Homework PAE 5

Exercise 3.

Orbital parameters:

- Eccentricity: 0.0002799;

- Semimajor axis: 6 892 km;

- Inclination: 97.385°;

- RA of Ascending note: 354.035°;

- Perigee x Apogee: 519.8 x 523.7 km;

- Argument of perigee: 9.198°;

- Mean anomaly: 350.930°;

- Period: 1h 34m 55s (94.92 min);

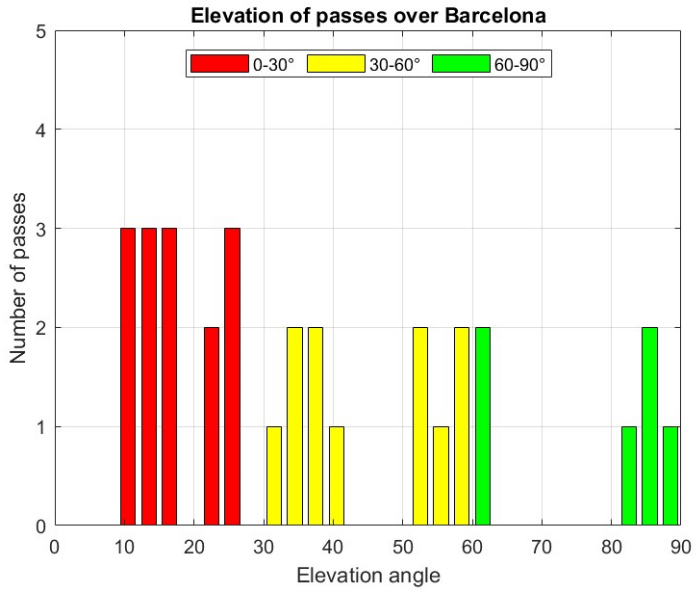
Exercise 4.

I've computed all passes for the next 10 days for the Barcelona GS (Lat: 41.39°, Long: 2.16°).

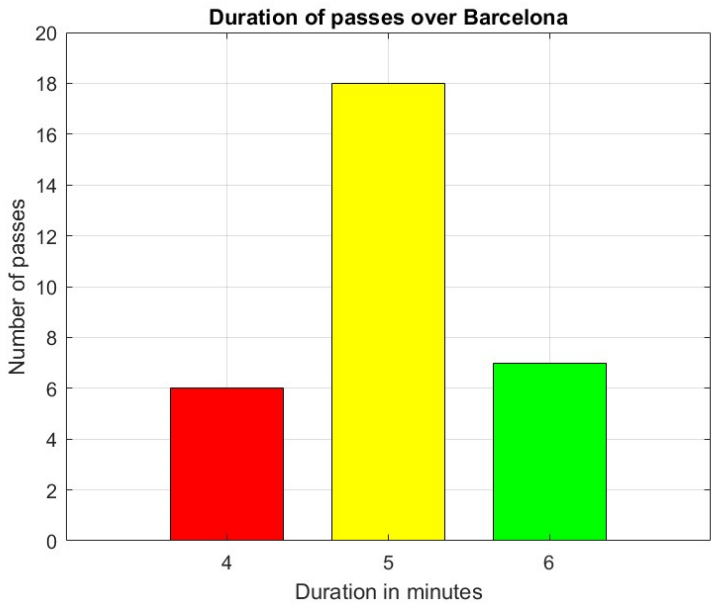
Using Python to filter out the text and isolate the relevant data and MATLAB for the graphs, below are the results.

Note: All graphs in this assignment are color-coded in order to show either the 3 elevation angle intervals, or the 3 different durations for a pass (4, 5 or 6 minutes). Obviously, red means the worst case, yellow is neither bad or good and green signifies the best case.

4.1.



4.2.



4.3.

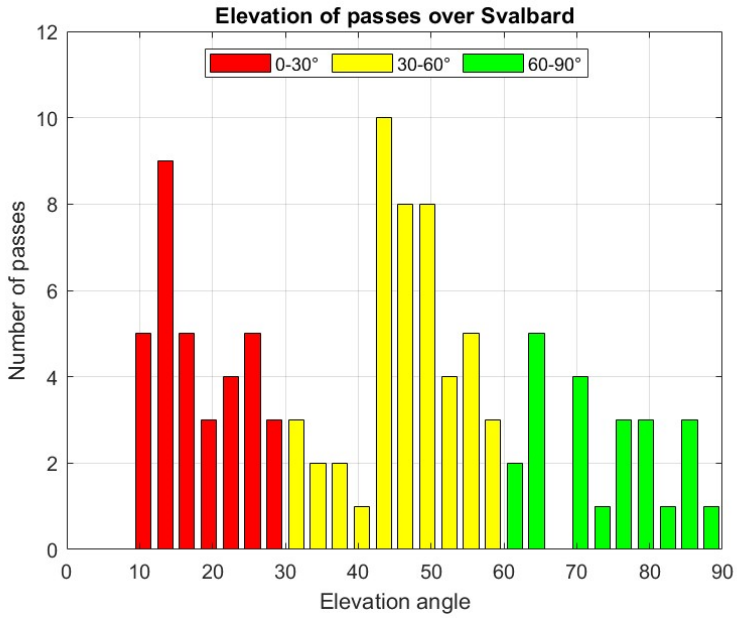
The minimum for the pass durations is **4 minutes**, while the maximum is **6 minutes**.

