```
## Load the data
import math
import pandas as pd
import numpy as np
import seaborn as sns
import datetime as dt
sns.set()
import matplotlib.pyplot as plt
import scipy.stats as stats
from scipy.stats.mstats import winsorize
from google.colab import drive
drive.mount("/content/gdrive", force_remount=True)
path = "/content/gdrive/MyDrive/elula_assignment/"
taxi = pd.read_csv(path+"taxi_dataFare.csv")
taxi.columns = [col.strip().replace(' ', '') for col in taxi.columns]
taxi = taxi.drop('Unnamed:0', axis=1)
#hr_employ = pd.read_csv(path+"hr_employ.csv")
#hr_employ.columns = [col.strip().replace(' ', '') for col in hr_employ.columns]
#hr_employ.drop(columns=hr_employ.columns[0], axis=1, inplace=True)

#from geopy.geocoders import Nominatim
#geolocator = Nominatim()

taxi['pickup_datetime'] = pd.to_datetime(taxi['pickup_datetime'])
taxi['dropoff_datetime'] = pd.to_datetime(taxi['dropoff_datetime'])
taxi['DayofWeek'] = taxi.pickup_datetime.dt.day_name()
taxi['Pick_Hour'] = taxi.pickup_datetime.dt.hour
taxi['pick_date'] = taxi.pickup_datetime.dt.date
taxi['drop_date'] = taxi.pickup_datetime.dt.date
duration = (pd.to_datetime(taxi['dropoff_datetime']) - pd.to_datetime(taxi['pickup_date
taxi['in_car'] = duration



#!python -m pip install basemap
#from mpl_toolkits.basemap import Basemap
```

```
Mounted at /content/gdrive
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
<ipython-input-2-c9e62e25345a> in <module>()
     31 taxi['in_car'] = duration
     32 
---> 33 taxi.groupby(taxi.rate_code)
[taxi.tip_amount].mean().reset_index().plot(kind='bar')
     34 
     35 #!python -m pip install basemap

1 frames

/usr/local/lib/python3.7/dist-packages/pandas/core/base.py in
__getitem__(self, key)
    220             if len(self.obj.columns.intersection(key)) != len(key):
```

1. What are busiest locations and hours?
2. How are passengers per trip, payment type, fare and tip amounts distributed?
3. How do times and fares vary by trips?
4. Is it possible to characterise taxi drivers based on work hours and how much they make?

```
4.25  4.75  15.75  16.5  5.25  5.5  5.75  28.0  21.0  6.75  6.0  0.5  0.75
```

```
### Busiest Locations
## Remove excess coords

taxi_zoom = taxi[(taxi.pickup_longitude> -74.5) & (taxi.pickup_longitude < -73.5)]
taxi_zoom = taxi[(taxi.pickup_latitude> 40.5) & (taxi.pickup_latitude < 41)]
taxi_zoom = taxi[(taxi.dropoff_longitude> -74.5) & (taxi.dropoff_longitude < -73.5)]
taxi_zoom = taxi[(taxi.dropoff_latitude> 40.5) & (taxi.dropoff_latitude < 41)]
BBox = (-74.50,   -73.50,  40.5, 41)
# 69 miles ~ 111 km (3 decimals ~ 100m)
pickup_latitude = taxi_zoom.pickup_latitude.round(3)
pickup_longitude = taxi_zoom.pickup_longitude.round(3)
dropoff_latitude = taxi_zoom.dropoff_latitude.round(3)
dropoff_longitude = taxi_zoom.dropoff_longitude.round(3)
pickup = pd.DataFrame({'Lat':pickup_latitude,'Lon':pickup_longitude})
dropoff = pd.DataFrame({'Lat':dropoff_latitude,'Lon':dropoff_longitude})
loc = pickup.value_counts().keys().tolist()
counts = pickup.value_counts(normalize=False).tolist()
location = geolocator.reverse(str(loc[0][0])+","+str(loc[0][1]))
print(location.address)
```

visualize busy areas on map

Show code

```
#@title Visualize pickup - dropoff spots in city
####### Plot lat-long
ruh_m = plt.imread(path+'map_zoom.png')
fig, ax = plt.subplots(figsize = (8,7))
```

