TeamName: 500 days of training

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from datetime import timedelta
```

In [2]:
```
# Importing all the csv as dataframes

ride_ids = pd.read_csv("./data/ride_ids.csv")
driver_ids = pd.read_csv("./data/driver_ids.csv")
driver_timestamps = pd.read_csv("./data/ride_timestamps.csv")
```

Questions asked and their progress

1. Number of rides - Cumulative - In Progress
2. Number of rides each day - In Progress
3. Time for the first ride from onboard - Not started
4. Time at which rides were taken - More exploratory related to the timings - Data Curated
5. (What is ride prime time and questions around that) - Surcharge.. cost of a ride changed according to prime time
6. Questions around distance- More exploratory
7. Percentage of prime time in the ride (Cumulative percentage etc) - Done
8. Time between accepting the ride and the arriving .- Done w.r.t data. Need to explore
9. Travel time - More exploratory
10. Compute value of a ride - Done
11. Span Of work each day - Incomplete (Time between the first ride of the day and the last ride of the day) - Median work hours each day, Mean
12. Days with ride - Completed

Data cleaning and joining the data

In [3]:
```
# Supporting functions

def costOfTrip(dist, time, prime_time):
    service_charge = 1.75
    base_cost = 2
    cost_by_dist = (dist* 0.000621371) * 1.15
    cost_by_time = time * (0.22/60)
    cost_prime_time = prime_time * (0.22/60)
    total_cost = service_charge + base_cost + cost_by_dist + cost_by_tim
    if total_cost < 5:
        return 5
    if total_cost > 400:
        return 400
    return total_cost
```

In [4]:
```
ride_ids["trip_cost"] = ride_ids.apply(lambda x: costOfTrip(x["ride_dist
```

In [5]:
```
total_trips = ride_ids.groupby('driver_id').size().reset_index(drop=Fals
total_trips.columns = ["driver_id", "total_trips"]
grp_sum = ride_ids.groupby('driver_id').cumsum().set_index(ride_ids.driv
grp_sum.columns = ["cumulative_ride_distance", "cumulative_ride_duration
```

In [6]:
```
ride_ids[grp_sum.columns] = grp_sum
```

In [7]:
```
ride_ids = ride_ids.merge(total_trips, on="driver_id", how="inner").rese
```

In [8]:
```
driver_ids["driver_onboard_date"] = pd.to_datetime(driver_ids["driver_on
driver_timestamps["timestamp"] = pd.to_datetime(driver_timestamps["times
```

In [9]:
```
driver_ids["driver_onboard_date"] = driver_ids["driver_onboard_date"].ap
driver_timestamps["timestamp"] = driver_timestamps["timestamp"].apply(la
```

In [10]:
```
s = driver_timestamps.assign(
river_timestamps.sort_values('timestamp', ascending=False).groupby("ride_


idnt work because some of the times werent in order between the events fo
```

In [11]:
```
df_pivot = driver_timestamps.pivot(index="ride_id", columns="event")
driver_timestamps = pd.DataFrame(df_pivot.to_records())
driver_timestamps.columns = ["ride_id", "accepted_at_time", "arrived_at_
```

In [12]:
```
driver_timestamps.columns = ["ride_id", "accepted_at_time", "arrived_at_
driver_timestamps["time_to_accept"] = (driver_timestamps["accepted_at_ti
driver_timestamps["time_to_arrive"] = (driver_timestamps["arrived_at_tim
driver_timestamps["time_for_customer_to_arrive"] = (driver_timestamps["p
```

In [13]:
```
# Merge the dataframes , to get one master dataframe.
merged_intermediate = ride_ids.merge(driver_ids, on="driver_id", how="ou
full_df = merged_intermediate.merge(driver_timestamps, on="ride_id", how
```

In [14]:
```
# Get the difference from onboard time to the last ride time

