# Data Analysis Overview

In this analysis file, we will leverage Python libraries such as `pandas`, `numpy`, `matplotlib`, and `seaborn` to derive insights from the processed data obtained in the data-cleansing file. The analysis will encompass:

1. **Basic Statistics:**
   - Compute descriptive statistics to gain an overview of the dataset's central tendencies and distributions.
2. **Time Series Analyses and Trends:**
   - Explore temporal patterns, trends, and seasonality in the data using time series analysis techniques.
3. **Operational Insights:**
   - Extract operational insights, such as peak activity periods, common routes, and other operational trends.
4. **Visualization and Reporting:**
   - Create visualizations using `matplotlib` and `seaborn` to effectively communicate findings. Generate reports summarizing key insights.

```python
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings

# Suppress all warnings
warnings.filterwarnings('ignore')

from os import listdir

year = 2023

all_dfs = []
folder_path = f'../../assets/data/processed/{year}/'

# load all file from folder path
for file_name in listdir(folder_path):
    all_dfs.append(pd.read_excel(f'{folder_path}{file_name}'))

logistics_df = pd.concat(all_dfs, ignore_index=True)
logistics_df
```

```
        load_id  time_span_in_hours destination_city destination_state  \
0      10711141                0.04          Ft Worth                TX

1      10711143                0.06          Ft Worth                TX
```

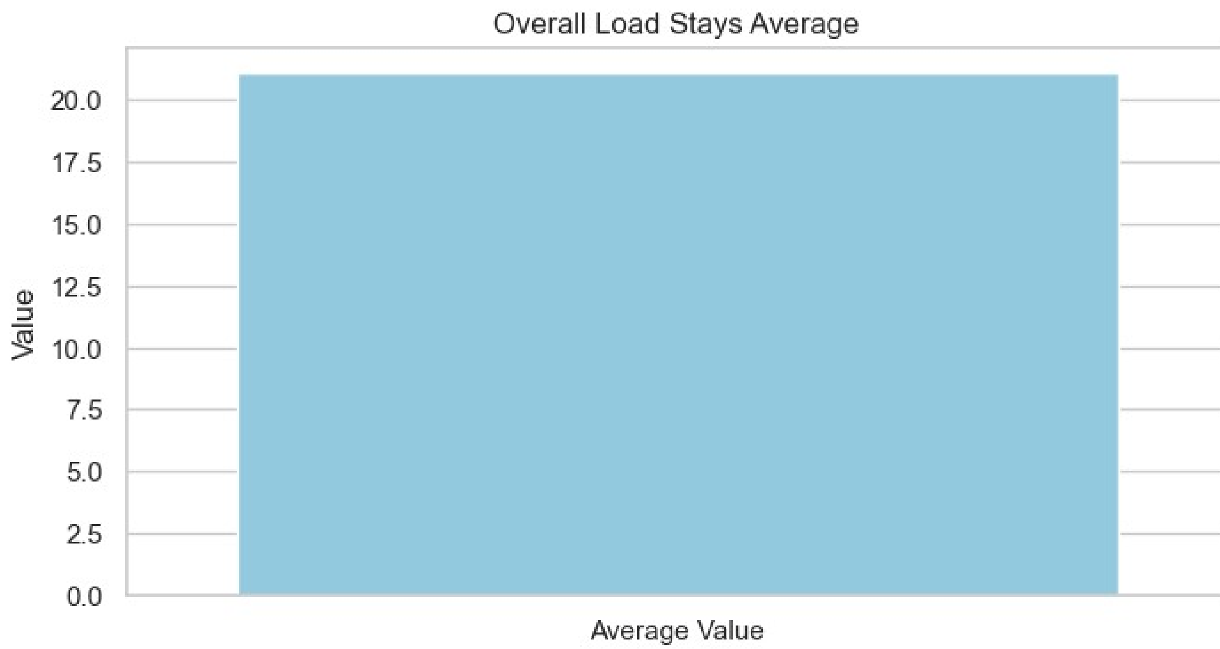
```
2      10711145                   0.29         Ft Worth                TX

3      10711151                   0.14         Ft Worth                TX

4      10711155                   0.96             ORLA                TX

...         ...                    ...              ...               ...

11378  10724771                   0.08         SARASOTA                FL

11379  10726991                  20.82      MARYLAND HE                MO

11380  30316024                   1.11         LA VALLE                WI

11381  30320680                   2.24           COLFAX                WI

11382  30320994                   0.68            PEKIN                IL


      origin_city origin_state     comment  miles     shipper
truck_type  ...  \
0        ABEILENE           TX  NO COMMENT      0  NO SHIPPER
F  ...
1        ABEILENE           TX  NO COMMENT      0  NO SHIPPER
F  ...
2        ABEILENE           TX  NO COMMENT      0  NO SHIPPER
F  ...
3        ABEILENE           TX  NO COMMENT      0  NO SHIPPER
F  ...
4        ABEILENE           TX  NO COMMENT      0  NO SHIPPER
F  ...
...           ...          ...         ...    ...         ...         .
..  ...
11378      ZWOLLE           LA  NO COMMENT      0  NO SHIPPER
F  ...
11379      ZWOLLE           LA  NO COMMENT      0  NO SHIPPER
F  ...
11380      ZWOLLE           LA   MUST TARP   1055         VFP
F  ...
11381      ZWOLLE           LA   MUST TARP   1151         VFP
F  ...
11382      ZWOLLE           LA   MUST TARP    798         VFP
F  ...

       added_hour  added_minute  added_second  added_week
deleted_month  \
0              12             7            52          48
11
1              11            50            31          48
11
```

```
2                12          10          26          48
11
3                11          53          48          48
11
4                10          40          12          48
11
...             ...         ...         ...         ...            .
..
11378             8           9           6          50
12
11379            12          48           7          50
12
11380            16          31          11          51
12
11381             9          49          55          52
12
11382            11          24          32          52
12

       deleted_day  deleted_hour  deleted_minute  deleted_second
deleted_week
0               28            12              10              27
48
1               28            11              53              49
48
2               28            12              27              53
48
3               28            12               2               9
48
4               29            11              37              34
48
...            ...           ...             ...             ...
...
11378           12             8              13              45
50
11379           14             9              37              28
50
11380           18            17              37              42
51
11381           27            12               4              35
52
11382           27            12               5               5
52

[11383 rows x 25 columns]
```

