to their destination in 5% less time(potentially thanks to reduced traffic from Uber Air), how much cheaper would it be for the passengers?

Thank you.

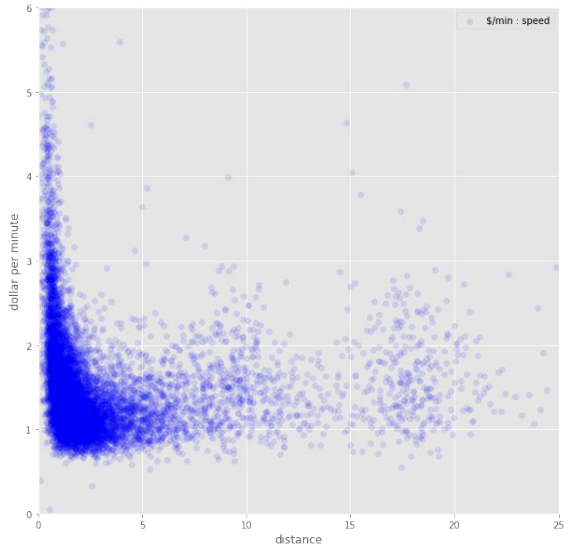
Dollar per Mile vs Distance

Pricing: as distance increases, dollar per mile decreases...



Demand (Dollar per speed VS Distance)

After 10 miles, the dollar per minute starts to increase again but there aren't many data points. That's where Uber Air has a chance.



Longer the distance, faster the speed.
Faster the speed is, cheaper the price is.