last_ride_in_df = max(full_df["accepted_at_time"]).tz_localize('US/Pacif
```

In [15]:
```
full_df["time_at_lyft"] = (last_ride_in_df-full_df["driver_onboard_date"
```

In [16]:
```
no_onboard_date_drivers = list(set(ride_ids.driver_id.unique()).differen
```

In [17]:
```
no_ride_drivers = list(set(driver_ids.driver_id.unique()).difference(set
```

In [18]:
```
full_df["prime_time_percent"] = full_df["ride_prime_time"] / full_df["ri
```

In [19]:
```
grouped_full = full_df.groupby('driver_id').agg({"mean", "median", "sum"
```

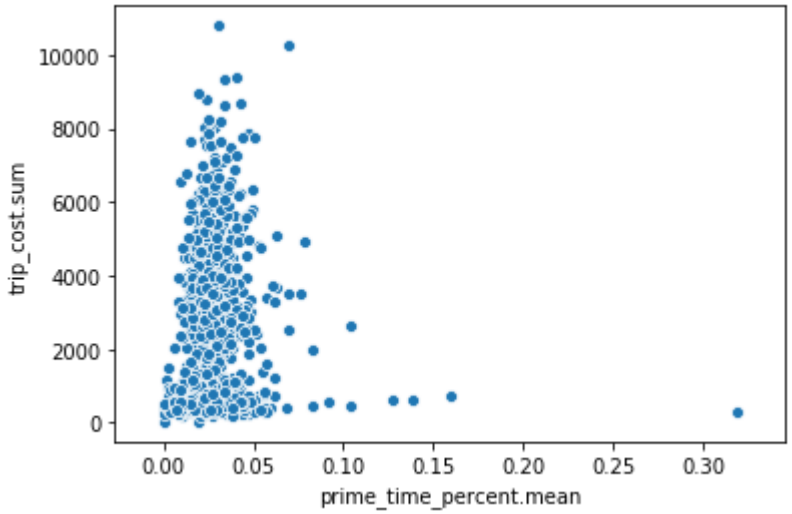
In [20]:
```
grouped_full.columns =grouped_full.columns.map('.'.join).str.strip('.')
```

In [21]:
```
grouped_full = grouped_full.reset_index(drop=False)
```

In [22]:
```
# Duration vs Price Model to figure out the outliers

sns.scatterplot(data=grouped_full, x="prime_time_percent.mean", y="trip_
```

Out[22]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e6d54b70>
```

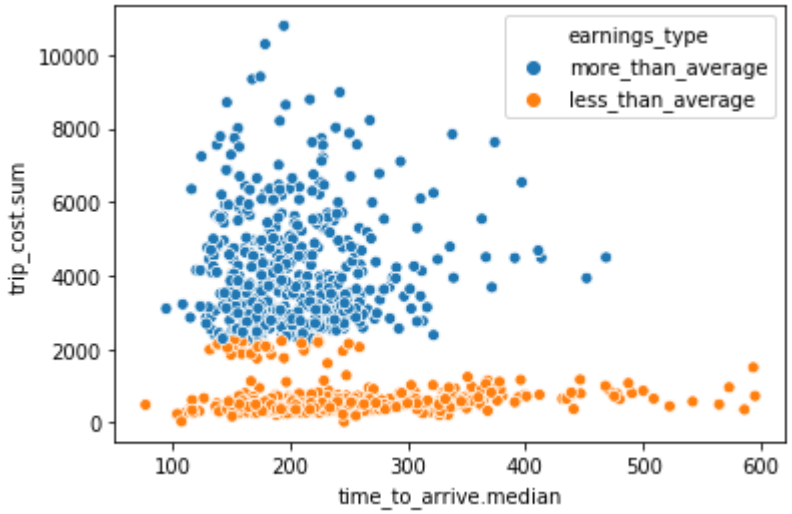


In [23]:
```
average_rider_earnings = grouped_full["trip_cost.sum"].mean()
```

In [24]:
```
grouped_full["earnings_type"] = grouped_full["trip_cost.sum"].apply(lamb
```

In [25]:
```
sns.scatterplot(data=grouped_full, y="trip_cost.sum", x="time_to_arrive.
```

Out[25]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1dc275438>
```



In [26]:
```
def timeOfDay(ts):
    hour = ts.hour
    if (hour >= 0) and (hour<5):
        return "ODD_TIME"
    if (hour >= 5) and (hour < 9):
        return "MORNING"
    if (hour >= 9) and (hour < 12):
        return "LATE_MORNING"
    if (hour >= 12) and (hour < 15):
        return "AFTERNOON"
    if (hour >= 15) and (hour < 18):
        return "EVENING"
    if (hour >= 18) and (hour < 21):
        return "NIGHT"
    if (hour >= 21) and (hour < 24):
        return "LATE_NIGHT"