## Basic Statistics and Time Series Trend Analysis

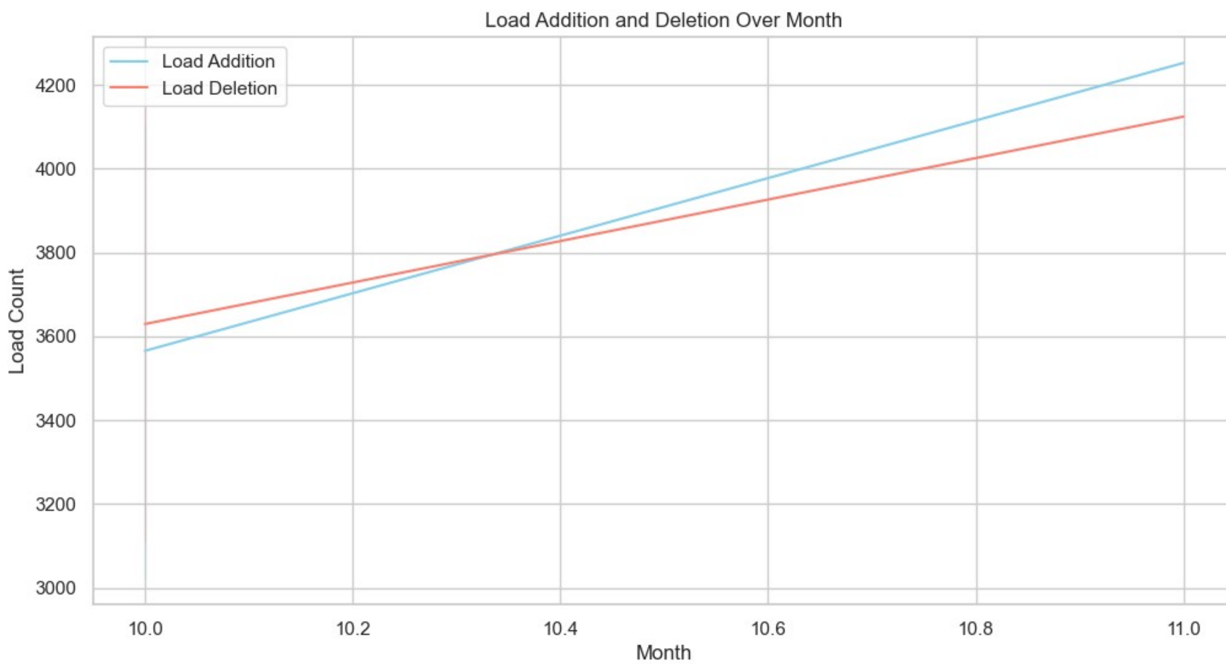
In this analysis, we will explore the average time a load stays in the system overall. Additionally, we will delve into time series trends, examining load duration patterns at a more granular level, such as weekly or monthly intervals. Visualization techniques will be employed to provide a clear representation of these insights. This combined approach aims to offer both a holistic understanding of load durations and nuanced insights into temporal trends.

```
overall_load_stays_average = logistics_df.time_span_in_hours.mean()

sns.set(style="whitegrid")

plt.figure(figsize=(8, 4))
sns.barplot(x=['Average Value'], y=[overall_load_stays_average],
color='skyblue')

plt.title('Overall Load Stays Average')
plt.ylabel('Value')
plt.show()
```