Visualize pickup - dropoff spots in city

```
ax.scatter(pickup_longitude, pickup_latitude, zorder=1, alpha= 0.2, c='b', s=5)
ax.scatter(dropoff_longitude, dropoff_latitude, zorder=1, alpha= 0.2, c='r', s=1)
ax.set_title('Plotting pick-up in blue and drop-off in red on NYC Map')
ax.set_xlim(BBox[0],BBox[1])
ax.set_ylim(BBox[2],BBox[3])
ax.imshow(ruh_m, zorder=0, extent = BBox, aspect= 'equal')
```

```
(40.751, -73.994)
```

Create hours_engaged data

Show code

Visualize hours that the taxis are employed

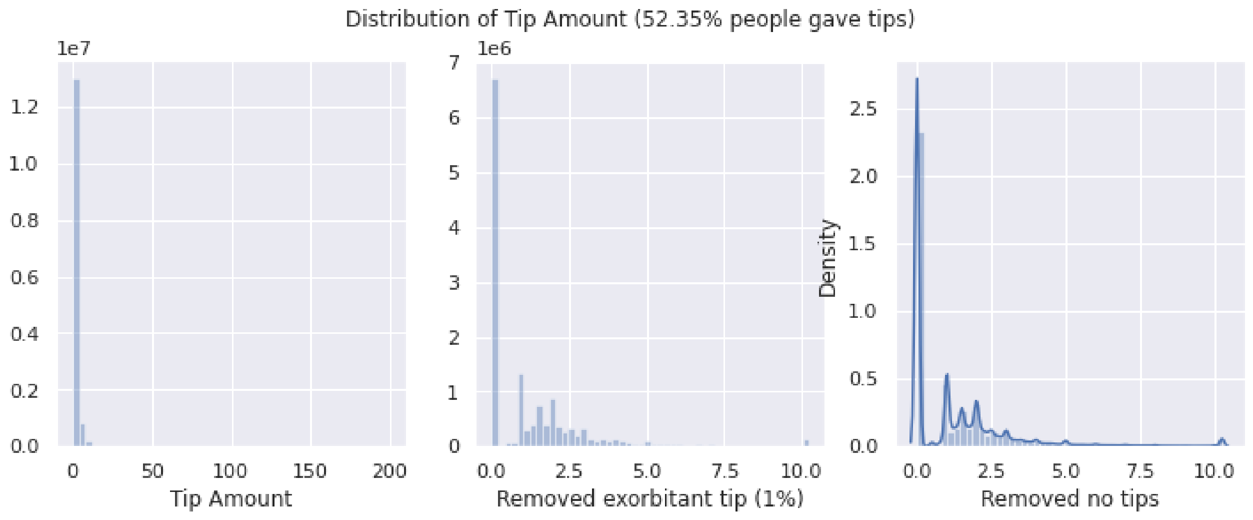
Show code

```
####### Distribution of Passengers
sns.distplot(taxi['passenger_count'],kde=False)
plt.title('Distribution of Passenger Count')
plt.show()
taxi = taxi[taxi.payment_type != 'NOC']
pay = taxi.payment_type.value_counts(normalize=True)
pay = pay.to_frame().reset_index()
pay = pay.rename(columns={'index':'Type', 'payment_type':'Frequency'})
pay = pay.replace('CRD','Card')
pay = pay.replace('CSH','Cash')
pay = pay.replace('DIS', 'Dispute')
pay = pay.replace('UNK','Unknown')
pay.set_index('Type', inplace=True)
fig, ax = plt.subplots(figsize=(6,4))
ax = pay.plot(kind='bar', cmap='Accent', legend=False, rot=0, ax=ax)
ax.set_xlabel('')
ax.set_ylabel('Percentage of Trips', fontsize=14)
fig.suptitle('53.9% payments with card and 46% in cash', fontsize=16)
plt.ticklabel_format(style='plain', axis='y')

############ Visualize tips distribution acc to rate code
taxi2 = taxi[['rate_code','tip_amount','passenger_count']]
taxi2.groupby(['rate_code'])['tip_amount'].mean().reset_index().plot(kind='bar',x='rate
---------------------------------------------------------------------------

############### Distribution of fare amounts
winsorized_amt = winsorize(taxi.total_amount, limits=[0.00, 0.01])
median = np.median(winsorized_amt)
lower = stats.scoreatpercentile(winsorized_amt, 5)
upper = stats.scoreatpercentile(winsorized_amt, 95)
(fig, ax) = plt.subplots(figsize=(10,4))
ax = sns.distplot(taxi.fare_amount, kde=False)
ax.set_title('Distribution Fare Amount', fontsize=18)
ax.set_xlabel('Fare Amount', fontsize=14)
ax.set_ylabel('Number of Trips', fontsize=14)
(fig, ax) = plt.subplots(1,2, figsize=(10,4))
