PUBLIC TRANSPORTATION EFFICIENCY ANALYSIS

Phase5 Submission:

INTRODUCTION :

Public Transportation Efficiency Analysis

Table of Contents

Project Overview

The Public Transportation Efficiency Analysis project is a data analysis and visualization platform that aims to assess and optimize the efficiency of public transportation systems. It leverages data from various sources to provide insights into transit operations, passenger flows, and overall system performance. This project offers tools and visualizations to support transportation authorities and urban planners in making data-driven decisions for improving public transportation.

Motivation

Efficient and reliable public transportation is crucial for urban sustainability and quality of life. This project is motivated by the need to:

- Understand how well public transportation systems are operating.
- Identify areas for improvement to enhance service quality and reduce congestion.
- Enable transportation authorities to allocate resources effectively.

- Provide data-driven insights for decision-making and policy adjustments.

Features

- **Data Integration**: Collect and integrate data from various sources, including transit agencies, GPS trackers, and passenger feedback.
- **Real-time Tracking**: Monitor and analyze real-time transit data to assess delays and service disruptions.
- **Route Optimization**: Suggest route optimizations to reduce travel times and improve passenger experience.
- **Data Visualization**: Create interactive dashboards and reports for visualizing transportation system performance.
- **Performance Metrics**: Calculate key performance indicators (KPIs) such as on-time performance, capacity utilization, and passenger satisfaction.

Data Sources

- Public transportation agencies' data feeds (GTFS, real-time data).
- GPS tracking data from vehicles.
- Passenger feedback and surveys.
- Open data sources related to urban mobility.

Dependencies

Before getting started, ensure that you have the following dependencies installed:

- Python 3.x
- Jupyter Notebook
- Pandas
- Matplotlib
- Seaborn
- Plotly
- Folium
- [Other project-specific libraries]

Getting Started

To set up and run the project, follow these steps:

Installation

- Clone the repository:
- bashCopy code

```
clone https://github.com/your-username/public-transport-analysis.git
```

- Install project dependencies:
- bashCopy code

Configuration

- Configure the project by editing the settings file, **`config.yaml`**. Specify data sources, API keys, and other relevant parameters.

Usage

To run the project, execute the Jupyter Notebooks or Python scripts provided in the project directory. These scripts will collect, analyze, and visualize public transportation data.

Data Analysis

The project offers various Jupyter Notebooks for data analysis and visualization. You can explore these notebooks to gain insights into public transportation efficiency and performance.

Contributing

Contributions to this project are welcome. If you'd like to contribute, please follow our contribution guidelines.

License

This project is licensed under the MIT License. You are free to use and modify the code as long as you follow the terms of the license.

```
python
import pandas as pd

# Load data from a CSV file (replace 'your_data.csv' with the actual file path)
data = pd.read_csv('your_data.csv')

# Basic data exploration
print("Data Overview:")
print(data.head())  # Display the first few rows of data

# Calculate key metrics
# Example 1: Average passenger load per route
average_load_per_route = data.groupby('Route')['PassengerLoad'].mean()

# Example 2: On-time performance
data['OnTime'] = data['ActualArrivalTime'] <= data['ScheduledArrivalTime']
on_time_performance = data['OnTime'].sum() / len(data) * 100  # Percentage of on-time arrivals

print("\nAverage Load per Route:")
print(average_load_per_route)
```

```
print("\nOn-Time Performance:")
print(f"On-Time Percentage: {on_time_performance:.2f}%")

# More analysis can be performed, such as identifying routes with consistently low on-time performance, optimizing schedules, and more.
```

```
%matplotlib inline
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import matplotlib.pyplot as plt
import datetime
import os
from math import sqrt
import warnings

## For Multiple Output in single cell
from IPython.core.interactiveshell import InteractiveShell
InteractiveShell.ast_node_interactivity = "all"
warnings.filterwarnings('ignore')
```

```
data = pd.read_csv('../input/unisys/ptsboardingsummary/20140711.CSV')
data.shape
data.head(10)
```