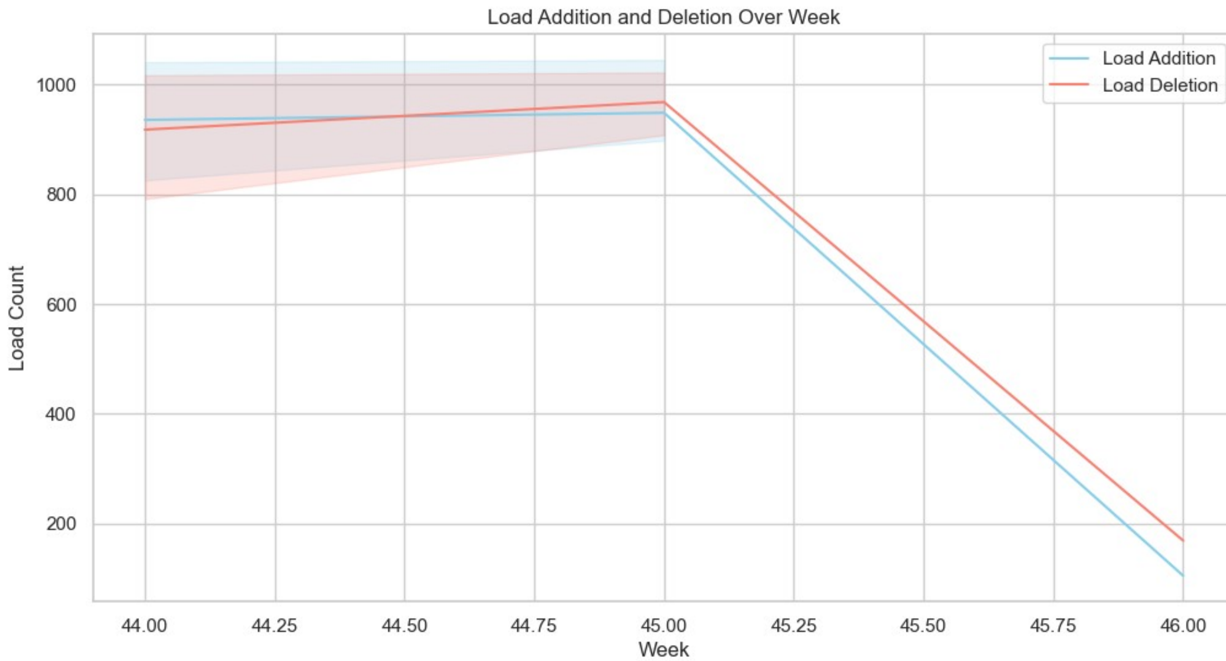



```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.lineplot(x='added_month',
y=logistics_df.groupby('added_month').size(
), data=logistics_df, color='skyblue', label='Load
Addition',legend=True)
sns.lineplot(x='deleted_month',
y=logistics_df.groupby('deleted_month').size(
), data=logistics_df, color='salmon', label='Load
Deletion',legend=True)

plt.title('Load Addition and Deletion Over Month')
```