ax[0] = sns.kdeplot(taxi.fare_amount, legend=False, ax=ax[0], shade=True)
# Remove top and bottom 1% of fare amounts
ax[1] = sns.kdeplot(winsorize(taxi.fare_amount, limits=[0.00, 0.01]), legend=False, ax=
ax[0].set_xlabel('Fare Amount')
ax[1].set_xlabel('Winsorized Fare Amount - removed top 1%')
fig.suptitle('Distribution of Fare Amount')
```

```
    /usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWar
```

```
################# Tip Amount Distribution 7359075.0 are tipping vs  14057949
taxi_tipper = taxi[taxi.tip_amount>0]
(fig, ax) = plt.subplots(1,3, figsize=(12,4))
ax[0] = sns.distplot(taxi.tip_amount, ax=ax[0], kde=False)
# Remove top and bottom 1% of fare amounts
ax[1] = sns.distplot(winsorize(taxi.tip_amount, limits=[0.0, 0.01]), ax=ax[1], kde=Fals
ax[0].set_xlabel('Tip Amount')
ax[1].set_xlabel('Removed exorbitant tip (1%)')
ax[2] = sns.distplot(winsorize(taxi.tip_amount, limits=[0.0, 0.01]), ax=ax[2], kde=True
ax[2].set_xlabel('Removed Tip amt=0')
fig.suptitle('Distribution of Tip Amount (52.35% people gave tips)')
del taxi_tipper
```

```
    /usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWar
      warnings.warn(msg, FutureWarning)
```



```
taxi['pickup_datetime'] = pd.to_datetime(taxi['pickup_datetime'])
taxi['dropoff_datetime'] = pd.to_datetime(taxi['dropoff_datetime'])
taxi['DayofWeek'] = taxi.pickup_datetime.dt.day_name()
taxi['Pick_Hour'] = taxi.pickup_datetime.dt.hour
taxi['pick_date'] = taxi.pickup_datetime.dt.date
taxi['drop_date'] = taxi.dropoff_datetime.dt.date
duration = (pd.to_datetime(taxi['dropoff_datetime']) - pd.to_datetime(taxi['pickup_date
taxi['in_car'] = duration


print(f"There are {taxi.medallion.nunique()} taxis, each earning ${taxi.groupby(['medal
print(f"There are {taxi.hack_license.nunique()} drivers, each earning ${taxi.groupby(['

##### Is it possible to characterise taxi drivers based on work hours and how much they
### yeah why not?

print(f"A taxi earns ${taxi.groupby(['medallion', 'drop_date'])['total_amount'].sum().m
print(f"A driver earns ${taxi.groupby(['hack_license', 'drop_date'])['total_amount'].su
# Max revenue per driver
dailyAmt_driver = taxi.groupby(['hack_license', 'drop_date'])['total_amount'].sum().sor
```

