

Bath Airport Simulation

Prepared by Tony Chu on 5/2/2022

A dark blue diagonal gradient bar that starts from the bottom left corner and extends towards the top right corner, covering the lower half of the slide.

Scenario: Service Station

- 3 Airlines: FOP, CHV, ABJ
- 20 Check-in desks
 - 1 - 8 for FOP
 - 9 - 15 for CHV
 - 16 - 20 for ABJ
- 12 Passport Control Gate
 - 1 - 4 for British
 - 5 - 12 for anyone
- Service Time
 - Check-in desks: Lognormal Distribution
 - mean=5 | standard deviation=0.5
 - Passport Control (Brits): Lognormal Distribution
 - mean=4 | standard deviation=0.1
 - Passport Control (Non-Brits): Lognormal Distribution
 - mean=4 | standard deviation=0.1
- History of breakdown time at check-in desks and passport control gates are given
 - The breakdown times are added to the total wait time at each service station

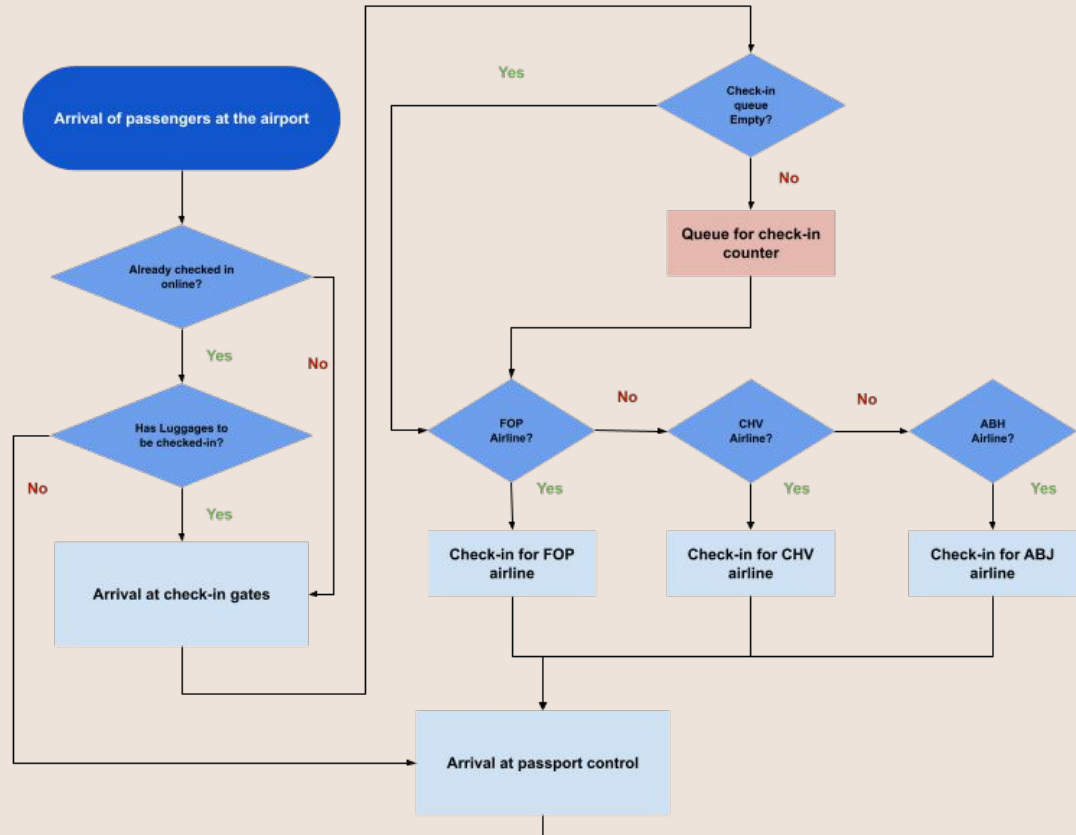
Scenario: Passengers

- The mean arrival rates per hour to the airport vary based on the day of the week and the hour of the day
- Passenger arrival is based on the mean arrival rates per hour given
- Passenger's time of arrival follows a negative exponential distribution
- Nationality & Airline information of each passenger is assigned based on the ratio of the Passenger dataset provided