#0 - 5 Odd time
# 5-9 Morning
# 9 -12
# 12 -3 # Afternoon
# 3 -6 Late afternoon
# 6 - 9 Night
# 9 - 12 Late Night
```

In [27]:
```
full_df["time_of_day"] = full_df.apply(lambda x: timeOfDay(x["picked_up_
```

In [28]:
```
full_df["month"] = full_df["picked_up_time"].apply(lambda x: x.month)
full_df["day"] = full_df["picked_up_time"].apply(lambda x: x.day)
```

In [29]:
```
def is_weekend_rush(ts, time_of_day):
    wkd = ts.weekday()
    hr = ts.hour
    if (wkd >= 5 ) or (wkd == 4 and time_of_day == "NIGHT") or (wkd == 4
        return True
    else:
        return False
```

In [30]:
```
full_df["is_weekend_rush"] = full_df.apply(lambda x: is_weekend_rush(x["
```

In [31]:
```
full_df["day_name"] = full_df["picked_up_time"].apply(lambda x: x.day_na
```

In [32]:
```
grouped_full = full_df.groupby("driver_id").agg({"mean", "median", "sum"
grouped_full.columns =grouped_full.columns.map('.'.join).str.strip('.')
grouped_full = grouped_full.reset_index(drop=False)
```

In [33]:
```
grouped_full["earnings_per_day"] = grouped_full["trip_cost.sum"]/grouped_
```

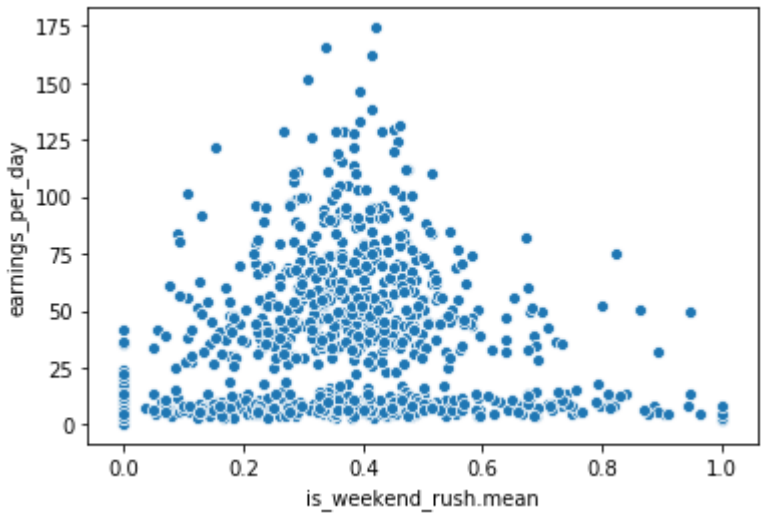
In [34]:
```
grouped_full["avg_rides_per_day"] = grouped_full["day.size"]/grouped_ful
```

In [35]:
```
def earningType(x, avgEarning):
    if x > (1.5 * avgEarning):
        return "OverAcheiver"
    elif x >= avgEarning:
        return "AboveAverage"
    elif x < (avgEarning - (0.5 * avgEarning)):
        return "UnderAcheiver"
    elif x < avgEarning:
        return "BelowAverage"
```

In [36]:
```
grouped_filtered = grouped_full[grouped_full["driver_id"].isin(no_ride_d
```

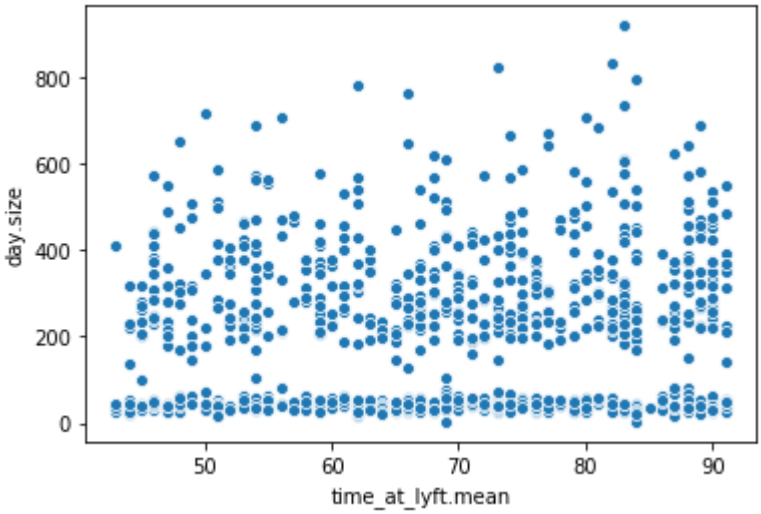
In [37]:
```
sns.scatterplot(data=grouped_filtered, x="is_weekend_rush.mean", y="earn
```

Out[37]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1dcc735c0>
```



