Flight Delays

Millions of people fly every day, and flight delays can be an unwelcome aspect of air travel. Just how often do flight delays occur?

In this project, we will work with airport flight data and explore how the day of week affects the likelihood of a delayed departure.

Loading the Data

The `'atlanta-airport-flights-2023.csv'` file contains a sample of domestic flights going out of the world's busiest airport. Load up the data and take a look.

```
1  import pandas as pd
2  import matplotlib.pyplot as plt
3
4  # Load the CSV file into a DataFrame
5  df = pd.read_csv('flights.csv')
6  df
```

	scheduled	actual	carrier	flight	tailnum	origin	dest	air_time	distance
0	04/29/2023, 16:35	04/29/2023, 17:01	WN	1079	N230WN	ATL	HOU	110.0	696
1	07/02/2023, 15:10	07/02/2023, 15:05	DL	355	N953AT	ATL	GPT	54.0	352
2	12/25/2023, 10:55	12/25/2023, 10:53	WN	291	N413WN	ATL	RDU	57.0	356
3	09/01/2023, 12:50	09/01/2023, 12:48	DL	1132	N947DZ	ATL	TYS	28.0	152
4	12/14/2023, 07:05	12/14/2023, 07:02	DL	40	N332DN	ATL	BOS	121.0	946
...	...	...	...	...	...	...	...	...	...
4995	11/15/2023, 14:20	11/15/2023, 14:17	WN	13	N400WN	ATL	MCO	63.0	404
4996	04/09/2023, 19:50	04/09/2023, 19:58	OH	1320	N567NN	ATL	CLT	42.0	226
4997	12/14/2023, 13:20	12/14/2023, 13:16	DL	695	N363NB	ATL	DAL	103.0	721
4998	12/06/2023, 13:05	12/06/2023, 13:01	DL	911	N992AT	ATL	GSO	56.0	306
4999	05/29/2023, 14:38	05/29/2023, 14:57	NK	952	N624NK	ATL	DFW	110.0	731

This line of code was used just to check if the two columns are actually dates in terms of their data type. This is to ensure that before any calculations are made, we have the right data types and we won't encounter any issues regarding computation errors.

```
# Checking the data types of 'scheduled' and 'actual' columns
departures = df[['scheduled', 'actual']]
departures.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   scheduled  5000 non-null   object
 1   actual     5000 non-null   object
dtypes: object(2)
memory usage: 78.3+ KB
```

Since we found out that the data type of the two columns is not datetime, we have to convert them before doing anything in it.

```
# Changing the datatypes of 'scheduled' and 'actual' columns to datetime
departures['scheduled'] = pd.to_datetime(departures['scheduled'])
departures['actual'] = pd.to_datetime(departures['actual'])
departures.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype         
---  ------     --------------  -----         
 0   scheduled  5000 non-null   datetime64[ns]
 1   actual     5000 non-null   datetime64[ns]
dtypes: datetime64[ns](2)
```

Inside the "departures" dataframe, we only have what we need identifying delayed flights, the cleaned "scheduled" and "actual" columns.

We can now use this data to answer our question. First, we can use the two columns to calculate and identify the delayed flight schedules.

```
1  departures['delay'] = departures['actual'] - departures['scheduled']
2  departures
```

	scheduled	actual	delay
0	2023-04-29 16:35:00	2023-04-29 17:01:00	0 days 00:26:00
1	2023-07-02 15:10:00	2023-07-02 15:05:00	-1 days +23:55:00
2	2023-12-25 10:55:00	2023-12-25 10:53:00	-1 days +23:58:00
3	2023-09-01 12:50:00	2023-09-01 12:48:00	-1 days +23:58:00
4	2023-12-14 07:05:00	2023-12-14 07:02:00	-1 days +23:57:00
...	...	...	...
4995	2023-11-15 14:20:00	2023-11-15 14:17:00	-1 days +23:57:00
4996	2023-04-09 19:50:00	2023-04-09 19:58:00	0 days 00:08:00
4997	2023-12-14 13:20:00	2023-12-14 13:16:00	-1 days +23:56:00
4998	2023-12-06 13:05:00	2023-12-06 13:01:00	-1 days +23:56:00
4999	2023-05-29 14:38:00	2023-05-29 14:57:00	0 days 00:19:00

5000 rows × 3 columns

The way we interpret the delay column is that: negative days mean that the flight departed earlier that then schedule time, to calculate how early each flight departed we just need to count until the time reaches '00:00:00'.

Any other rows that exceed '0 days 00:00:00' are the flights who departed later than the scheduled time.

To easily identify which flights are actually late, we can identify which of them left within the grace period of 15 minutes. Once past the 15-minute mark, they are considered late.

```
# Identify late flights
departures['is_late'] = departures['delay'] > pd.Timedelta(minutes=15)
departures
```

	scheduled	actual	delay	is_late
0	2023-04-29 16:35:00	2023-04-29 17:01:00	0 days 00:26:00	True
1	2023-07-02 15:10:00	2023-07-02 15:05:00	-1 days +23:55:00	False
2	2023-12-25 10:55:00	2023-12-25 10:53:00	-1 days +23:58:00	False
3	2023-09-01 12:50:00	2023-09-01 12:48:00	-1 days +23:58:00	False
4	2023-12-14 07:05:00	2023-12-14 07:02:00	-1 days +23:57:00	False
...	...	...	...	...
4995	2023-11-15 14:20:00	2023-11-15 14:17:00	-1 days +23:57:00	False
4996	2023-04-09 19:50:00	2023-04-09 19:58:00	0 days 00:08:00	False
4997	2023-12-14 13:20:00	2023-12-14 13:16:00	-1 days +23:56:00	False
4998	2023-12-06 13:05:00	2023-12-06 13:01:00	-1 days +23:56:00	False
4999	2023-05-29 14:38:00	2023-05-29 14:57:00	0 days 00:19:00	True

5000 rows × 4 columns

With that, we can now identify which flights are late.