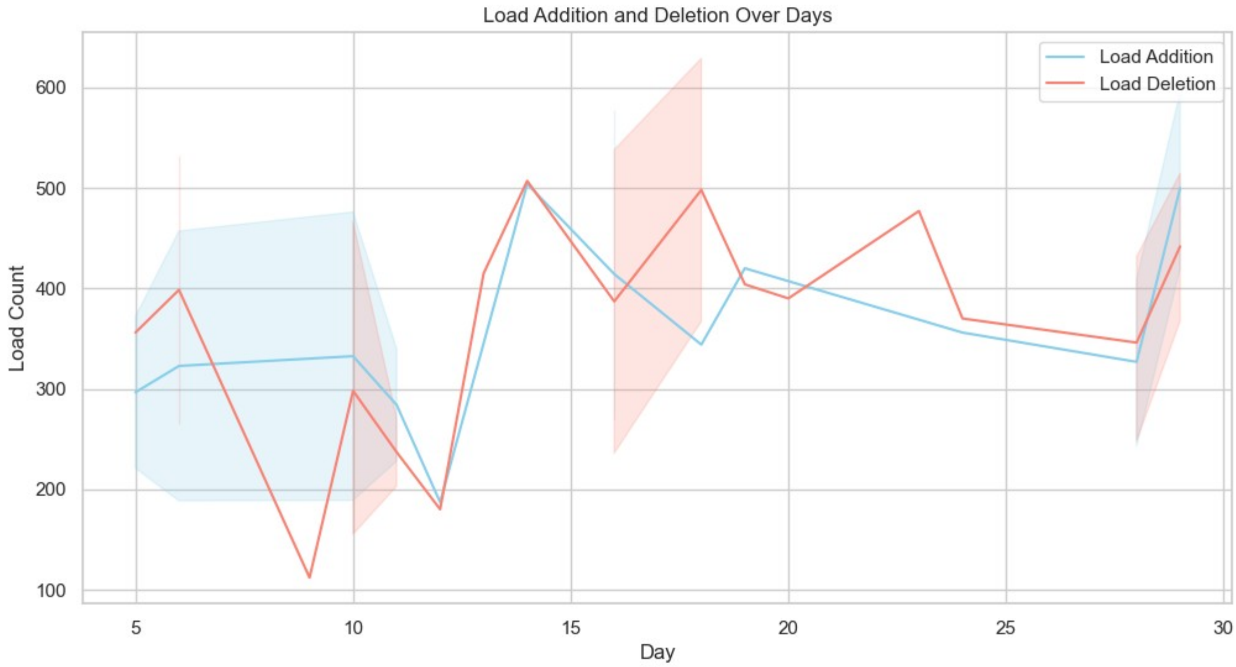
```
plt.xlabel('Month')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```



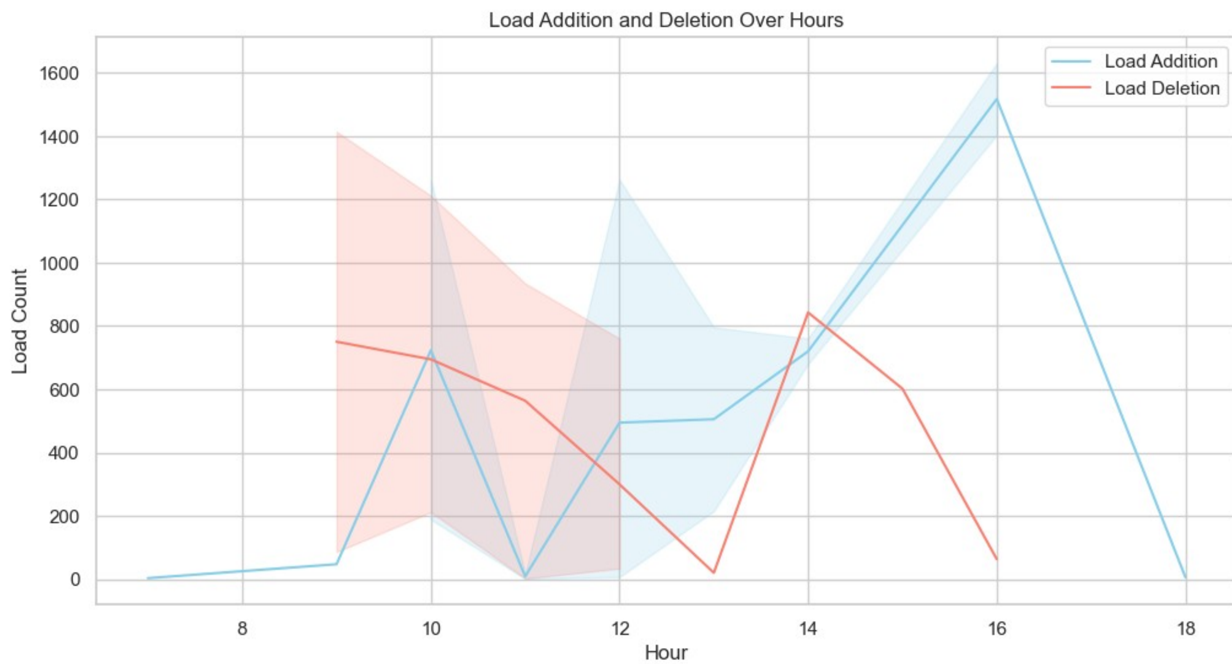

```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.lineplot(x='added_week',
y=logistics_df.groupby('added_week').size(
), data=logistics_df, color='skyblue', label='Load
Addition',legend=True)
sns.lineplot(x='deleted_week',
y=logistics_df.groupby('deleted_week').size(
), data=logistics_df, color='salmon', label='Load
Deletion',legend=True)

plt.title('Load Addition and Deletion Over Weeks')
plt.xlabel('Week')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```




```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.lineplot(x='added_day', y=logistics_df.groupby('added_day').size(
), data=logistics_df, color='skyblue', label='Load
Addition',legend=True)
sns.lineplot(x='deleted_day',
y=logistics_df.groupby('deleted_day').size(
), data=logistics_df, color='salmon', label='Load
Deletion',legend=True)

plt.title('Load Addition and Deletion Over Days')
plt.xlabel('Day')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```




```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.lineplot(x='added_hour',
y=logistics_df.groupby('added_hour').size(
), data=logistics_df, color='skyblue', label='Load
Addition',legend=True)
sns.lineplot(x='deleted_hour',
y=logistics_df.groupby('deleted_hour').size(
), data=logistics_df, color='salmon', label='Load
Deletion',legend=True)

plt.title('Load Addition and Deletion Over Hours')
plt.xlabel('Hour')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```

