**Analysis of Daily Passenger Numbers and Ticket Prices Using Fourier Transform**

**Name:** Rahul Yadav Suresh
**Student ID:** 23072902

**Introduction:** In order to find recurring patterns, this research will compute a Fourier series approximation and investigate the variance in the daily passenger counts for flights. The average ticket price for 2022 is also determined, and the power spectrum of daily passenger changes is reviewed. Two figures are used to illustrate the findings:

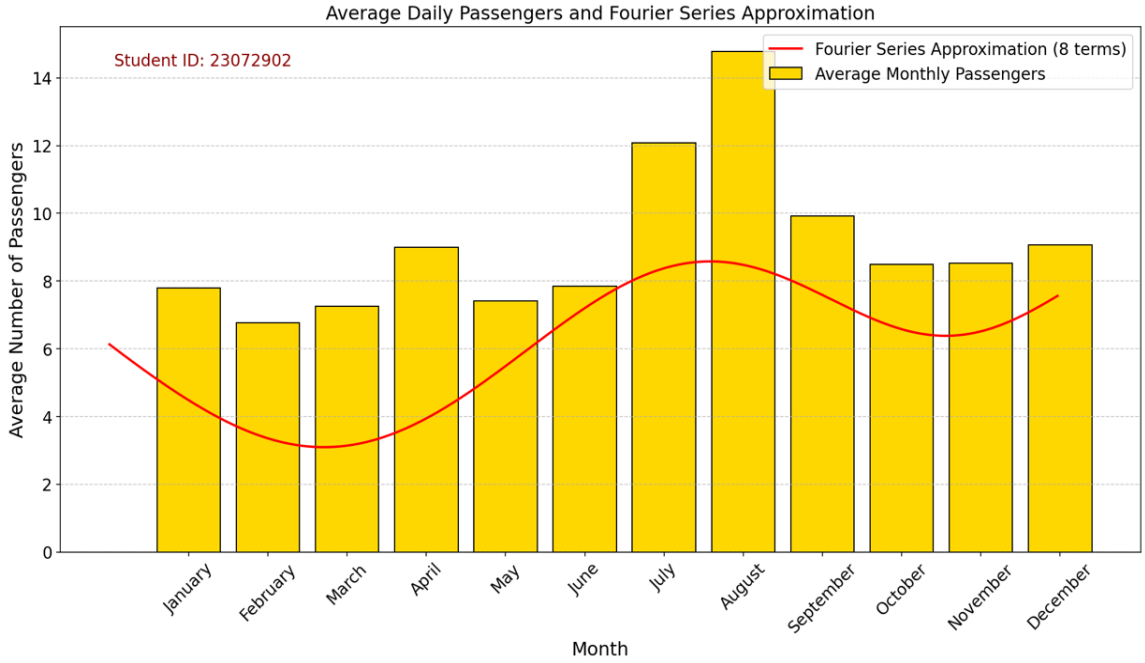
**Data Description:**

• **Day**: Day index, which is an integer that indicates the initial day number.
• **Date**: The entry's real date.
• **Number**: The total number of travellers on that particular day.
• **Price**: The cost of the ticket for that day.

**Figure 1: Average Monthly Passengers and Fourier Series Approximation:**
This graphic shows the Fourier series approximation for daily passenger number changes as well as the average monthly passengers for each month of the year.

**Formula**-(which have been used).

- **Average Monthly Passengers** $= \frac{1}{N}\sum_{i=1}^{N} \text{Number}_i$
- **Fourier Series Approximation**: $S(t) = \sum_{k=0}^{N}(a_k \cdot \cos(2\pi f_k t) + b_k \cdot \sin(2\pi f_k t))$




**Interpretation**: The bar chart in Figure 1 illustrates the seasonal fluctuations in passenger numbers, which peak during the holidays and fall during off-peak times. The differences are brought out by the Fourier series approximation, which successfully captures the underlying yearly cyclical pattern.

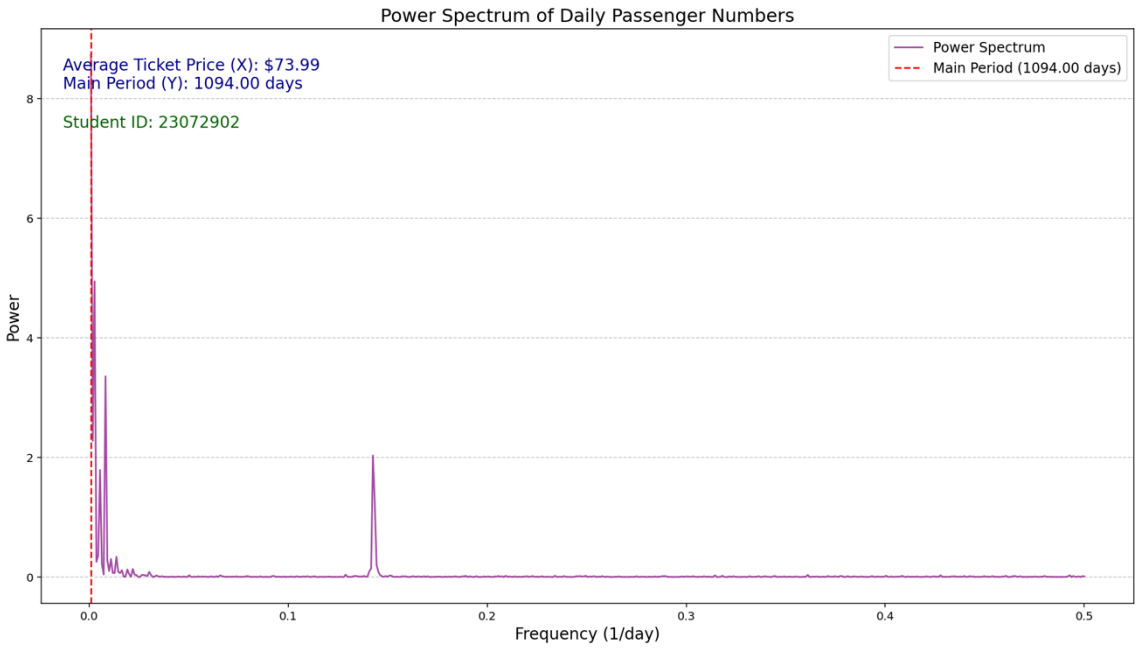
**Figure 2: Power Spectrum and Main Period :** power spectrum, main period (Y) and average ticket price (X) for 2022 are calculated accordingly.

**Formulas**:

**Power Spectrum**: $P(f_k) = a_k^2 + b_k^2$

**Main Period (Y)**: $Y = \frac{1}{f_{\max}}$

**Average Ticket Price (X)** for 2022: $X = \frac{1}{N}\sum_{i=1}^{N} \text{Price}_i$




**Interpretation:** The daily passenger power spectrum is displayed in Figure 2, where the main period **(Y)** represents the biggest cycle in the variations. The frequency that has the greatest power, is indicated by the red vertical line. To put the price patterns for the year in perspective, the average ticket price **(X)** for 2022 is also shown.

**Calculated Values:**

- Average Ticket Price **(X)** for 2022: **73.99$**
- Main Period **(Y)**: **1094.00 days**

**Conclusion:**

By breaking down the daily variation in the passenger number into periodic components, the Fourier transform reveals underlying cyclical trends. The Fourier series approximation and the average monthly passengers are displayed in Figure 1, which captures both underlying periodic patterns and seasonal changes. The primary period (Y) is shown as the dominating frequency in the power spectrum of the daily passenger counts in Figure 2. Additionally, the 2022 average ticket price (X) is displayed. The average ticket price (X) gives an indication of the pricing structure for flights in 2022, while the primary period (Y) offers insights on the dominating cycle in passenger numbers.