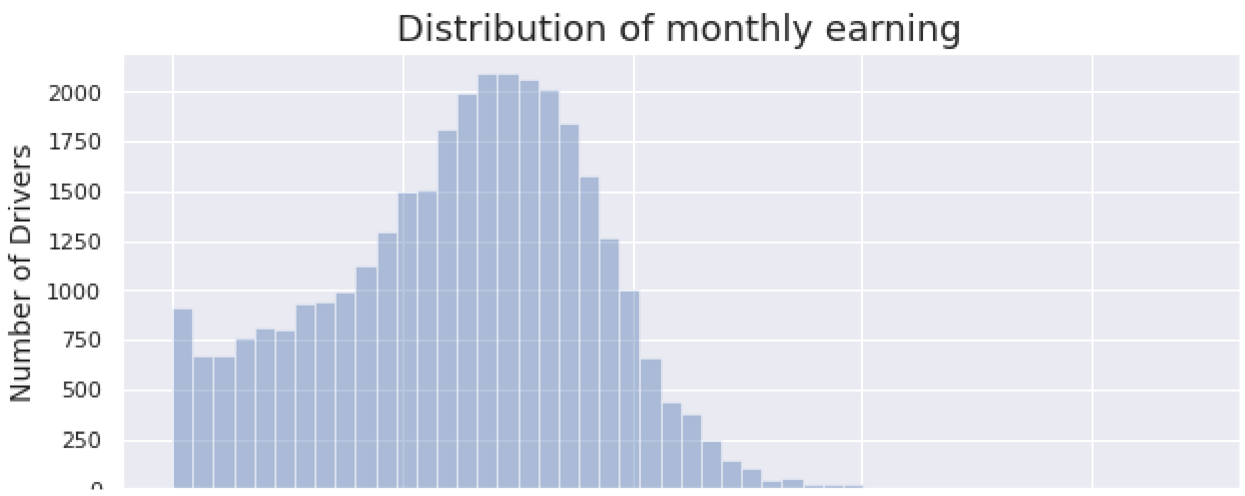
```
monthlyAmt_driver = taxi.groupby(['hack_license'])['total_amount'].sum().sort_values(as
# Max revenue per taxi
taxi.groupby(['medallion', 'drop_date'])['total_amount'].sum().sort_values(ascending=Fa

########## hr_eng = pd.concat([taxi[['hack_license','drop_date','fare_amount','tip_amou
#### sort_driver = hr_eng.groupby(['hack_license']) ### crashes everytime!!$%@$#^@$
id = []
earned = []
for  cnt, earn in enumerate(monthlyAmt_driver):
  #print(monthlyAmt_driver.keys()[cnt])
  #print(f"Fare earned {earn}")
  id.append(monthlyAmt_driver.keys()[cnt])
  earned.append(earn)

earn = pd.DataFrame({'hack_license': id, 'monthly_income': earned})
taxi2 = taxi[['hack_license','drop_date','fare_amount','tip_amount','dropoff_latitude',
              'dropoff_longitude','pickup_longitude','pickup_latitude','in_car']]
del taxi
######## High Income
ls = []
taxi_high = pd.DataFrame(columns=['hack_license','drop_date','fare_amount','tip_amount'
              'dropoff_longitude','pickup_longitude','pickup_latitude','in_car'])
hr_high = pd.DataFrame(columns = [str(i) for i in range(24)])
earn_high = earn[earn['monthly_income']>10000]
#for cnt in range(len(earn_high)):
#  ls.append(taxi2.index[taxi2['hack_license'] == earn_high['hack_license'][cnt]].tolis
#  taxi_high = taxi_high.append(taxi2.iloc[ls[cnt]], ignore_index=True)
#  hr_high = hr_high.append(hr_employ.iloc[ls[cnt]], ignore_index=True)


############ Low Income
```

```
  File "<ipython-input-8-21b09cd20ac9>", line 2
    print(f"There are {taxi.hack_license.nunique()} drivers, each earning
${taxi.groupby(['hack_license', 'drop_date'])['total_amount'].sum().mean()}
per day on an avg"")

^
SyntaxError: EOL while scanning string literal
```