In [38]:
```
sns.scatterplot(data=grouped_filtered, x="time_at_lyft.mean", y="day.siz
```

Out[38]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e6319ef0>
```



In [39]:
```
median_earning = grouped_filtered["trip_cost.sum"].median()
avg_earning = grouped_filtered["trip_cost.sum"].mean()
grouped_filtered["median_cut_off_earning"] = grouped_filtered["trip_cost
grouped_filtered["mean_cut_off_earning"] = grouped_filtered["trip_cost.s
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:3: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  This is separate from the ipykernel package so we can avoid doing imp
orts until
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:4: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  after removing the cwd from sys.path.
```

In [186]:
```
grouped_filtered.columns
```

Out[186]:
```
Index(['driver_id', 'ride_distance.mean', 'ride_distance.median',
       'ride_distance.size', 'ride_distance.sum', 'ride_duration.mean',
       'ride_duration.median', 'ride_duration.size', 'ride_duration.su
m',
       'ride_prime_time.mean', 'ride_prime_time.median',
       'ride_prime_time.size', 'ride_prime_time.sum', 'trip_cost.mean',
       'trip_cost.median', 'trip_cost.size', 'trip_cost.sum',
       'cumulative_ride_distance.mean', 'cumulative_ride_distance.media
n',
       'cumulative_ride_distance.size', 'cumulative_ride_distance.sum',
       'cumulative_ride_duration.mean', 'cumulative_ride_duration.media
n',
       'cumulative_ride_duration.size', 'cumulative_ride_duration.sum',
       'cumulative_ride_prime_time.mean', 'cumulative_ride_prime_time.m
edian',
       'cumulative_ride_prime_time.size', 'cumulative_ride_prime_time.s
um',
       'cumulative_trip_cost.mean', 'cumulative_trip_cost.median',
       'cumulative_trip_cost.size', 'cumulative_trip_cost.sum',
       'total_trips.mean', 'total_trips.median', 'total_trips.size',
       'total_trips.sum', 'time_to_accept.mean', 'time_to_accept.media
n',
       'time_to_accept.size', 'time_to_accept.sum', 'time_to_arrive.mea
n',
       'time_to_arrive.median', 'time_to_arrive.size', 'time_to_arrive.
sum',
       'time_for_customer_to_arrive.mean',
       'time_for_customer_to_arrive.median',
       'time_for_customer_to_arrive.size', 'time_for_customer_to_arriv
e.sum',
       'time_at_lyft.mean', 'time_at_lyft.median', 'time_at_lyft.size',
       'time_at_lyft.sum', 'prime_time_percent.mean',
       'prime_time_percent.median', 'prime_time_percent.size',
       'prime_time_percent.sum', 'month.mean', 'month.median', 'month.s
ize',
       'month.sum', 'day.mean', 'day.median', 'day.size', 'day.sum',
       'is_weekend_rush.mean', 'is_weekend_rush.median',
       'is_weekend_rush.size', 'is_weekend_rush.sum', 'earnings_per_da
y',
       'avg_rides_per_day', 'median_cut_off_earning', 'mean_cut_off_ear
ning',
       'tuples', 'maxStreak', 'totalDaysAppUsed', 'active_percent'],
      dtype='object')
```

In [185]:
```
grouped_filtered.groupby(['median_cut_off_earning']).agg({"mean", "sum",
```

Out[185]:

	ride_distance.mean				ride_distance.median		
	mean	median	size	sum	mean	median	size
median_cut_off_earning							
AboveAverage	6711.774452	6464.393701	187	1.255102e+06	4034.994652	3978.00	187
BelowAverage	7201.046249	6170.930000	77	5.544806e+05	4459.928571	3940.50	77
OverAcheiver	7185.143589	6676.148515	282	2.026210e+06	4182.053191	3952.25	282
UnderAcheiver	7416.032699	6914.800000	391	2.899669e+06	4530.575448	4240.50	391

4 rows × 292 columns

In [40]:
```
passive_riders = grouped_filtered[grouped_filtered["avg_rides_per_day"]
```

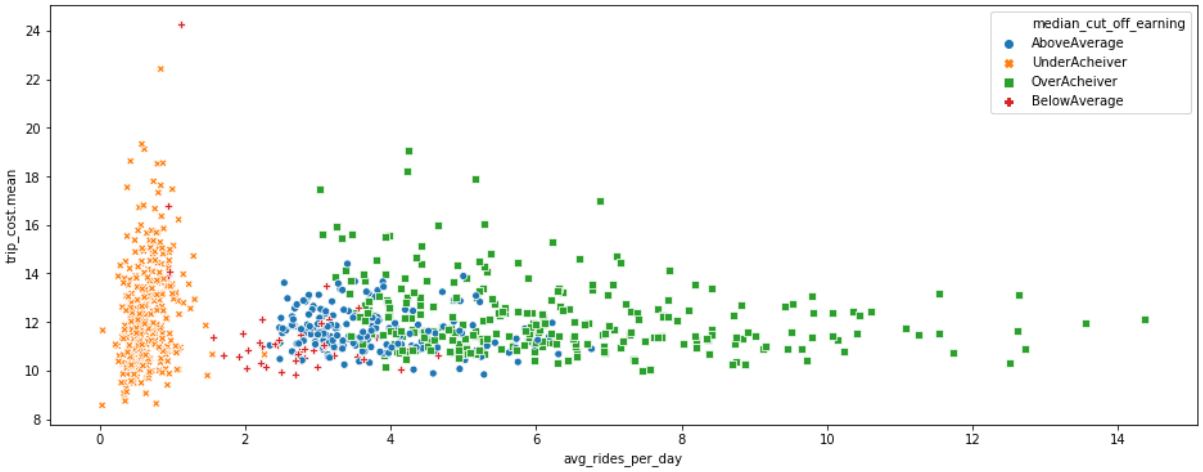
In [41]:
```
passive_riders.shape
```

Out[41]:
```
(350,)
```

In [42]:
```
active_riders = grouped_filtered[grouped_filtered.driver_id.isin(passive_
```

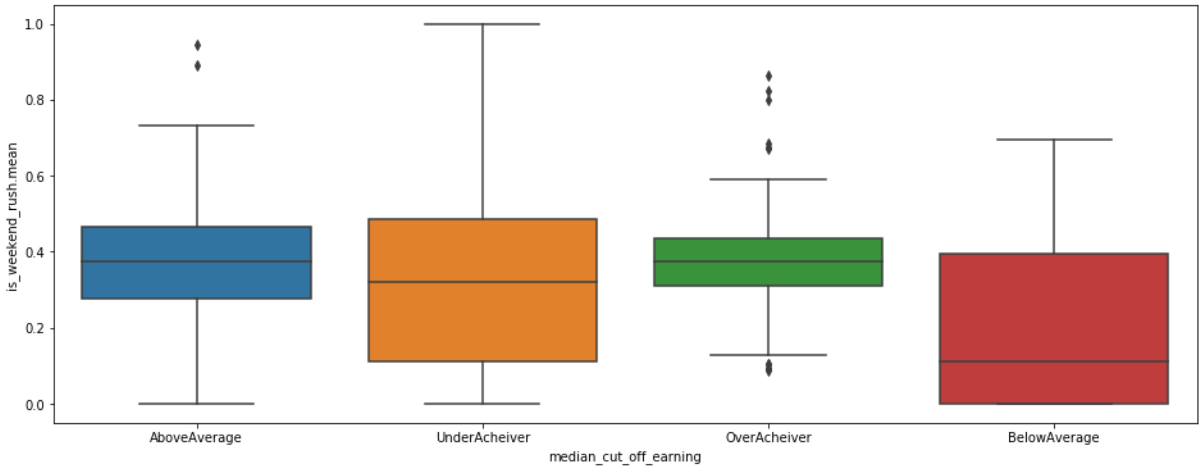
In [43]:
```
plt.figure(figsize=(16, 6))
sns.scatterplot(data=grouped_filtered, x="avg_rides_per_day", y="trip_co
```

Out[43]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e5af0710>
```



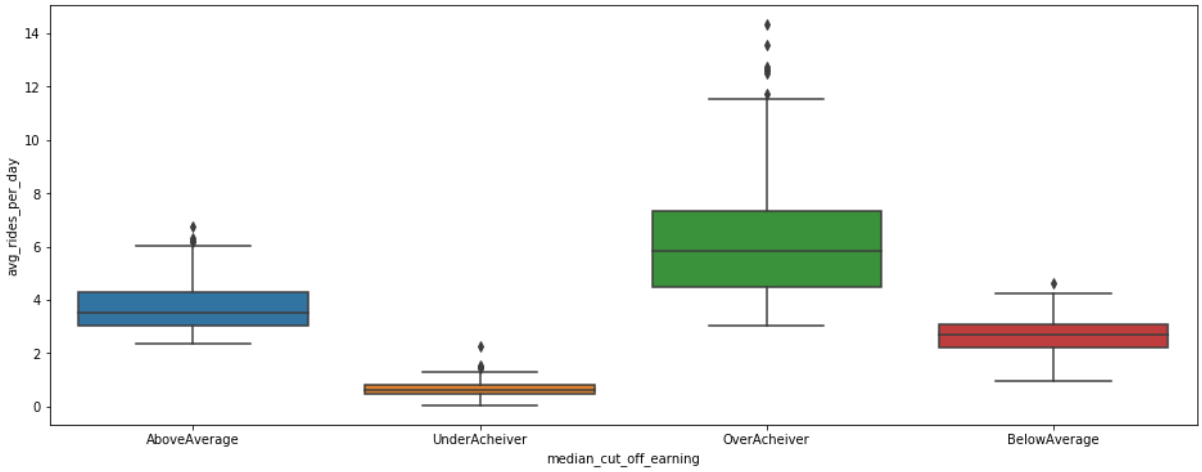
In [187]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="is_weel
```

Out[187]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1d9d04780>
```



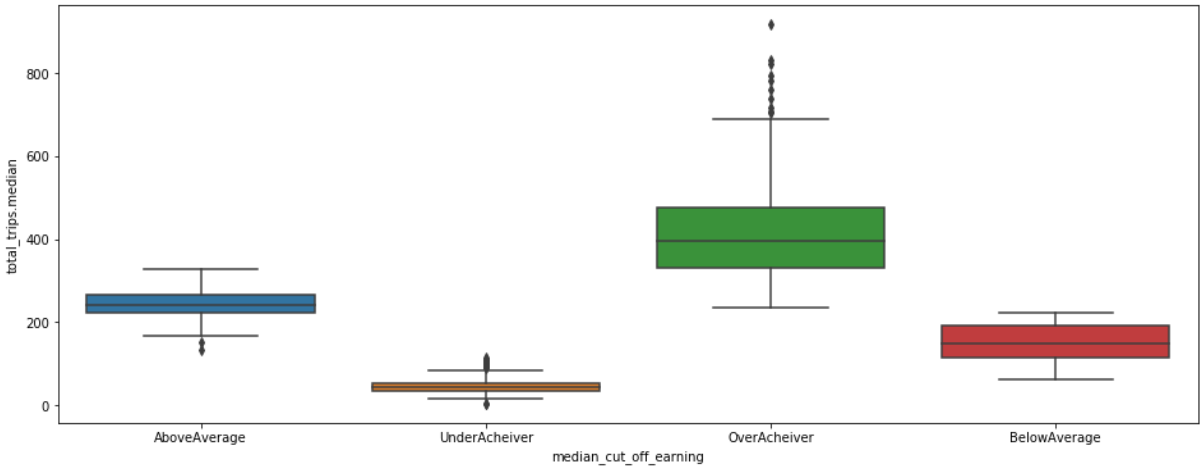
In [45]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="avg_ri
```

Out[45]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e5a807b8>
```