TripID	RouteID	StopID	StopName	WeekBeginning	NumberOfBoardings	
0	23631	100	14156	181 Cross Rd	2013-06-30 00:00:00	1
1	23631	100	14144	177 Cross Rd	2013-06-30 00:00:00	1
2	23632	100	14132	175 Cross Rd	2013-06-30 00:00:00	1
3	23633	100	12266	Zone A Arndale Interchange	2013-06-30 00:00:00	2
4	23633	100	14147	178 Cross Rd	2013-06-30 00:00:00	1
5	23634	100	13907	9A Marion Rd	2013-06-30 00:00:00	1

6	23634	100	14132	175 Cross Rd	2013-06-30 00:00:00	1
7	23634	100	13335	9A Holbrooks Rd	2013-06-30 00:00:00	1
8	23634	100	13875	9 Marion Rd	2013-06-30 00:00:00	1
9	23634	100	13045	206 Holbrooks Rd	2013-06-30 00:00:00	1

```
out_geo = pd.read_csv('../input/outgeo/output_geo.csv')
out_geo.shape
out_geo.head()
```

```
(4165, 10)
```

Out[3]:

	accuracy	formatted_address	google_place_id	input_string	latitude	longitude	number_of_results	postcode	status	type
0	ROOFTOP	181 Cross Rd, Westbourne Park SA 5041, Australia	ChIJKT7I9rbPsGoRVHMHkIy-Oyk	181 Cross Rd	-34.966656	138.592148	1	5041	OK	street_address
1	ROOFTOP	177 Cross Rd, Westbourne Park SA 5041, Australia	ChIJ-VFZ87bPsGoRyfVgC5qbPpE	177 Cross Rd	-34.966607	138.592301	1	5041	OK	street_address
2	ROOFTOP	175 Cross Rd, Westbourne Park SA 5041, Australia	ChIJIztlirbPsGoR38KRk76kPFI	175 Cross Rd	-34.966758	138.592715	1	5041	OK	street_address

3	GEOMETRIC_CENTER	Zone A Arndale Interchange - South side, Kilke...	ChIJn0C1hCPGsGoRIWvCdhF1RIg	Zone A Arndale Interchange	-34.875160	138.551628	1	5009	OK	bus_station,establishment,point_of_interest,tr...
4	ROOFTOP	178 Cross Rd, Malvern SA 5061, Australia	ChIJycNiylvOsGoRdhfq9GKnpq0	178 Cross Rd	-34.964960	138.611477	1	5061	OK	street_address

External Features

In [4]:

```
#DistanceFromCentre: Distance measure from the city centre
#For Calculating Distance between centre with other bus stops by using
Longitude and Latitude
#we have used the Haversine formula

from math import sin, cos, sqrt, atan2, radians
def calc_dist(lat1,lon1):
    ## approximate radius of earth in km
    R = 6373.0
    dlon = radians(138.604801) - radians(lon1)
    dlat = radians(-34.921247) - radians(lat1)
    a = sin(dlat / 2)**2 + cos(radians(lat1)) * cos(radians(-34.921247)) *
sin(dlon / 2)**2
    c = 2 * atan2(sqrt(a), sqrt(1 - a))
    return R * c


out_geo['dist_from_centre'] =
out_geo[['latitude','longitude']].apply(lambda x: calc_dist(*x), axis=1)
```

In [6]:

```
out_geo.head()
```

accuracy	formatted_address	google_place_id	input_string	latitude	longitude	number_of_results	postcode	status	type	dist_from_centre	
0	ROOFTOP	181 Cross Rd, Westbourne Park SA 5041, Australia	ChIJKT7I9rbPsGoRVHMHkly-Oyk	181 Cross Rd	-34.966656	138.592148	1	5041	OK	street_address	5.180961
1	ROOFTOP	177 Cross Rd, Westbourne Park SA 5041, Australia	ChIJ-VFZ87bPsGoRyfVgC5qbPpE	177 Cross Rd	-34.966607	138.592301	1	5041	OK	street_address	5.172525
2	ROOFTOP	175 Cross Rd, Westbourne Park SA 5041, Australia	ChIJIztlirbPsGoR38KRk76kPFI	175 Cross Rd	-34.966758	138.592715	1	5041	OK	street_address	5.180709
3	GEOMETRIC_CENTER	Zone A Arndale Interchange - Southside, Kilke...	ChIJn0C1hCPGsGoRIWvCdhF1Rlg	Zone A Arndale Interchange	-34.875160	138.551628	1	5009	OK	bus_station,establishment,point_of_interest,tr...	7.057549