SEARCH STACK OVERFLOW

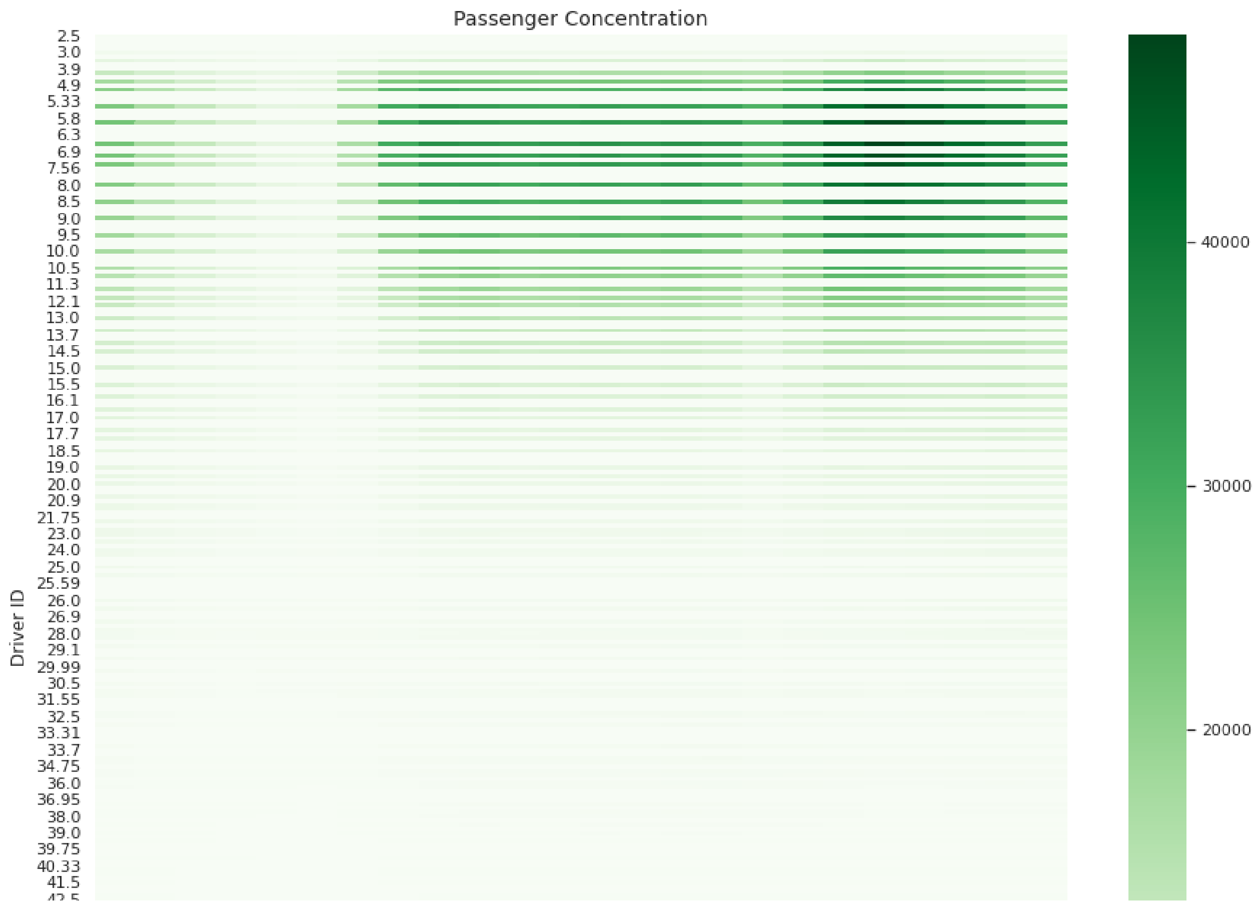
```
(fig, ax) = plt.subplots(figsize=(10,4))
ax = sns.distplot(earned, kde=False)
ax.set_title('Distribution of monthly earning', fontsize=18)
ax.set_xlabel('Monthly Income of Drivers', fontsize=14)
ax.set_ylabel('Number of Drivers', fontsize=14)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWar
  warnings.warn(msg, FutureWarning)
Text(0, 0.5, 'Number of Drivers')
```



```
pass_conc = taxi[['Pick_Hour','fare_amount','hack_license']]
pass_conc.loc[pass_conc.fare_amount > 100, 'fare_amount'] = 168
pass_conc.loc[((pass_conc.fare_amount < 100) & (pass_conc.fare_amount > 55)), 'fare_amc
pass_conc = pass_conc.groupby(['Pick_Hour','fare_amount'])['hack_license'].size().reset

pass_conc_piv = pd.pivot_table(pass_conc, values="hack_license",index=["fare_amount"],
#pass_conc_piv = pass_conc_piv[['Monday','Tuesday','Wednesday','Thursday','Friday','Sat
fig, ax = plt.subplots(figsize=(15,13))
ax = sns.heatmap(pass_conc_piv, ax=ax, cmap='Greens')
ax.set_xlabel('Hour of Day', fontsize=12)
ax.set_ylabel('Driver ID', fontsize=12)
ax.set_title('Passenger Concentration', fontsize=14)
```

```
/usr/local/lib/python3.7/dist-packages/pandas/core/indexing.py:1817: SettingWit
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/sta
  self._setitem_single_column(loc, value, pi)
Text(0.5, 1.0, 'Passenger Concentration')
```

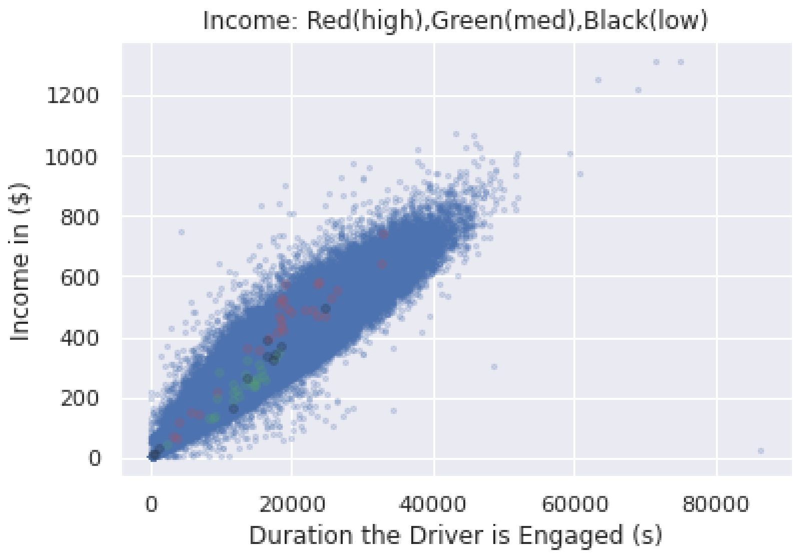


```
############### If you were a taxi owner, how would you maximize your earnings in a day?
taxi = pd.read_csv(path+"taxi_dataFare.csv")
taxi.columns = [col.strip().replace(' ', '') for col in taxi.columns]
taxi = taxi.drop('Unnamed:0', axis=1)
# What are the busiest days and hours for taxi drivers?
pass_conc = taxi.groupby(['DayofWeek','Pick_Hour'])['passenger_count'].size().reset_inc
pass_conc_piv = pd.pivot_table(pass_conc, values="passenger_count",index=["Pick_Hour"],
pass_conc_piv = pass_conc_piv[['Monday','Tuesday','Wednesday','Thursday','Friday','Satu

fare_conc = taxi.groupby(['DayofWeek','Pick_Hour'])['fare_amount'].size().reset_index()
fare_conc_piv = pd.pivot_table(fare_conc, values="fare_amount",index=["Pick_Hour"], col
fare_conc_piv = fare_conc_piv[['Monday','Tuesday','Wednesday','Thursday','Friday','Satu
#plot pivot table as heatmap using seaborn
fig, ax = plt.subplots((1,3),figsize=(5,5))
ax[0] = sns.heatmap(pass_conc_piv, ax=ax, cmap='Greens')
ax[0].set_xlabel('Day of Week', fontsize=12)
ax[0].set_ylabel('Hour of Day', fontsize=12)
ax[0].set_title('Passenger Concentration', fontsize=14)

ax[1] = sns.heatmap(fare_conc_piv, ax=ax, cmap='Greens')
ax[1].set_xlabel('Day of Week', fontsize=12)
ax[1].set_ylabel('Hour of Day', fontsize=12)
ax[1].set_title('Fare Concentration', fontsize=14)
```

Q4. Is it possible to characterise taxi drivers based on work hours and how much they make?