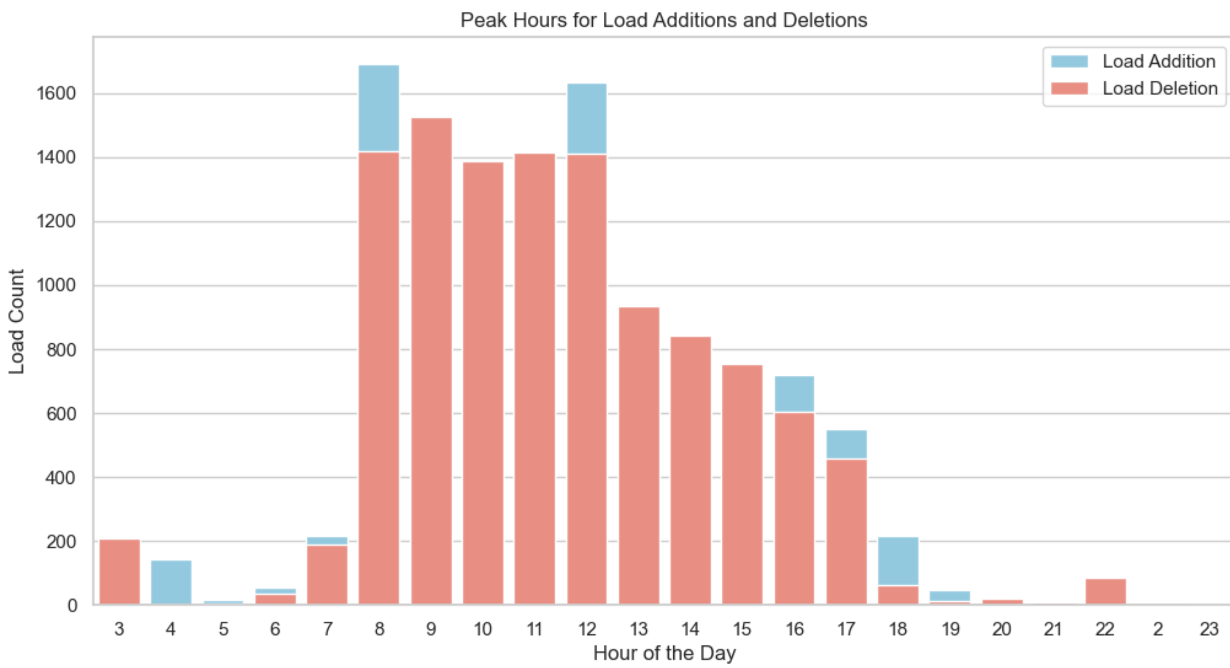



## Operational Insights

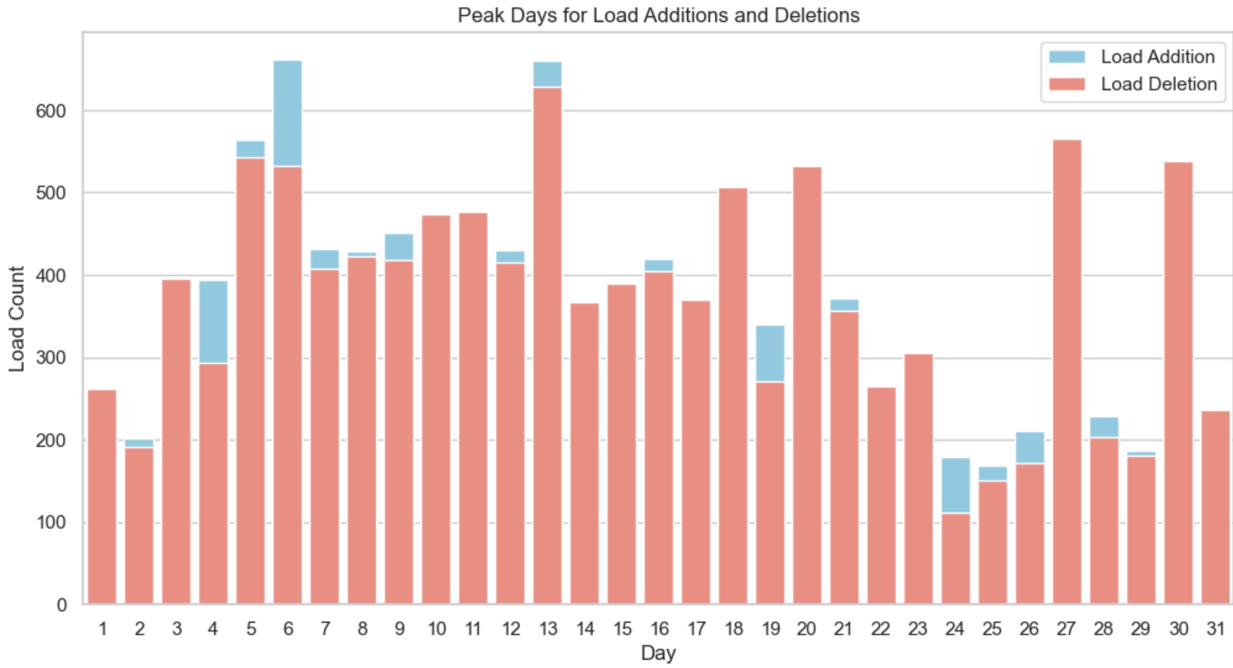
In this analysis, we focus on two key operational insights:

1. **Peak Periods Identification:**
   - Utilizing time-based analysis, we identify peak periods for both load additions and deletions. Visualization through bar plots highlights the hours of the day with the highest load activity.
2. **Average Turnaround Time Assessment:**
   - Calculating the average turnaround time for loads provides insights into the typical duration a load stays in the system. This metric aids in understanding operational efficiency and performance.

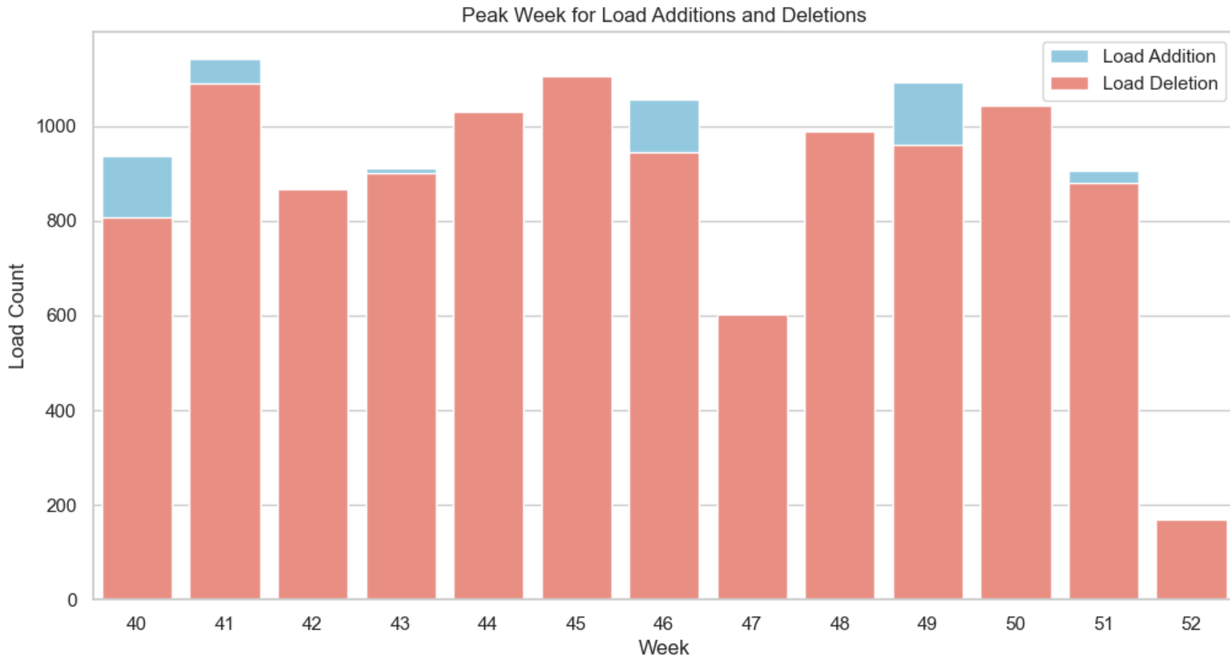
```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.countplot(x='added_hour', data=logistics_df, color='skyblue',
label='Load Addition')
sns.countplot(x='deleted_hour', data=logistics_df, color='salmon',
label='Load Deletion')

plt.title('Peak Hours for Load Additions and Deletions')
plt.xlabel('Hour of the Day')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```




```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.countplot(x='added_day', data=logistics_df, color='skyblue',
label='Load Addition')
sns.countplot(x='deleted_day', data=logistics_df, color='salmon',
label='Load Deletion')

plt.title('Peak Days for Load Additions and Deletions')
plt.xlabel('Day')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```




```
sns.set(style="whitegrid")

plt.figure(figsize=(12, 6))
sns.countplot(x='added_week', data=logistics_df, color='skyblue',
label='Load Addition')
sns.countplot(x='deleted_week', data=logistics_df, color='salmon',
label='Load Deletion')

plt.title('Peak Week for Load Additions and Deletions')
plt.xlabel('Week')
plt.ylabel('Load Count')
plt.legend()
plt.show()
```