Now, we need to identfy how the days of the week might affect the delayed flights. First, we have to identify each flight's day of the week.

```
departures['day_name'] = departures['actual'].dt.strftime('%a')
# Only display late flights
departures = departures.query("is_late == False")
departures
```

	scheduled	actual	delay	is_late	day_name
1	2023-07-02 15:10:00	2023-07-02 15:05:00	-1 days +23:55:00	False	Sun
2	2023-12-25 10:55:00	2023-12-25 10:53:00	-1 days +23:58:00	False	Mon
3	2023-09-01 12:50:00	2023-09-01 12:48:00	-1 days +23:58:00	False	Fri
4	2023-12-14 07:05:00	2023-12-14 07:02:00	-1 days +23:57:00	False	Thu
5	2023-08-27 23:25:00	2023-08-27 23:26:00	0 days 00:01:00	False	Sun
...	...	...	...	...	...
4991	2023-11-17 23:35:00	2023-11-17 23:28:00	-1 days +23:53:00	False	Fri
4995	2023-11-15 14:20:00	2023-11-15 14:17:00	-1 days +23:57:00	False	Wed
4996	2023-04-09 19:50:00	2023-04-09 19:58:00	0 days 00:08:00	False	Sun
4997	2023-12-14 13:20:00	2023-12-14 13:16:00	-1 days +23:56:00	False	Thu
4998	2023-12-06 13:05:00	2023-12-06 13:01:00	-1 days +23:56:00	False	Wed

4008 rows × 5 columns

Great, now we have the days. The next step is to calculate the number of late flights that fall under each day of the week. For this, we can just use df.group() and sum(). In the previous code we can see that we already filtered out the late flights, it was done to make it easier to count the flights.

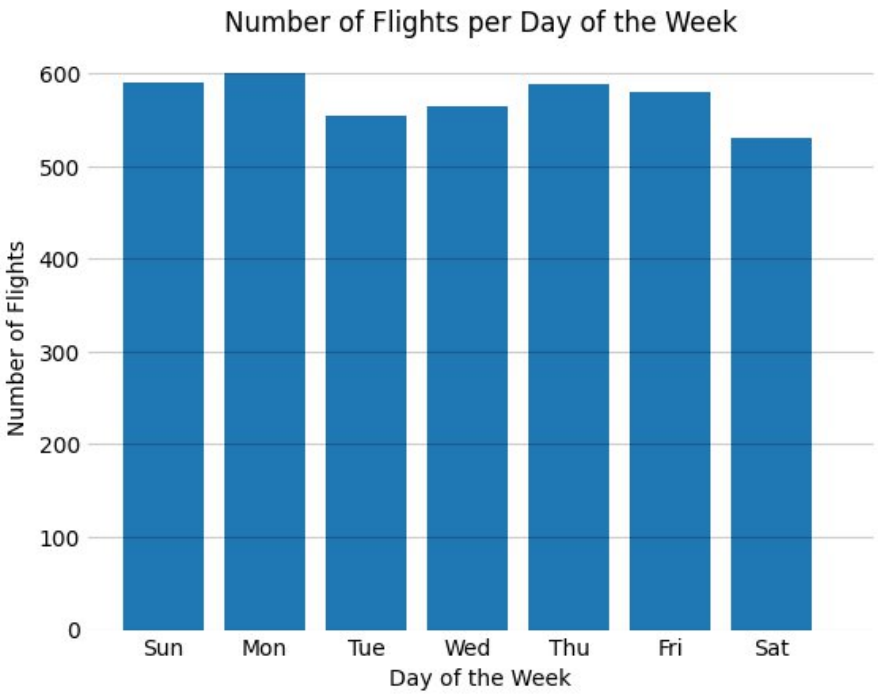
We will also need to re-arrange the days in a much proper way.

```
1
2  # Number of flights per day of the week
3  solution = departures.value_counts('day_name')
4  solution = solution.reindex(['Sun', 'Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat']).reset_index(name='flights')
5  solution.columns = ['day_name', 'flights']
```

We can now graph the result!

```python
def clean_bar_axes( ):
    ax = plt.gca()
    ax.spines[['top', 'bottom', 'right' , 'left']].set_visible(False)
    ax.grid(axis='y', color='black', alpha=0.2)
    ax.tick_params(axis='both', length=0)
    ax.set_xticks([0,1, 2, 3, 4,5,6,7])

plt.bar(solution['day_name'], solution['flights'])
plt.xlabel('Day of the Week')
plt.ylabel('Number of Flights')
plt.title('Number of Flights per Day of the Week')
clean_bar_axes()
```



The day of the week with the fewest delated flight is Saturday. According to a quick research, Saturday likely has the fewest delayed flights because it is typically a less busy travel day compared to weekdays. Business travel is lower, and many airlines schedule fewer flights, reducing congestion at airports. With less air traffic and fewer passengers, there are fewer opportunities for delays caused by scheduling conflicts, airspace congestion, or operational bottlenecks.