Lab 5 Solutions

Summer Session A, 2023, Ethan M.

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1 Section 1: Markdown Syntax

1.1 Subsection 1.1

The **quick** brown fox *jumps* over the `lazy` dog.

> That was a really cool sentence!

1.2 Subsection 1.2: Itemized and Enumerated Lists

- It is very important to check the Binomial Conditions before using the Binomial Distribution!
  - Failure to check the necessary conditions can lead to incorrect results.
  - Incorrect results are not good!

1.3 Subsection 1.3: Typesetting Equations

The Pythagorean Theorem states that $a^2 + b^2 = c^2$

$$f_X(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

- **Pythagorean Theorem:** $a^2 + b^2 = c^2$
- **Euler's Identity:** $e^{i\pi} + 1 = 0$

$$f_X(x) = \begin{cases} \frac{1}{b-a} & \text{if } a \leq x \leq b \\ 0 & \text{otherwise} \end{cases}$$

$$\begin{aligned} \overline{x} &= \frac{1}{n}\sum_{i=1}^{n} x_i \\ n\overline{x} &= \sum_{i=1}^{n} x_i \end{aligned}$$

1.4 Section 1.4: Hyperlinks

PSTAT Department Website

2 Section 2: Importing and Manipulating Data

```
[1]: from datascience import *
```

```
[2]: air = Table.read_table("https://pstat5a.github.io/Files/Datasets/air22.csv")
```

To find the number of observational units, we simply count the rows in the table using the `.num_rows` method:

```
[3]: air.num_rows
```

```
[3]: 20345
```

To find the number of variables (i.e. the number of columns in the data matrix), we use the `.num_columns` method:

```
[4]: air.num_columns
```

```
[4]: 21
```

Following the hint, we can use the `.labels` method to list the column *labels* (i.e. variable names) of the data matrix:

```
[5]: air.labels
```

```
[5]: ('year',
      'month',
      'carrier',
      'carrier_name',
      'airport',
      'airport_name',
      'arr_flights',
      'arr_del15',
      'carrier_ct',
      'weather_ct',
      'nas_ct',
      'security_ct',
      'late_aircraft_ct',
      'arr_cancelled',
      'arr_diverted',
      'arr_delay',
      'carrier_delay',
      'weather_delay',
      'nas_delay',
      'security_delay',
      'late_aircraft_delay')
```

To display only the `arr_del15` column we can use the command:

```
[6]: air.column("arr_del15")
```

```
[6]: array([  7.,   3.,  14., …,   3.,   1.,  17.])
```

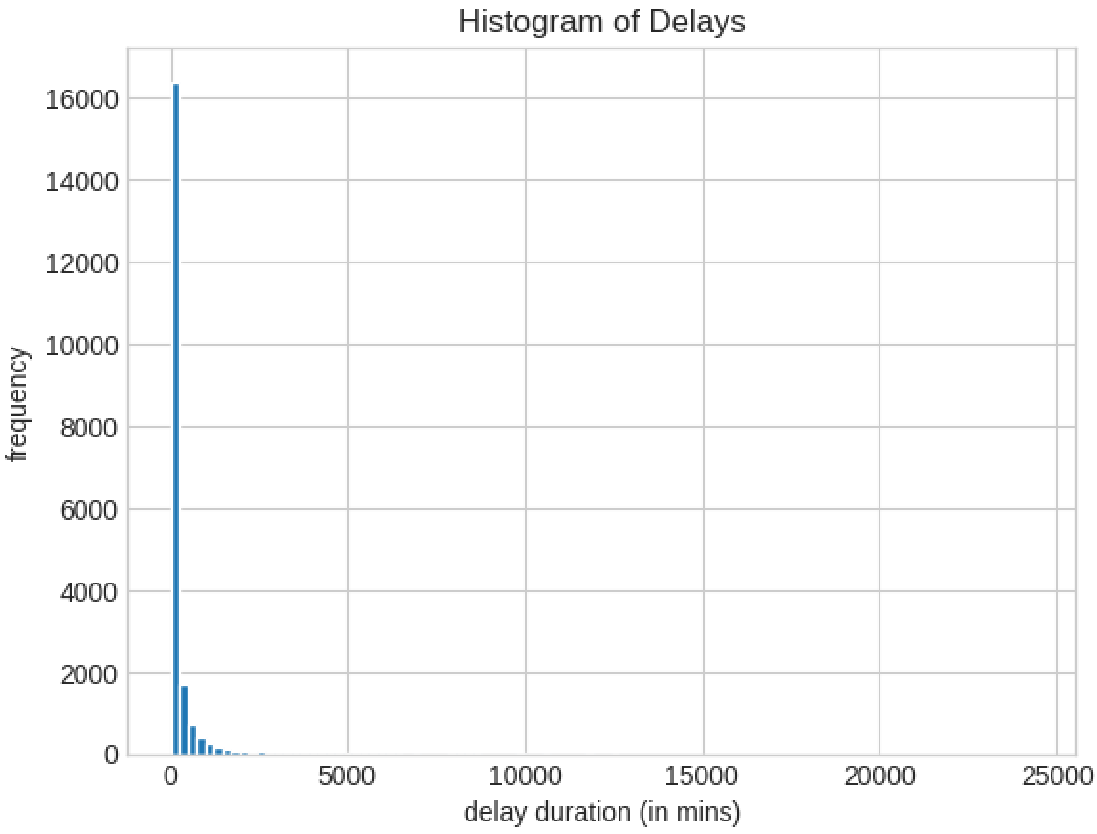
To find which years were included in the dataset, we display the year column of the data matrix:

```
[7]: air.column("year") # seems like only 2022 is included in the dataset
```

```
[7]: array([2022, 2022, 2022, …, 2022, 2022, 2022])
```

```
[8]: %matplotlib inline
     import matplotlib
     import matplotlib.pyplot as plt
     plt.style.use('seaborn-v0_8-whitegrid')
```

```
[9]: plt.hist(air.column("weather_delay"),
              bins = 100,
              edgecolor = "white");
     plt.xlabel("delay duration (in mins)");
     plt.ylabel("frequency");
     plt.title("Histogram of Delays");
```