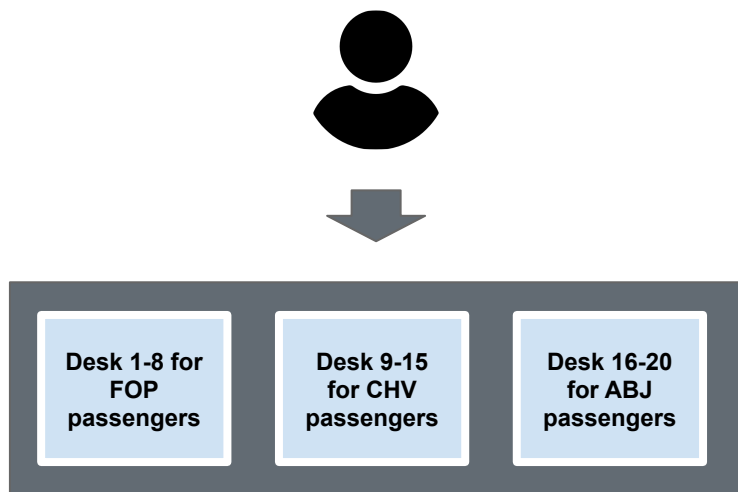
Questions to be addressed

1. How many passport control gates are needed to make sure that the waiting time in the passport control stage is less than a minute 98% of times?
2. Should the airport combine check-in desks of FOP and CHV airlines?
3. Is the current allocation of check-in desks and passport control gates ideal?

Flowchart of the current Bath Airport (Check-in desks)

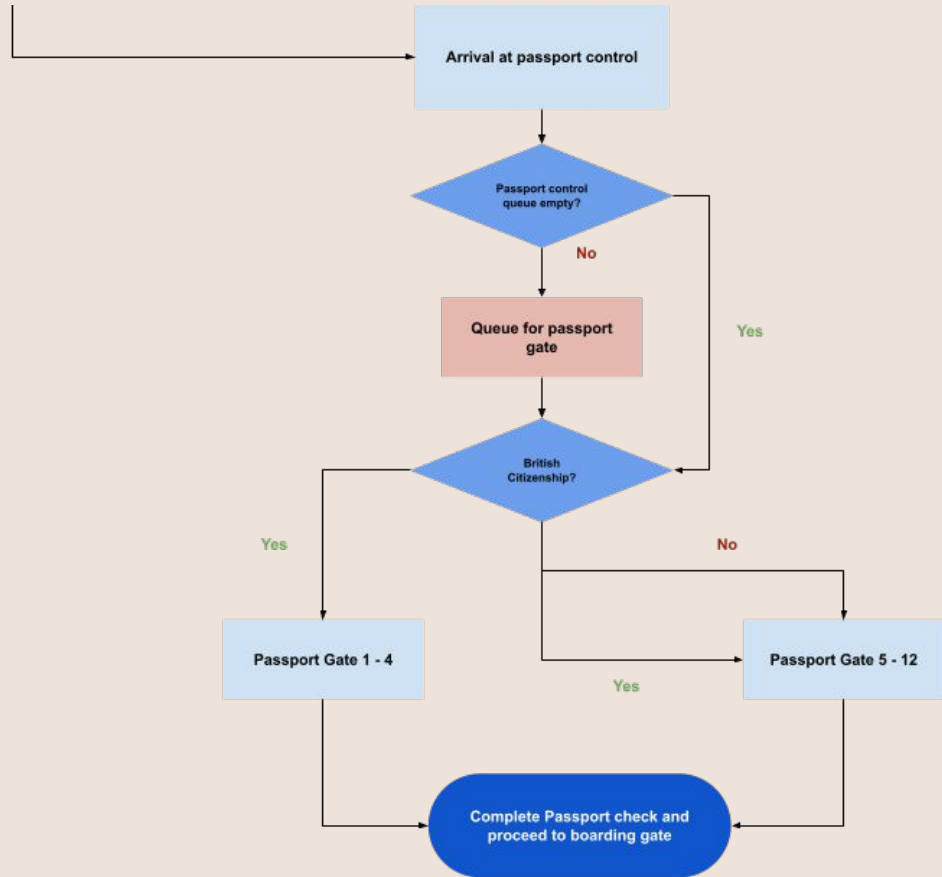


Check-in Desk Process Elaboration

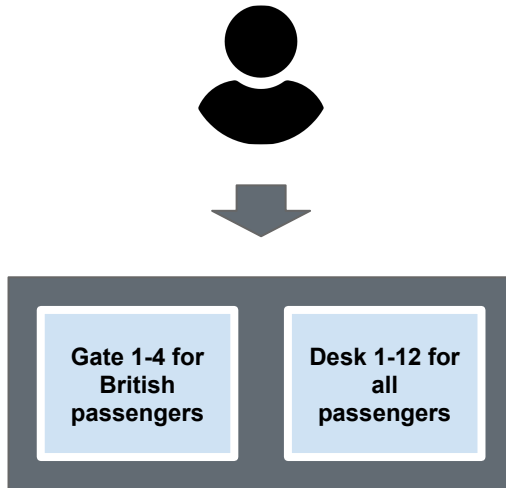


- If passengers arrive after one of the associated airline's check-in desks finishes services:
 - Proceed to an empty check-in desk
- If passengers arrive before one of the associated airline's check-in desks finishes service:
 - Wait in the queue till one of the desk finishes services first
 - Then proceed to that check-in desk

Flowchart of the current Bath Airport (Passport Gates)



Passport Gate Process Elaboration



Regardless of passengers skipping check-in process or not:

- If passengers arrive after one of the passport gates that serves the passengers nationality finishes services:
 - proceed to an empty passport gate

- If passengers arrive before one of the passport gates that serves the passengers nationality finishes services:
 - Wait in the queue till one of the gate finishes services first
 - Then proceed to that passport gate

4 Parameters for Model Customization

4 parameters are customizable for the decision makers:

1. Number of days to run the simulation
 - Always starts from Monday
2. Number of Check-in Desks
 - The number of check-in desks for each airline will be assigned based on the original ratio:
 - FOP: 40% | CHV: 35% | ABJ: 25%
3. Number of Passport Gates
 - The number of passport gates for different nationality will be assigned based on the original ratio:
 - British: 100% | Non-British: 33%
4. Whether to combine CHV & FOP Check-in desks
 - When activated, the number of check-in desks will be assigned with the ratio as the following:
 - ABJ: 40% | CHV or FOP: 60%

4 Types of Simulation Output

4 output can be produced by this simulation model:

1. Check-in desks' average wait time
2. Passport gates' average wait time
3. Total average wait time
4. Ratio of total passengers who has less than 1 minute of waiting time at the passport gate

Assumptions & Limitations

1. The simulation is a non-terminating simulation as there are always passengers arriving at the airport at each hour for the entire week.
2. The simulation disregards the business hours from 12AM to 6AM as the passenger mean arrival rates of this period of time is not provided.
3. Information provided by the management team, as well as the statistical distributions of the service time are presumed to be accurate and reflect the real-world scenario
4. Removal of initialization bias is not performed.
5. Due to the limitation of the model built, it is unable to perform sufficient number of replications required (rule of thumb is 10) in order to ensure accurate results at the end.

Final Simulation Outcome

Final Simulation Outcome #1

Q1. Number of passport gates required to make sure that the waiting time in the passport control stage is less than a minute 98% of times.

Ans:

If run the model for 7 days without changing the number of check-in desks(20), according to figure 1, the Bath airport would then need **22 passport gates** to ensure the waiting time is less than a minute 98% of the time.