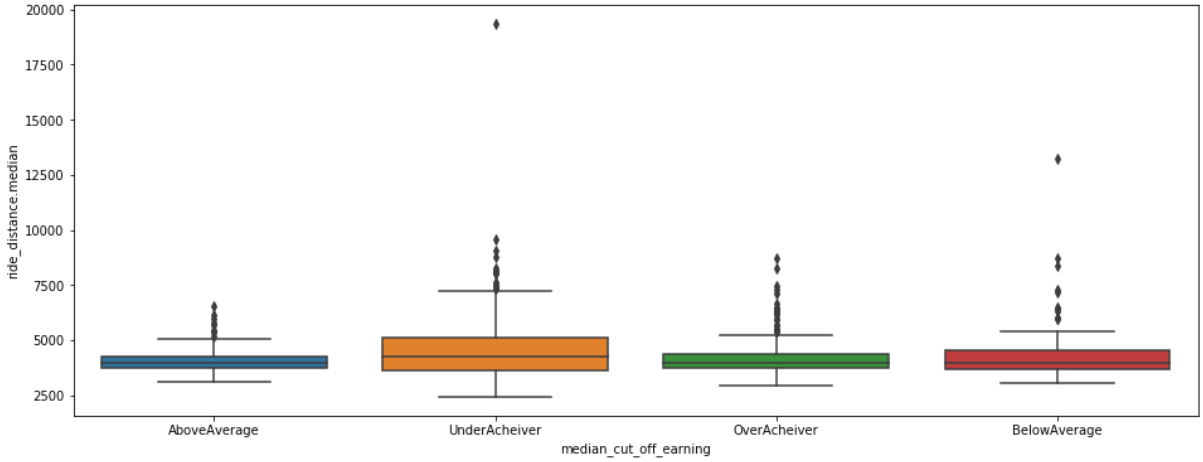
In [46]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="total_
```

Out[46]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e5942a20>
```



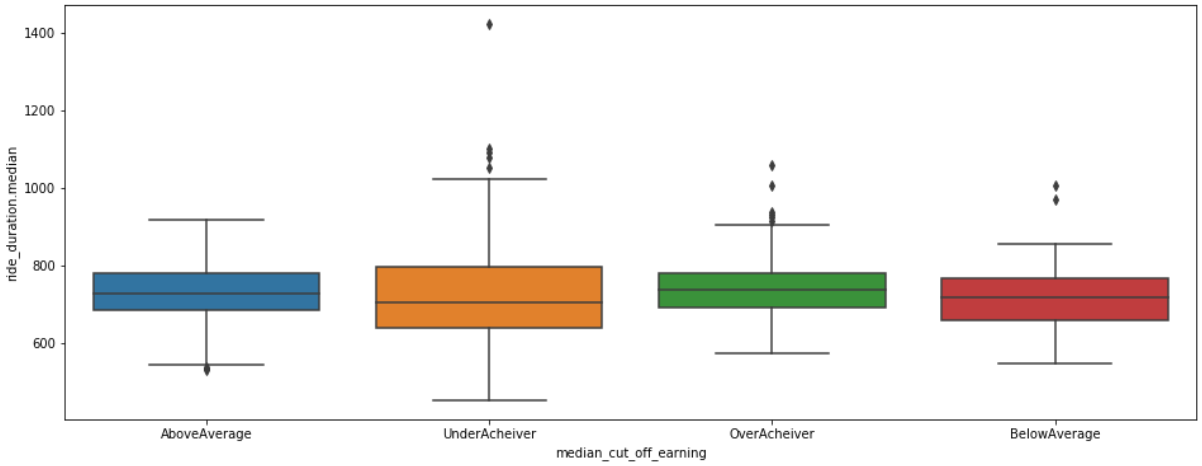
In [196]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="ride_d
```

Out[196]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1d9504b00>
```



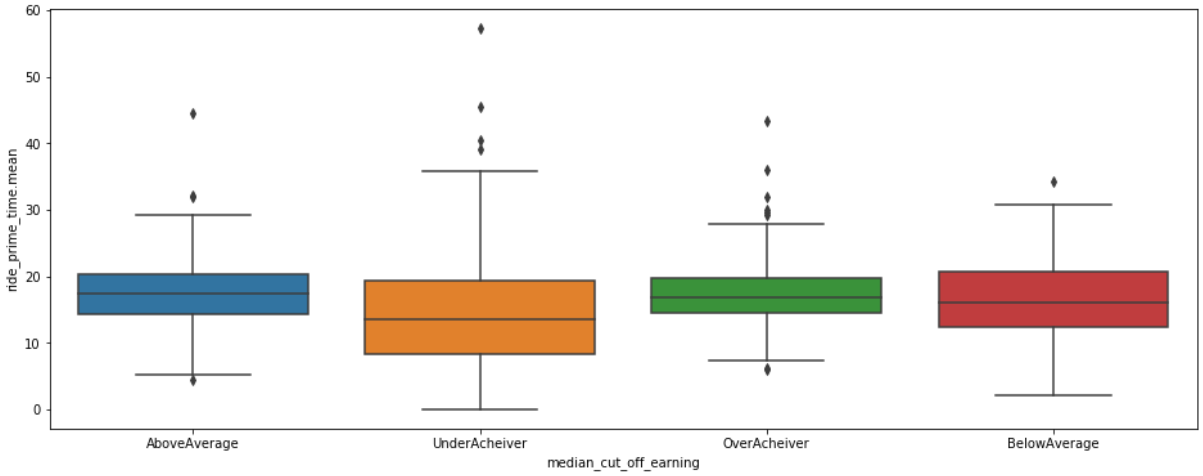
In [48]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="ride_d
```

Out[48]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e6378208>
```