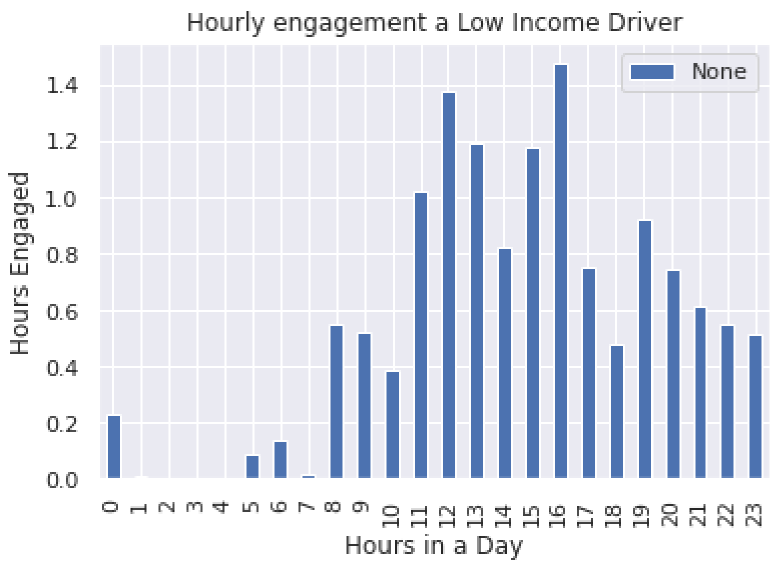
```
taxi = taxi[['hack_license','pick_date','total_amount','in_car']]
#hr_employ = pd.read_csv(path+"hr_employ.csv")
#hr_employ.columns = [col.strip().replace(' ', '') for col in hr_employ.columns]
#hr_employ.drop(columns=hr_employ.columns[0], axis=1, inplace=True)
result = pd.concat([taxi, hr_employ], axis=1, join='inner')
del hr_employ
driver_day_trips = result.groupby(['hack_license','pick_date']).sum().reset_index()
fig, ax = plt.subplots(figsize=(6,4))
ax.scatter(driver_day_trips.in_car, driver_day_trips.total_amount, zorder=1, alpha= 0.2
ax.set( xlabel= "Duration the Driver is Engaged (s)",ylabel = "Income in ($)")
plt.show()
```

```
monthly_earnings = driver_day_trips.groupby('hack_license')['total_amount'].sum().reset
high_earning = monthly_earnings[monthly_earnings['total_amount']>12000]
average_earning = monthly_earnings[(monthly_earnings['total_amount']>4000)&(monthly_ear
low_earning = monthly_earnings[(monthly_earnings['total_amount']<3000)]
hi = driver_day_trips[driver_day_trips['hack_license'] == high_earning['hack_license'][
med = driver_day_trips[driver_day_trips['hack_license'] == average_earning['hack_licens
low = driver_day_trips[driver_day_trips['hack_license'] == low_earning['hack_license'][
fig, ax = plt.subplots(figsize=(6,4))
ax.scatter(driver_day_trips.in_car, driver_day_trips.total_amount, zorder=1, alpha= 0.2
ax.scatter(hi.in_car, hi.total_amount, zorder=1, alpha= 0.2, c='r', s=15)
ax.scatter(med.in_car, med.total_amount, zorder=1, alpha= 0.2, c='g', s=15)
ax.scatter(low.in_car, low.total_amount, zorder=1, alpha= 0.2, c='k', s=15)
ax.set( xlabel= "Duration the Driver is Engaged (s)",ylabel = "Income in ($)",title ="I
plt.show()
```



```
taxi = pd.read_csv(path+"hr_high.csv")
taxi.columns = [col.strip().replace(' ', '') for col in taxi.columns]
taxi = taxi.drop('Unnamed:0', axis=1)
#taxi.mean().plot(kind='bar',legend=True, title='Hourly engagement of high earners 1 mo
#hi5 = hi[[str(i) for i in range(24) ]]
#hi5.mean().plot(kind='bar',legend=True, title='Hourly engagement a High Income Driver'
#med5 = med[[str(i) for i in range(24) ]]
#med5.mean().plot(kind='bar',legend=True, title='Hourly engagement a Medi Income Driver
lo5 = low[[str(i) for i in range(24) ]]
lo5.mean().plot(kind='bar',legend=True, title='Hourly engagement a Low Income Driver',x
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f913add2510>
```



```
ax = taxi.plot(kind = "barh", y = "mean", legend = False, title = "Average Avocado Pric
# X
ax.set_xlabel("Price ($)")
# Y
ax.set_ylabel("")
ax.set_yticklabels(["Conventional", "Organic"])
# Overall
for key, spine in ax.spines.items():
    spine.set_visible(False)
ax.tick_params(bottom = False, left = False)
ax.errorbar(avocado_prices["mean"], avocado_prices.index, xerr = avocado_prices["double
            linewidth = 1.5, color = "black", alpha = 0.4, capsize = 4)
```

✓ 1s completed at 10:01 PM