From a total of 31 passes, the average (mean) is **5.0323 minutes**, while the mean of these values is **5 minutes**, with 18 out of 31 passes lasting 5 minutes.

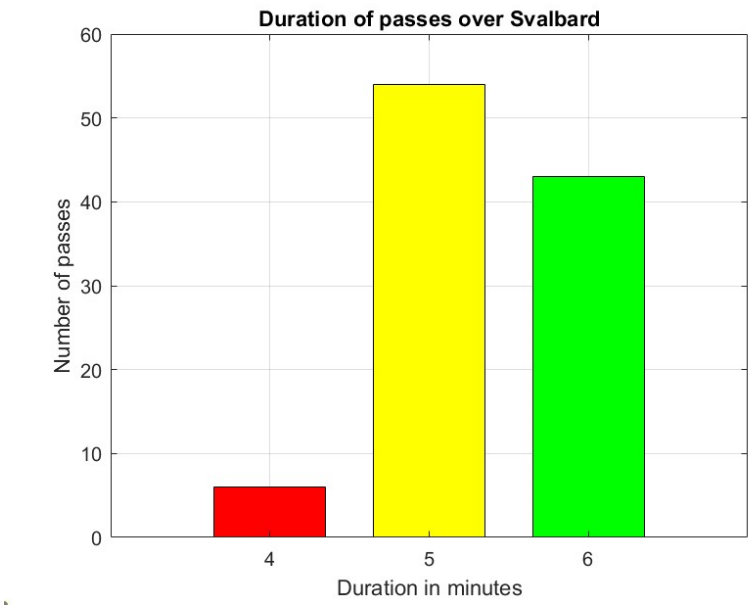
Exercise 5.

Analog to **Exercise 4** for the Svalbard (Norway) station.

5.1.



5.2.



5.3.

The minimum for the pass durations is **4 minutes**, while the maximum is **6 minutes**.

From a total of 103 passes, the average (mean) is **5.3592 minutes**, while the mean of these values is still **5 minutes**, with 54 out of 103 passes lasting 5 minutes.

Exercise 6.

From the last 2 assignments, I reached the conclusion that we can use:

- BW = 125 kHz;
- SF = 7;
- CR = 4/5;
- Payload size = 19 bytes for a complete transmission.

So, for our 2 cases, using this https://shorturl.at/bikrZ online calculator for the LoRa packet airtime, we obtain a packet airtime of **51.456 ms**.

We will now compute the number of packets per pass and per day for both the Barcelona and Svalbard GSs, both for our case and for a worse case (for a very conservative minimum).

For the **Barcelona GS**:

No. of packets per pass (on average) = 5.0323 * 10^3 / 51.456 ≈ **97 packets**.

No. of packets per day (on average) = 97 * 33/10 = 97 * 3.3 ≈ **320 packets**.

For the **Svalbard GS**:

No. of packets per pass (on average) = 5.3592 * 10^3 / 51.456 ≈ **104 packets**.

No. of packets per day (on average) = 104 * 103/10 = 104 * 10.3 ≈ **1071 packets**.

And, for a worse case of:

- BW = 125 kHz;
- SF = 8;
- CR = 4/6;
- Payload size = 19 bytes for a complete transmission.

We obtain a packet airtime of **90.112** ms.

For the **Barcelona GS**:

No. of packets per pass (on average) = 5.0323 * 10^3 / 90.112 ≈ **55 packets**.

No. of packets per day (on average) = 55 * 33/10 = 55 * 3.3 ≈ **181 packets**.

For the **Svalbard GS**:

No. of packets per pass (on average) = 5.3592 * 10^3 / 90.112 ≈ **59 packets**.

No. of packets per day (on average) = 59 * 103/10 = 59 * 10.3 ≈ **607 packets**.