4	ROOFTOP	178 Cross Rd, Malvern SA 5061, Australia	ChIJycNiylvOsGoRdhfq9GKnpq0	178 Cross Rd	-34.964960	138.611477	1	5061	OK	street_address	4.900099

```
#exp_data = out_geo.head(10)
##Fill the missing values with mode
out_geo['type'].fillna('street_address',inplace=True)
out_geo['type'] = out_geo['type'].apply(lambda x: str(x).split(',')[-1])
```

```
out_geo['type'].unique()
```

Out[8]:

```
array(['street_address', 'transit_station', 'premise', 'political',
       'school', 'route', 'intersection', 'point_of_interest',
       'subpremise', 'real_estate_agency', 'university', 'travel_agency',
       'restaurant', 'supermarket', 'store', 'post_office'], dtype=object)
```

In [9]:

```
data['WeekBeginning'] = pd.to_datetime(data['WeekBeginning']).dt.date
data['WeekBeginning'][1]
```

Out[9]:

```
datetime.date(2013, 6, 30)
```

Data Aggregation

In [10]:

```
#Combine the Geolocation and main input file to get final Output File.
data= pd.merge(data,out_geo,how='left',left_on = 'StopName',right_on =
'input_string')
data.head(5)
data.shape
```

TripID	RouteID	StopID	StopName	WeekBeginning	NumberOfBoardings	accuracy	formatted_address	google_place_id	input_string	latitude	longitude	number_of_results	postcode	status	type	dist_from_centre	
0	23631	100	14156	181 Cross Rd	2013-06-30	1	ROOFTOP	181 Cross Rd, Westbourne Park SA 5041, Australia	ChIJKT7I9rbPsGoRVHMHkIy-Oyk	181 Cross Rd	-34.966656	138.592148	1	5041	OK	street_address	5.180961
1	23631	100	14144	177 Cross Rd	2013-06-30	1	ROOFTOP	177 Cross Rd, Westbourne Park SA 5041, Australia	ChIJ-VFZ87bPsGoRyfVgC5qbPpE	177 Cross Rd	-34.966607	138.592301	1	5041	OK	street_address	5.172525
2	23632	100	14132	175 Cross Rd	2013-06-30	1	ROOFTOP	175 Cross Rd, Westbourne Par	ChIJIztlirbPsGoR38KRk76kPFI	175 Cross Rd	-34.966758	138.592715	1	5041	OK	street_address	5.180709

								k SA 5041, Australia									
3	23633	100	12266	Zone A Arndale Interchange	2013-06-30	2	GEOMETRIC_CENTER	Zone A Arndale Interchange - Southside, Kilke...	ChIJn0C1hCPGsGoRIWvCdhF1RIg	Zone A Arndale Interchange	-34.875160	138.551628	1	5009	OK	transit_station	7.057549
4	23633	100	14147	178 Cross Rd	2013-06-30	1	ROOFTOP	178 Cross Rd, Malvern SA 5061, Australia	ChIJycNiylvOsGoRdhfq9GKnpq0	178 Cross Rd	-34.964960	138.611477	1	5061	OK	street_address	4.900099

Out[10]:

(10857234, 17)

In [11]:

```
#Columns to keep for further analysis
col = ['TripID', 'RouteID', 'StopID', 'StopName',
'WeekBeginning','NumberOfBoardings',
      'latitude', 'longitude','postcode','type','dist_from_centre']
data = data[col]
```

In [12]:

```
##saving the final dataset
#data.to_csv('Weekly_Boarding.csv',index=False)
```

Aggregate the Data According to Weeks and Stop names

- **NumberOfBoardings_sum** Number of Boardings within particular week for each Bus stop
- **NumberOfBoardings_count** Number of times data is recorded within week
- **NumberOfBoardings_max** Maximum number of boarding done at single time within week

In [13]:

```
grouped = data.groupby(['StopName','WeekBeginning','type'])
#grouped.head()
```

In [14]:

```
# st_week_grp1 =
pd.DataFrame(data.groupby(['StopName','WeekBeginning','type']).agg({'Number
OfBoardings': ['sum', 'count']})).reset_index()
grouped =
data.groupby(['StopName','WeekBeginning','type']).agg({'NumberOfBoardings'
: ['sum', 'count','max']})
grouped.columns = ["_".join(x) for x in grouped.columns.ravel()]
```