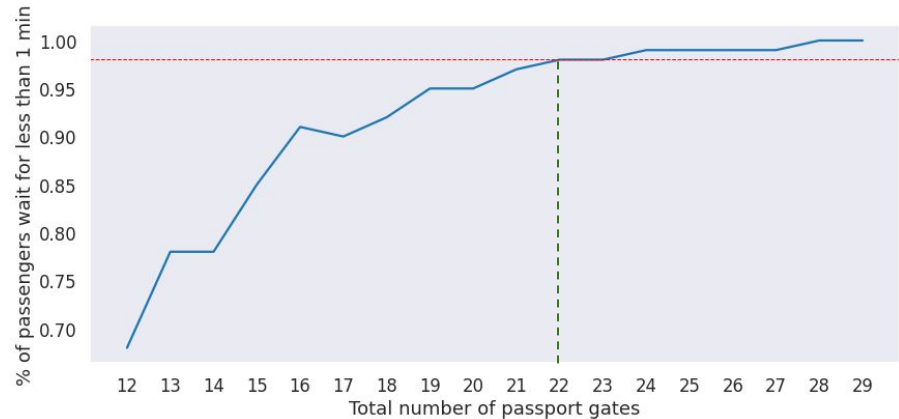


Figure 1. Number of gates vs. % of passengers waiting for less than 1 min

Final Simulation Outcome #2

Q2. Should the airport combine check-in desks of FOP and CHV airlines?

Ans:

It is not advised to combine the check-in desks for both FOP and CHV airlines as the average waiting time at the check-in desks increase significantly and is continuing to increase as the time goes by.

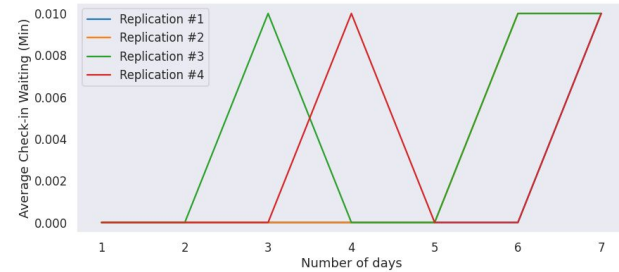


Figure 2. Average wait time at check-in without combining FOP & CHV

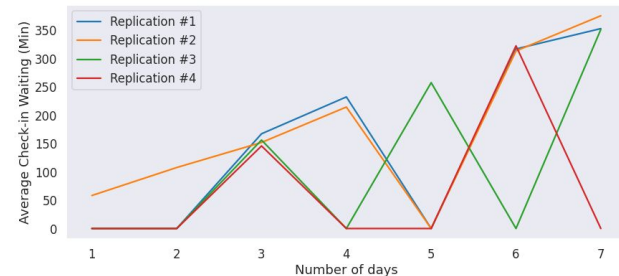


Figure 3. Average wait time at check-in combining FOP & CHV

Final Simulation Outcome #2

Q3. Any other suggestions for the service station allocations?

Ans:

After running 5 replications, figure 4 suggests that by increasing just **4 more passport gates** to 16 can significantly lower the total average waiting time through the two service stations.

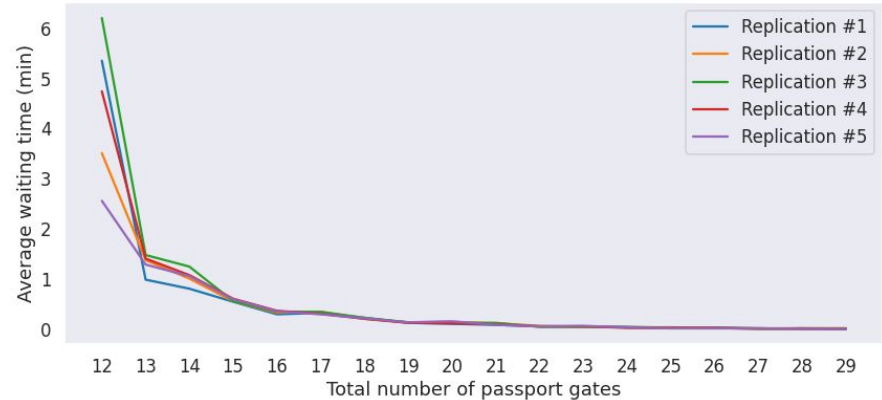


Figure 4. Average total wait time vs. number of passport gates