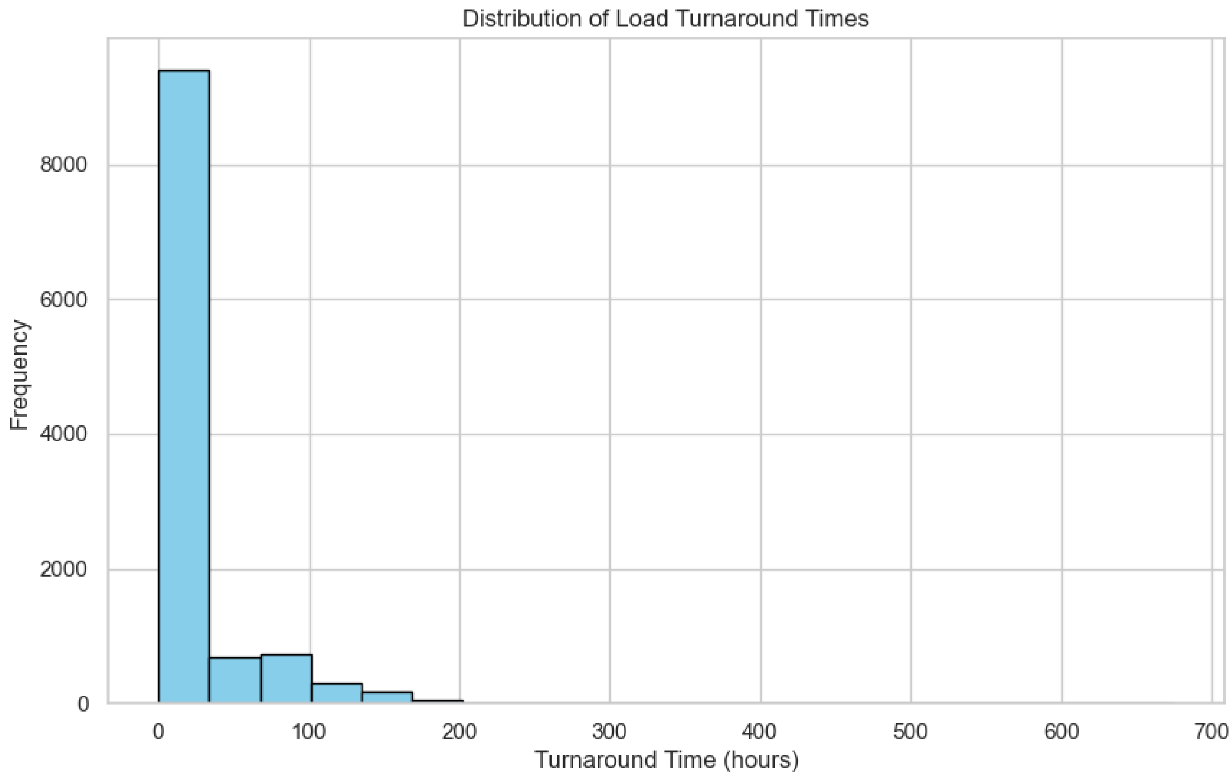

```
average_turnaround_time = logistics_df.time_span_in_hours.mean()

df = pd.DataFrame(data={'average_turnaround_time_hours':
[round(average_turnaround_time)]})
df
```

| | average_turnaround_time_hours |
|---|---|
| 0 | 21 |

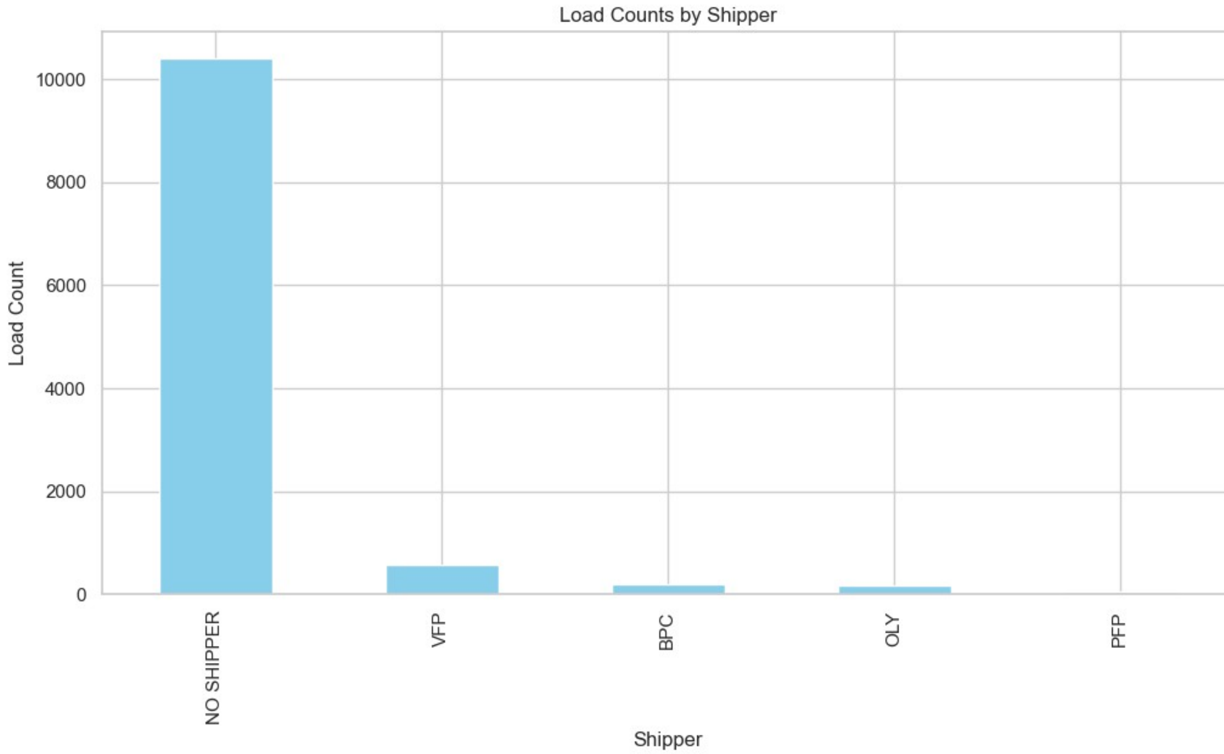
## Visualization and Reporting

In this analysis, we leverage visualizations to succinctly convey key findings. Utilizing graphs and charts, we provide a clear and intuitive representation of the dataset's patterns and insights. This visual approach enhances the accessibility and interpretation of the data, facilitating effective communication of our analytical results.

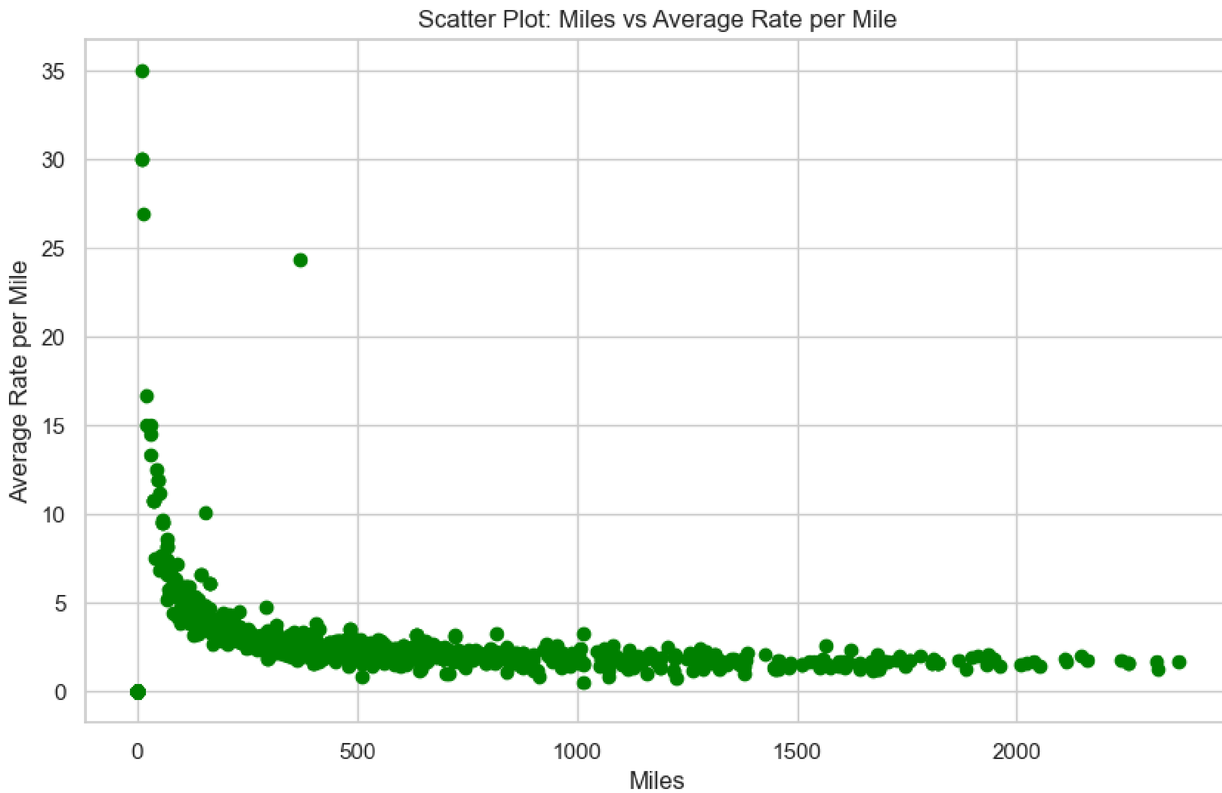
```
plt.figure(figsize=(10, 6))
plt.hist(logistics_df['time_span_in_hours'], bins=20, color='skyblue',
edgecolor='black')
plt.title('Distribution of Load Turnaround Times')
plt.xlabel('Turnaround Time (hours)')
plt.ylabel('Frequency')
plt.show()
```




```
plt.figure(figsize=(12, 6))
logistics_df['shipper'].value_counts().plot(kind='bar',
color='skyblue')
plt.title('Load Counts by Shipper')
plt.xlabel('Shipper')
plt.ylabel('Load Count')
plt.show()
```




```
plt.figure(figsize=(10, 6))
plt.scatter(logistics_df['miles'],
logistics_df['average_rate_per_mile'], color='green')
plt.title('Scatter Plot: Miles vs Average Rate per Mile')
plt.xlabel('Miles')
plt.ylabel('Average Rate per Mile')
plt.show()
```


Scatter Plot: Miles vs Average Rate per Mile
Average Rate per Mile
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
Miles