Here's how we can easily find the answer to the question "how many observational units were recorded from Alaska Airlines?"

As mentioned in the lab handout, `air.column("carrier") == "AS"` returns a boolean vector with `True` elements corresponding to values in `carrier` that have values `AS`. Since `True` is encoded as `1` and `False` is encoded as `0` (as was discussed in a previous lab), summing up the elements in the array `air.column("carrier") == "AS"` will result in the total *number* of `True` elements; i.e. the number of flights that were maintained by Alaska Airlines.

[10]:
```
sum(air.column("carrier") == "AS")
```

[10]:
```
975
```

The code `air.row(air.column(1) == 1)` is selecting the rows of the `air` data matrix whose second column entry (i.e. month) entry is equal to 1; i.e. it returns the portion of the data matrix corresponding to flights taking place in January.

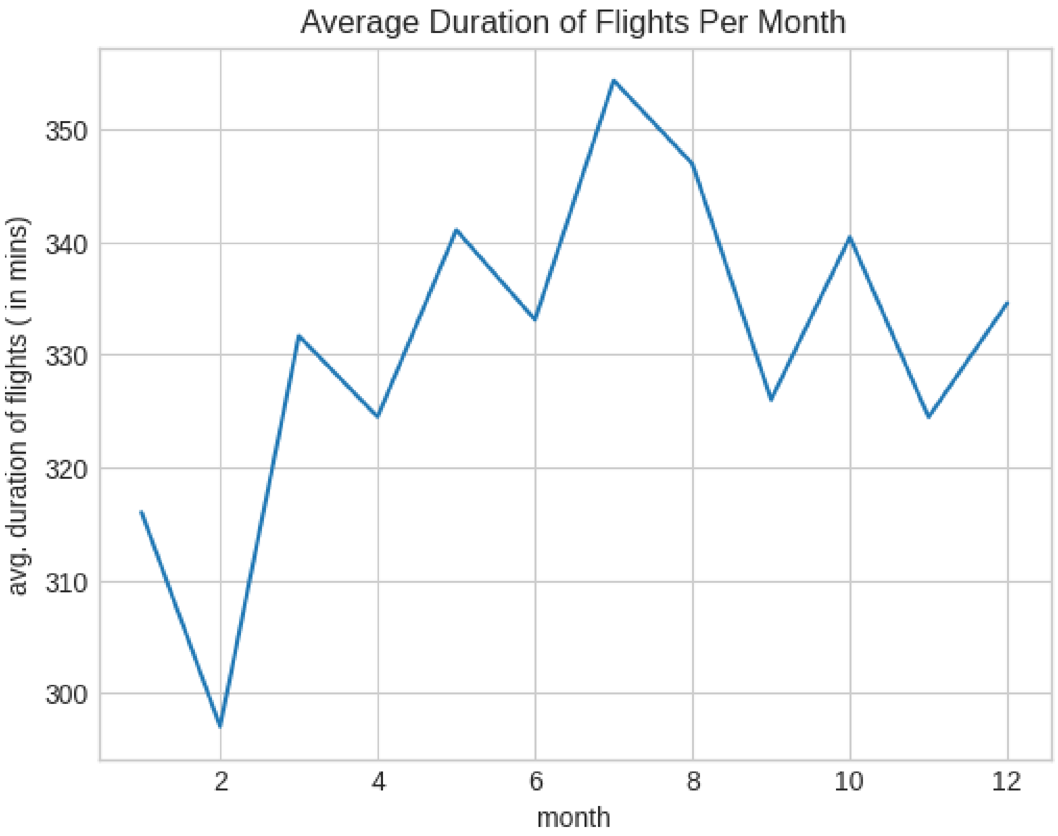
The code `air.row(air.column(1) == 2)[6]` returns the durations of flgihts that took place in February (i.e. the *second* month).

Thus, putting these two facts together, we can create a `for`-loop to give us the average duration of flights per month:

[11]:
```
import numpy as np

means = []
for k in np.arange(1, 13):
  means.append(np.nanmean(air.row(air.column(1) == k)[6]))
```

[12]:
```
plt.plot(np.arange(1, 13),
         means);
plt.xlabel("month");
plt.ylabel("avg. duration of flights ( in mins)");
plt.title("Average Duration of Flights Per Month");
```


Average Duration of Flights Per Month
avg. duration of flights (in mins)
350
340
330
320
310
300
2
4
6
8
10
12
month

[ ]: