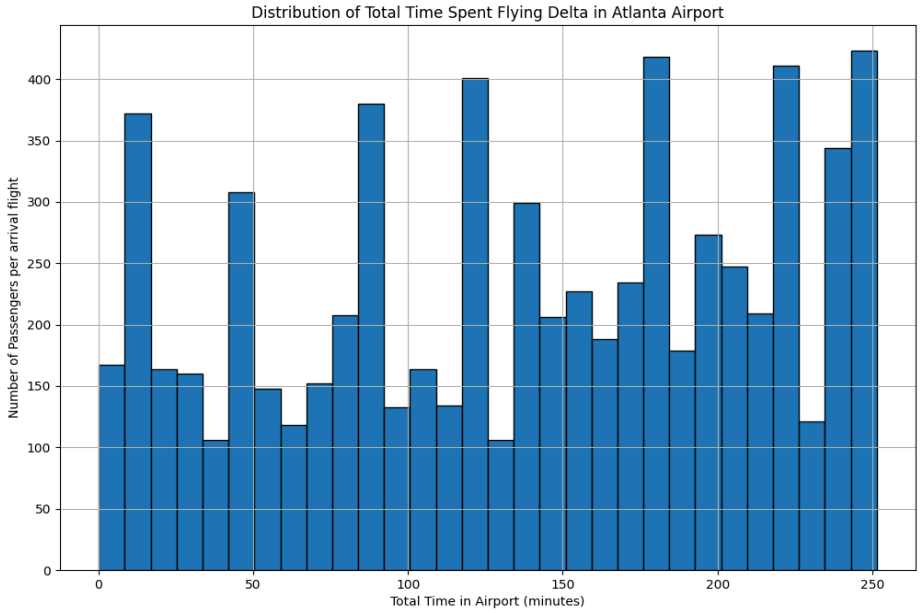
ATLANTA AIRPORT QUEUE TIME FOR DELTA FLIGHTS (Bhargav Ashok Project)



Average Waiting Time in the Atlanta Airport (Delta Flight): <u>136.42 minutes OR 2.27 hours</u>
Average Total Time in the Atlanta Airport (Delta Flight): <u>136.87 minutes OR 2.28 hours</u>

The graph uses a random exponential distribution for each part of the flight waiting times (arrivals, check-in, security, and boarding) to replicate the variability in time in an airport setting depending on the passenger. The distribution of the graph is multi-modal due to this randomness, with the highest peak of waiting time coming from over 400 passengers waiting almost 4 hours at most with the average being around 2 hours and 20 minutes.

Summary of graph: This graph showcases the average waiting time for a Delta flight in the Atlanta Airport (in minutes) based on a sample size from a Boeing 737 Delta plane and average queue times per minute based on research and personal experience, being a Metro-Atlanta resident.

Everyone can agree that the airport can be a stressful place, especially one of the busiest airports in the world. With the population of Atlanta growing exponentially over the next 5-10 years, there has to be a better way to decrease waiting times for Delta flights (flight queue times at the airport) to increase customer satisfaction, human traffic flow, and overall airport efficiency.

Delta moved its headquarters to Atlanta, Georgia in 1941 and has become one of the most consistent and innovative airlines since its conception. The company began securing air mail routes over the southern United States, and then eventually expanded internationally over time in the late 1970s, and early 80s.

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This data can be a good predictor of flight traffic due to its sample size and random assessment for Delta flights. However, more analysis would be needed to make decisions for other airlines at the Atlanta Airport.

So what can we do about it?

Potential solutions to mitigate Delta flight traffic

- Build more terminals and better transportation systems within the airport to mitigate any bottlenecks.
- Create new systems to have queues automated at certain process points in the delta terminal (automated camera checks, faster conveyor belts, larger baggage claim system, etc.).
- Increase TSA security lanes and staff to treat more customers per minute.
- Increase the number of entrances and add more check-in systems into the airport to prevent traffic overflow and reduce average check-in time.
- Ways to find more solutions: Customer feedback, engineering solutions/analytics, learning more about average customer ticket purchases (i.e. family purchases, couple purchases, single trips) and duration of flights (round-trip, one way).

Code:

```
import numpy as np
import matplotlib.pyplot as plt
# Parameters
num_passengers = 7000 #passengers per flight (used as sample size from a Delta Boeing 737 with passengers and staff multiplied by arrivals per day/24)
arrivals = 6 # average number of passengers arriving per minute
check_in = 9 # passengers served per minute at check-in
security = 7 # passengers served per minute at security
boarding = 5 # passengers boarded per minute

#Data taken from and approximated using:
https://www.atl.com/about-atl/atl-factsheet/
#Data also taken from and estimated using: https://www.atl.com/times/
#Research: https://www.delta.com/us/en/aircraft/boeing/737-800
# Research: https://www.georgiaencyclopedia.org/articles/business-economy/
#Research: https://simpleflying.com/aircraft-flight-crew-requirements/
#estimation of rates based on research and personal experience

# Initialize/set-up variables
np.random.seed(42)
inter_arrival_times = np.random.exponential(1/arrivals, num_passengers)
arrival_times = np.cumsum(inter_arrival_times)

# Check-in
check_in_times = np.zeros(num_passengers)
```

```
start_check_in = np.zeros_like(arrival_times)
end_check_in = np.zeros_like(arrival_times)

for i in range(num_passengers):
    if i == 0:
        start_check_in[i] = arrival_times[i]
    else:
        start_check_in[i] = max(arrival_times[i], end_check_in[i - 1])
# used to loop through each passenger when they arrived and started their
check-in by waiting for other passengers ahead to finish.

    check_in_times[i] = np.random.exponential(1 / check_in)
    end_check_in[i] = start_check_in[i] + check_in_times[i]

# Security
security_times = np.zeros(num_passengers)
start_security = np.zeros_like(arrival_times)
end_security = np.zeros_like(arrival_times)

for i in range(num_passengers):
    start_security[i] = max(end_check_in[i], end_security[i - 1] if i > 0 else
0)
# used to loop through each passenger when they have ended check_in and started
security after the previous passenger ends, as each passenger is added, the
queue cycles through loop
    security_times[i] = np.random.exponential(1 / security)
    end_security[i] = start_security[i] + security_times[i]

# Boarding process
boarding_times = np.zeros(num_passengers)
start_boarding = np.zeros_like(arrival_times)
end_boarding = np.zeros_like(arrival_times)

for i in range(num_passengers):
    start_boarding[i] = max(end_security[i], end_boarding[i - 1] if i > 0 else
0)
# used to loop through each passenger when they have ended security and started
boarding after the previous passenger enters boarding

    boarding_times[i] = np.random.exponential(1 / boarding)
    end_boarding[i] = start_boarding[i] + boarding_times[i]

# Calculate times for each checkpoint
total_waiting_times = (start_check_in - arrival_times) + (start_security -
end_check_in) + (start_boarding - end_security)
average_waiting_time = np.mean(total_waiting_times)
total_times_in_airport = end_boarding - arrival_times
average_time_in_airport = np.mean(total_times_in_airport)
```

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```
print(f"Average Waiting Time: {average_waiting_time:.2f} minutes")
print(f"Average Total Time in Airport: {average_time_in_airport:.2f} minutes")


plt.figure(figsize=(12, 8))
plt.hist(total_times_in_airport, bins=30, edgecolor='black')
plt.xlabel('Total Time in Airport (minutes)')
plt.ylabel('Number of Passengers per arrival flight')
plt.title('Distribution of Total Time Spent Flying Delta in Atlanta Airport')
plt.grid(True)
plt.show()
```