

# Taxi time dependency on runway and parking area

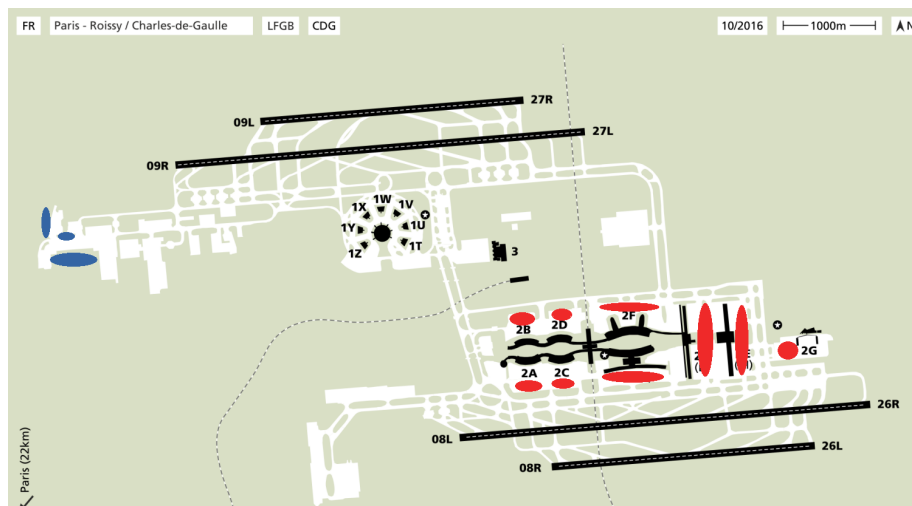
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## Introduction

We explored the dependency of taxi time on the runway and on the parking area, with a particular focus on Air France and FedEx flights.

We expect the taxi time to be larger when the distance between the parking slot and the runway is larger. This is especially evident with FedEx flight, since they all leave from the same parking area (called I), situated at the periphery of the airport platform.

## 1 Airport Structure



**Figure 1:** Map of Charles de Gaulle airport. The red ovals correspond to the gates where Air France aircrafts usually park. The blue ovals correspond where FedEx aircrafts park.

Figure 1 shows a map of the entire airport, where the parking areas for FedEx and AirFrance aircrafts are evidenced.

We can see from the map that Air France aircrafts have a quicker access to the runways, especially the southern ones, since their parking position is central. FedEx aircraft, on the other side, have a quite quick access to the northern runways only when they are taking off facing east or landing facing west. While the large distance from the southern runways might be a reason for delay.

### 1.1 The runways

To better understand the variations in taxi time, it's essential to explain the standard use of the four runways, that take different names based on whether the aircrafts face east or west.

Runway	Airport zone	Facing	Movement
09L	North	East	Arrival
27R	North	West	Arrival
09R	North	East	Departure
27L	North	West	Departure
08R	South	East	Arrival
26L	South	West	Arrival
08L	South	East	Departure
26R	South	West	Departure

## 2 Air France flights

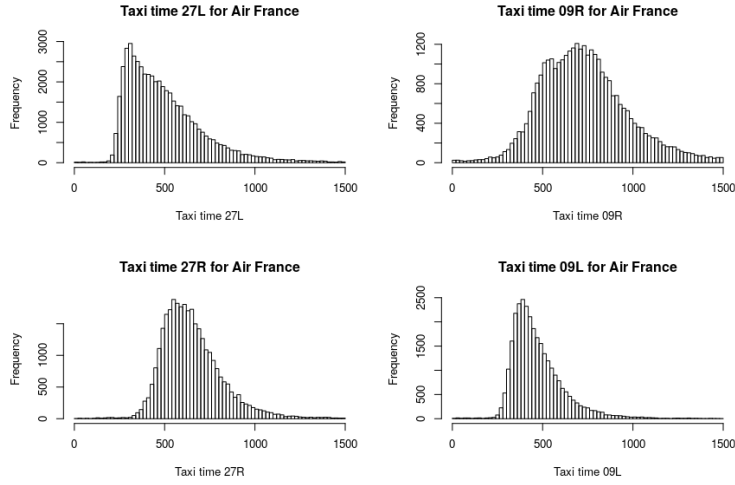
To see if there were significant differences in the taxi times of Air France flights based on the runway, we computed the mean and the standard deviation of taxi times for all the runways.

Runway	Mean taxi time (s)	$\sigma$ (s)	Frequency
08R	305	184	13%
26R	344	221	22%
26L	386	154	20%
08L	426	270	16%
09L	480	190	6%
27L	511	284	10%
27R	660	211	6%
09R	766	334	7%

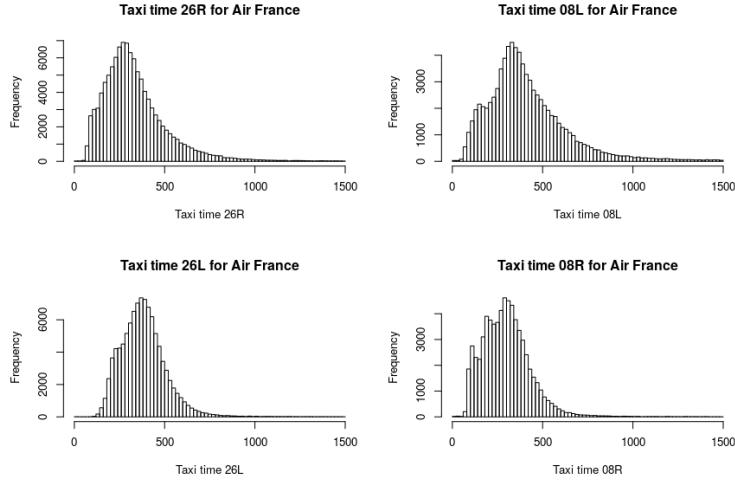
**Table 1:** Taxi time averaged over a total of 511791 Air France flights, relative standard deviation and relative frequency of usage of that runway ordered by increasing mean.

It is evident from the table 1 that the taxi time is shorter for southern runways for Air France flights: this is explained by the shorter distance between

southern runways and Air France parking areas. Moreover, we performed an ANOVA test to verify if the difference between the taxi times for different runways were statistically significant, resulting in a strong evidence that they are (p-value lower than  $10^{-15}$ ).



**Figure 2:** Distribution of taxi times for Air France flights for the northern runways.



**Figure 3:** Distribution of taxi times for Air France flights for the northern runways.

We plotted the distribution of taxi times for Air France flights grouped by runway in Figures 2 and 3.

### 3 FedEx flights

We analysed FedEx flights to be able to explain the peak in the taxi time at 3 a.m. In fact, from approximately 1:30 a.m. to 3:30 a.m., most of the flights are from FedEx or its partners, like ASL Airlines Ireland.

We present below the table and the histograms analogous to those showed for Air France.

Runway	Mean taxi time (s)	$\sigma$ (s)	Frequency
27R	325	155	26 %
09R	340	217	17%
09L	536	138	19%
26L	666	203	2%
27L	680	247	20%
08L	828	262	7%
08R	832	238	1%
26R	1099	314	8%

**Table 2:** Taxi time avaraged over a total of 23832 FedEx flights, relative standard deviation and relative frequency of usage of that runway ordered by increasing mean.

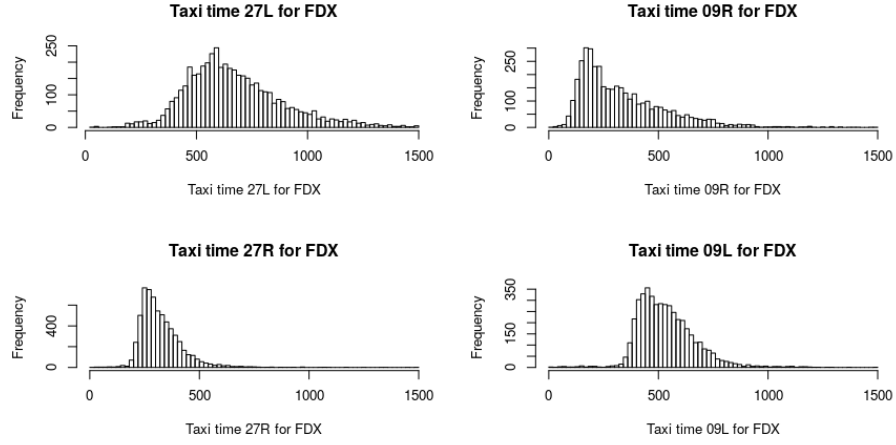
As expected, we see that the mean taxi time is low only for the runways dedicated to the take off facing east and to the landing facing west. As in the case of Air France flights, the ANOVA test suggested that the taxi times for different runways are significantly different.

In Figures 4 and 5 the distributions for taxi times for different runways are shown.

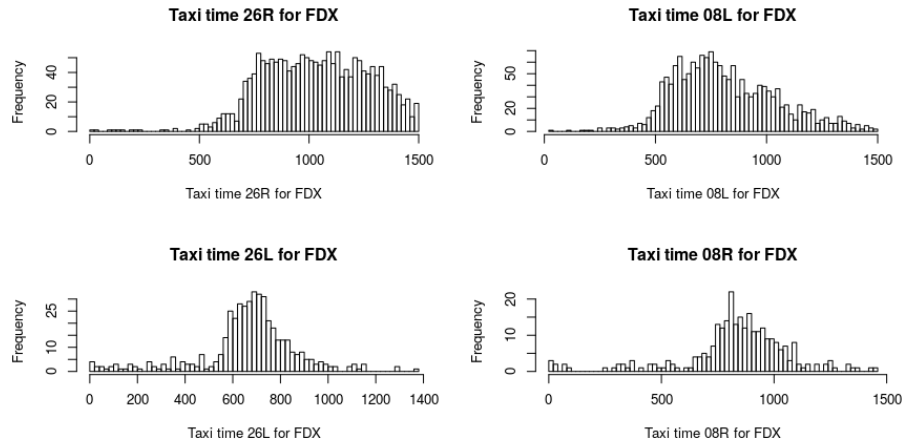
### 4 Comments and future work

As expected, the mean taxi time increases as the distance between the parking slot and the runway increases.

What can be further analyzed are the non-Gaussian shapes of some of the distributions presented. In fact, for what it concerns FedEx flights, this can partly be imputed to the low number of observations. But for what it concerns Air France flights, we can see that some of the curves, such as the ones for runways 09R, 26R, 08L and 08R, look like the sum of two or more Gaussians. It would be interesting to isolate the factors that cause this kind of shapes.



**Figure 4:** Distribution of taxi times for FedEx flights for the northern runways.



**Figure 5:** Distribution of taxi times for FedEx flights for the southern runways.