In [15]:

```
grouped.head(10)
grouped.columns
```

Out[15]:

			NumberOfBoardings_sum	NumberOfBoardings_count	NumberOfBoardings_max
StopName	WeekBeginning	type			
1 Anzac Hwy	2013-06-30	street_address	1003	378	51
	2013-07-07	street_address	783	360	28
	2013-07-14	street_address	843	343	45
	2013-07-21	street_address	710	356	28
	2013-07-28	street_address	898	379	41
	2013-08-04	street_address	799	378	40
	2013-08-11	street_address	1012	358	71
	2013-08-18	street_address	793	333	41
	2013-08-25	street_address	897	354	45
	2013-09-01	street_address	1368	431	59

Out[15]:

```
Index(['NumberOfBoardings_sum', 'NumberOfBoardings_count',
       'NumberOfBoardings_max'],
      dtype='object')
```

In [16]:

```
st_week_grp = pd.DataFrame(grouped).reset_index()
st_week_grp.shape
st_week_grp.head()
```

Out[16]:

```
(207864, 6)
```

Out[16]:

	StopName	WeekBeginning	type	NumberOfBoardings_sum	NumberOfBoardings_count	NumberOfBoardings_max
0	1 Anzac Hwy	2013-06-30	street_address	1003	378	51
1	1 Anzac Hwy	2013-07-07	street_address	783	360	28
2	1 Anzac Hwy	2013-07-14	street_address	843	343	45
3	1 Anzac Hwy	2013-07-21	street_address	710	356	28
4	1 Anzac Hwy	2013-07-28	street_address	898	379	41

In [17]:

```
st_week_grp1 =
pd.DataFrame(st_week_grp.groupby('StopName')["WeekBeginning"].count()).reset_index()
st_week_grp1.head()
```

Out[17]:

	StopName	WeekBeginning
0	1 Anzac Hwy	54
1	1 Bartels Rd	54
2	1 Botanic Rd	54
3	1 Frome Rd	54
4	1 Fullarton Rd	54

In [18]:

```
#Gathering only the Stop Name which having all 54 weeks of Dat
aa = list(st_week_grp1[st_week_grp1['WeekBeginning'] == 54]['StopName'])
aa[1:10]
```

Out[18]:

```
['1 Bartels Rd',
 '1 Botanic Rd',
 '1 Frome Rd',
 '1 Fullarton Rd',
 '1 George St',
 '1 Glen Osmond Rd',
 '1 Goodwood Rd',
 '1 Henley Beach Rd',
 '1 Kensington Rd']
```

In [19]:

```
bb = st_week_grp[st_week_grp['StopName'].isin(aa)]
bb.head()
bb.shape

type(bb)
```

Out[19]:

	StopName	WeekBeginning	type	NumberOfBoardings_sum	NumberOfBoardings_count	NumberOfBoardings_max
0	1 Anzac Hwy	2013-06-30	street_address	1003	378	51
1	1 Anzac Hwy	2013-07-07	street_address	783	360	28
2	1 Anzac Hwy	2013-07-14	street_address	843	343	45
3	1 Anzac Hwy	2013-07-21	street_address	710	356	28
4	1 Anzac Hwy	2013-07-28	street_address	898	379	41

Out[19]:

```
(175446, 6)
```

Out[19]:

```
pandas.core.frame.DataFrame
```

In [20]:

```
#removing the stoppage which are not having the data of whole 54 weeks
new_data = data[data['StopName'].isin(aa)]
new_data.shape
print("data without stopage removing: ", data.shape)
print("data, after removing stoppage not having the data of whole 54
weeks: ", new_data.shape)
```

Out[20]:

```
(10567931, 11)
```

```
data without stopage removing:  (10857234, 11)
data, after removing stoppage not having the data of whole 54 weeks:
(10567931, 11)
```

In [21]:

```
new_data.head(2)
filtered_data = new_data[new_data['dist_from_centre'] <= 100]
filtered_data.shape
```

Out[21]:

	TripID	RouteID	StopID	StopName	WeekBeginning	NumberOfBoardings	latitude	longitude	postcode	type	dist_from_centre
0	23631	100	14156	181 Cross Rd	2013-06-30	1	-34.966656	138.592148	5041	street_address	5.180961
1	23631	100	14144	177 Cross Rd	2013-06-30	1	-34.966607	138.592301	5041	street_address	5.172525

Out[21]:

```
(10341468, 11)
```

In [22]:

```
data = filtered_data.copy()
data.shape
```

Out[22]:

```
(10341468, 11)
```

In [23]:

```
#No of boarding for each stopage in all weeks
#bb["StopName"].groupby(NumberOfBoardings_sum)
stopageName_with_boarding =
bb.groupby(['StopName']).agg({'NumberOfBoardings_sum': ['sum']})

#stopageName_with_boarding.columns = ["_".join(x) for x in
stopageName_with_boarding.columns.ravel()]
#stopageName_with_boarding.head()
stopageName_with_boarding =
pd.DataFrame(stopageName_with_boarding.reset_index())
```

In [24]:

```
#type(stopageName_with_boarding)
stopageName_with_boarding.columns = ["StopName",
"Total_boarding_on_the_stopage"]
#stopageName_with_boarding.shape
stopageName_with_boarding.head()
```

Out[24]:

	StopName	Total_boarding_on_the_stopage
0	1 Anzac Hwy	39429
1	1 Bartels Rd	8412
2	1 Botanic Rd	14868
3	1 Frome Rd	67458
4	1 Fullarton Rd	585

In [25]:

```
## save the aggregate data
#bb.to_csv('st_week_grp.csv', index=False)
```

Data Exploration

In [26]:

```
data.nunique()
#data.isnull().sum()
#data['WeekBeginning'].unique()
```

Out[26]:

```
TripID              39211
RouteID               616
StopID               5838
StopName             3127
WeekBeginning          54
NumberOfBoardings     359
latitude             2393
longitude            2379
postcode              138
type                    8
dist_from_centre     2397
dtype: int64
```

Data Visualization

In [27]:

```
##can assign the each chart to one axes at a time
fig,axrr=plt.subplots(2,2,figsize=(15,15))

ax=axrr[0][0]
ax.set_title("No of Boardings")
data['NumberOfBoardings'].value_counts().sort_index().head(20).plot.bar(ax
=axrr[0][0])

ax=axrr[0][1]
ax.set_title("WeekBeginning")
data['WeekBeginning'].value_counts().plot.area(ax=axrr[0][1])

ax=axrr[1][0]
ax.set_title("most Busiest Route")
data['RouteID'].value_counts().head(10).plot.bar(ax=axrr[1][0])

ax=axrr[1][1]
ax.set_title("least Busiest Route")
data['RouteID'].value_counts().tail(10).plot.bar(ax=axrr[1][1])
```

Out[27]:

```
Text(0.5,1,'No of Boardings')
```

Out[27]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff880af0940>
```

Out[27]:

```
Text(0.5,1,'WeekBeginning')
```

Out[27]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff709a6bb38>
```

Out[27]:

```
Text(0.5,1,'most Busiest Route')
```

Out[27]:

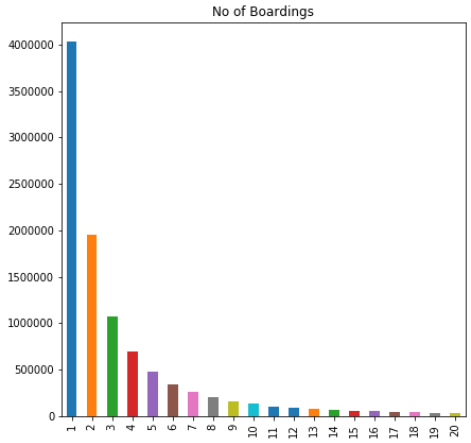
```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff709a48e10>
```

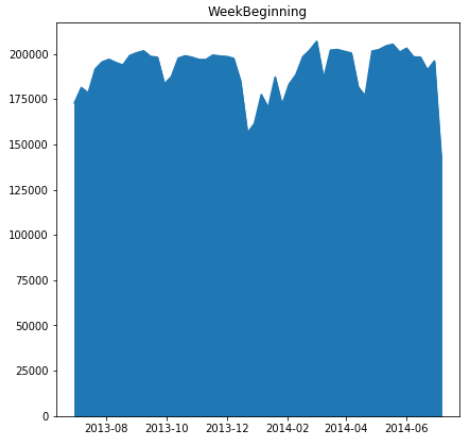
Out[27]:

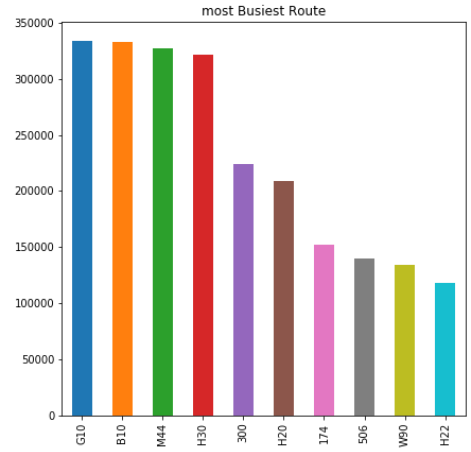
```
Text(0.5,1,'least Busiest Route')
```

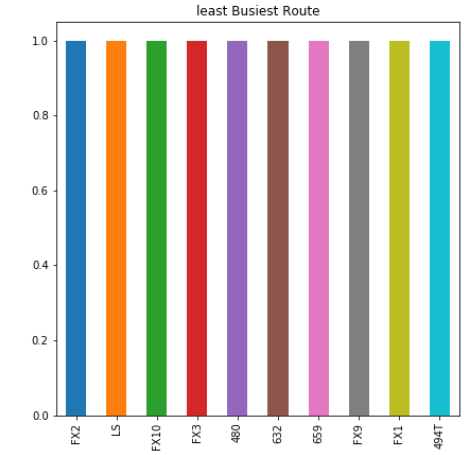
Out[27]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff736bbafd0>
```









In [28]:

```
stopageName_with_boarding =
stopageName_with_boarding.sort_values('Total_boarding_on_the_stopage',
ascending = False)
#stopage with most no of boarding
stopageName_with_boarding.head(10)
```

Out[28]:

	StopName	Total_boarding_on_the_stopage
3054	I2 North Tce	628859
3125	X1 King William St	622099
3032	F2 Grenfell St	604149
3130	X2 King William St	583227
3021	E1 Currie St	550396
3207	Zone C Paradise Interchange	547709

3015	D1 King William St	541046
3211	Zone C Tea Tree Plaza Intercha	451960
3025	E3 Currie St	399351
3039	G3 Grenfell St	356518

In [29]:

```
#stopage with least no of boarding
stopageName_with_boarding.tail(10)
```

Out[29]:

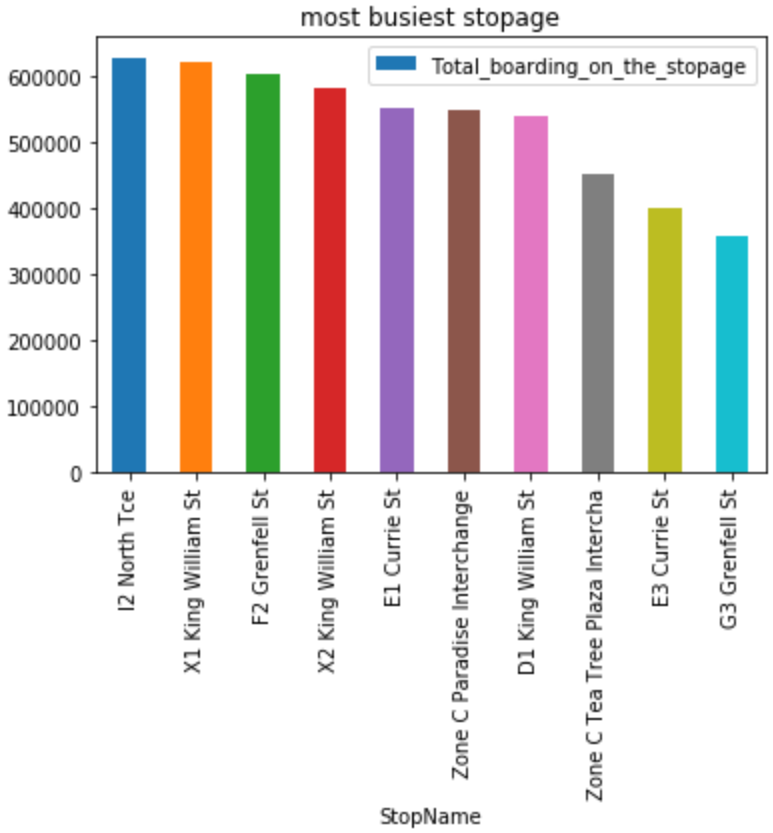
	StopName	Total_boarding_on_the_stopage
1845	45 Mcintyre Rd	292
2318	57 Philip Hwy	281
2732	75B Frick St	275
58	109 Regency Rd	274
1633	39D Glenloth Dr	266
170	127 Lyndoch Rd	264
3086	Strathalbyn South Tce	227
1231	31 Glenroy St	221
558	19 Gilles Rd	215
294	145 The Esplanade	175

In [30]:

```
ax = stopageName_with_boarding.head(10).plot.bar(x='StopName',
y='Total_boarding_on_the_stopage', rot=90)
ax.set_title("most busiest stopage")
```

Out[30]:

```
Text(0.5,1,'most busiest stopage')
```

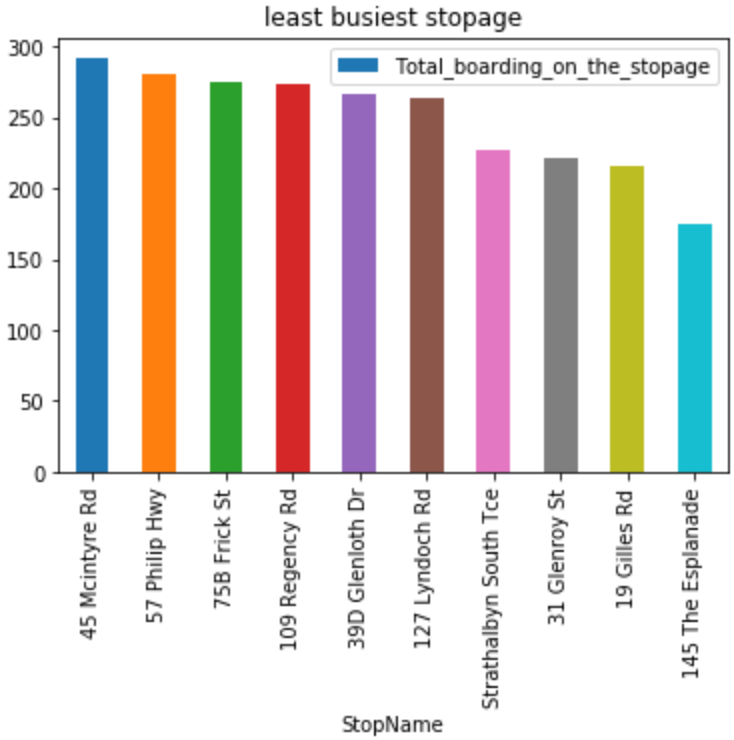


In [31]:

```
ax = stopageName_with_boarding.tail(10).plot.bar(x='StopName',
y='Total_boarding_on_the_stopage', rot=90)
ax.set_title("least busiest stopage")
```

Out[31]:

```
Text(0.5,1,'least busiest stopage')
```



In [32]:

```
data['WeekBeginning'].value_counts().mean()
```

Out[32]:

```
191508.66666666666
```

In [33]:

```
# data['dist_from_centre'].nunique()
bb_grp = data.groupby(['dist_from_centre']).agg({'NumberOfBoardings':
['sum']}).reset_index()
bb_grp.columns = bb_grp.columns.get_level_values(0)
bb_grp.head()
bb_grp.columns
bb_grp.tail()
```

Out[33]:

	dist_from_centre	NumberOfBoardings
0	0.000018	1892435
1	0.131368	167535
2	0.309089	356518
3	0.314937	1484824

4	0.326005	120061

Out[33]:

```
Index(['dist_from_centre', 'NumberOfBoardings'], dtype='object')
```

Out[33]:

	dist_from_centre	NumberOfBoardings
2392	86.471064	18905
2393	94.826409	321
2394	99.625655	1101
2395	99.665190	4373
2396	99.748995	21216

In [34]:

```
import plotly.graph_objs as go
from plotly.offline import iplot

trace0 = go.Scatter(
    x = bb_grp['dist_from_centre'],
    y = bb_grp['NumberOfBoardings'],mode = 'lines+markers',name = 'X2 King
William St')

data1 = [trace0]
layout = dict(title = 'Distance Vs Number of boarding',
              xaxis = dict(title = 'Distance from centre'),
              yaxis = dict(title = 'Number of Boardings'))
fig = dict(data=data1, layout=layout)
iplot(fig)
```

In [35]:

```
#clustering Technique// based on the distance from city centre

x = data["dist_from_centre"]
distance_10 = []
distance_10_50 = []
distance_50_100 = []
#distance_100_ = []
distance_100_more = []
total = 0
outlier = []
outlier_ = 0
for i in x:
```

```
    if(i<=10):
        distance_10.append(i)
        total += 1
    elif(i<=50):
        distance_10_50.append(i)
        total += 1
    elif(i<=100):
        distance_50_100.append(i)
        total += 1
    #elif(i>100 and i< 2000):
        #distance_100_more.append(i)
        #total += 1
    #elif(i>2000):
        #outlier.append(i)
        #outlier_ += 1
```

In [36]:

```
print(outlier_)
```

```
0
```

In [37]:

```
y = len(distance_10)+len(distance_10_50)+len(distance_50_100)
#+len(distance_100_more)
#print(y)
#print(total)
```

In [38]:

```
print(total)
print("passangers, boarding the buses in the radious of 10Km from the city
center = ", (len(distance_10)/total)*100)
print("passanger, boarding the buses from the distance of 10Km to 50Km
from the city center = ", (len(distance_10_50)/total)*100)
print("passanger, boarding the buses from the distance of 50Km to 100 from
the city center = ", (len(distance_50_100)/total)*100)
#print("passanger, boarding the buses from the distance of 100Km and more
from the city center = ", (len(distance_100_more)/total)*100)
```

```
10341468
passangers, boarding the buses in the radious of 10Km from the city center
=  64.31275521038212
passanger, boarding the buses from the distance of 10Km to 50Km from the
```

```
city center =  33.16731241638035
passanger, boarding the buses from the distance of 50Km to 100 from the
city center =  2.5199323732375327
```

In [39]:

```
#busiest route on weekly basis
#data.head(10)
# st_week_grp1 =
pd.DataFrame(data.groupby(['StopName','WeekBeginning','type']).agg({'Number
OfBoardings': ['sum', 'count']})).reset_index()
grouped_route = data.groupby(['RouteID']).agg({'NumberOfBoardings':
['sum', 'max']})
grouped_route.columns = ["_".join(x) for x in
grouped_route.columns.ravel()]
```

In [40]:

```
"""grouped_route = grouped_route.head().reset_index()
type(grouped_route)
grouped_route = grouped_route.sort_values("NumberOfBoardings_sum",
ascending = True)
#stopageName_with_boarding =
stopageName_with_boarding.sort_values('Total_boarding_on_the_stopage',
ascending = False)
#stopage with most no of boarding
#stopageName_with_boarding.head(10)
#grouped_route["NumberOfBoardings_sum"] =
grouped_route["NumberOfBoardings_sum"] / 365
grouped_route.head(10)
grouped_route.shape"""
```

Out[40]:

```
'grouped_route =
grouped_route.head().reset_index()\ntype(grouped_route)\ngrouped_route =
grouped_route.sort_values("NumberOfBoardings_sum", ascending =
True)\n#stopageName_with_boarding =
stopageName_with_boarding.sort_values(\'Total_boarding_on_the_stopage\',
ascending = False)\n#stopage with most no of
boarding\n#stopageName_with_boarding.head(10)\n#grouped_route["NumberOfBoa
rdings_sum"] = grouped_route["NumberOfBoardings_sum"] /
365\ngrouped_route.head(10)\ngrouped_route.shape'
```

....

In [41]:

```
"""route_data = grouped_route[grouped_route['RouteID'] == "G10"]
route_data.head()"""
```

Out[41]:

```
'route_data = grouped_route[grouped_route[\'RouteID\'] ==
"G10"]\nroute_data.head()'
```