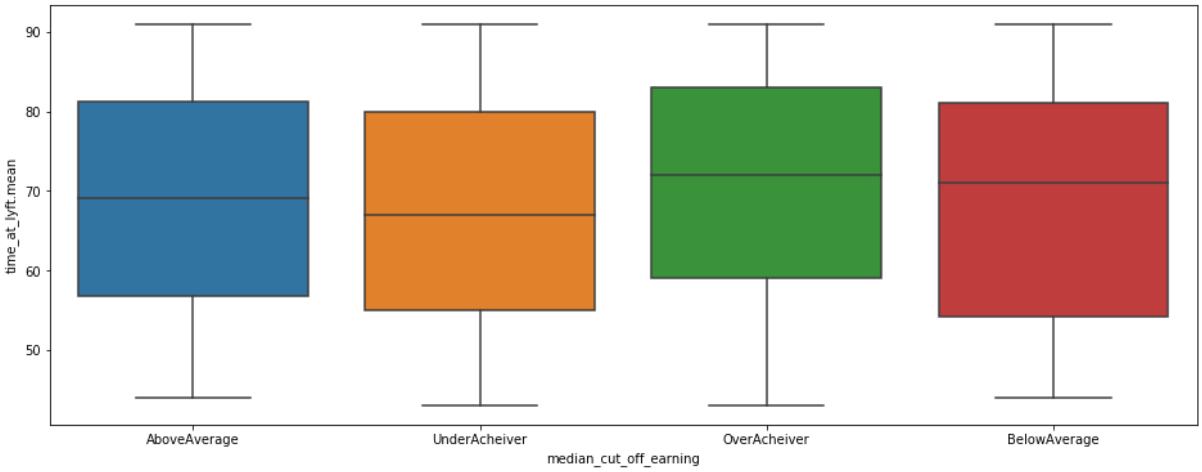
In [49]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="ride_p
```

Out[49]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e58d7550>
```



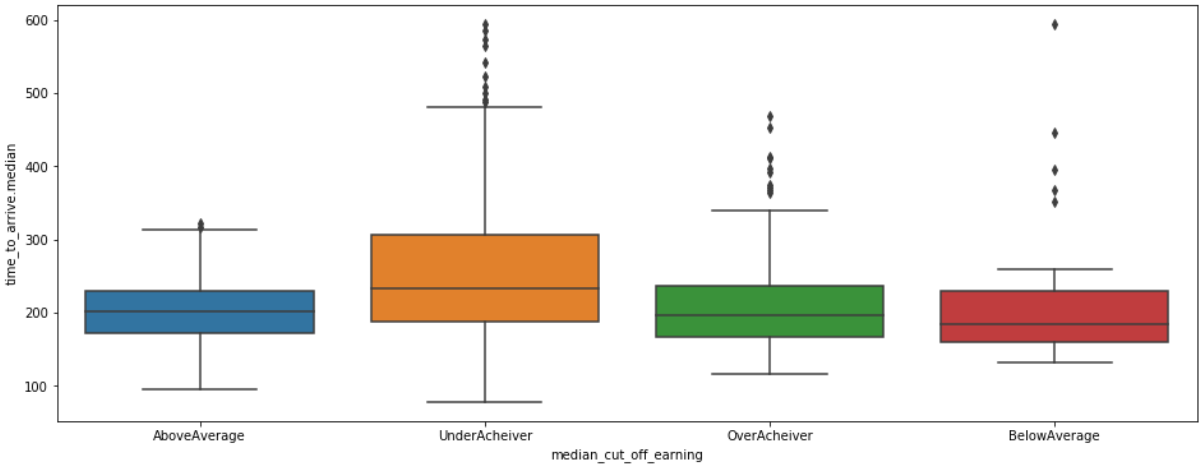
In [50]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="time_a
```

Out[50]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e59967f0>
```



In [193]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="time_t
```

Out[193]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1d9732f60>
```

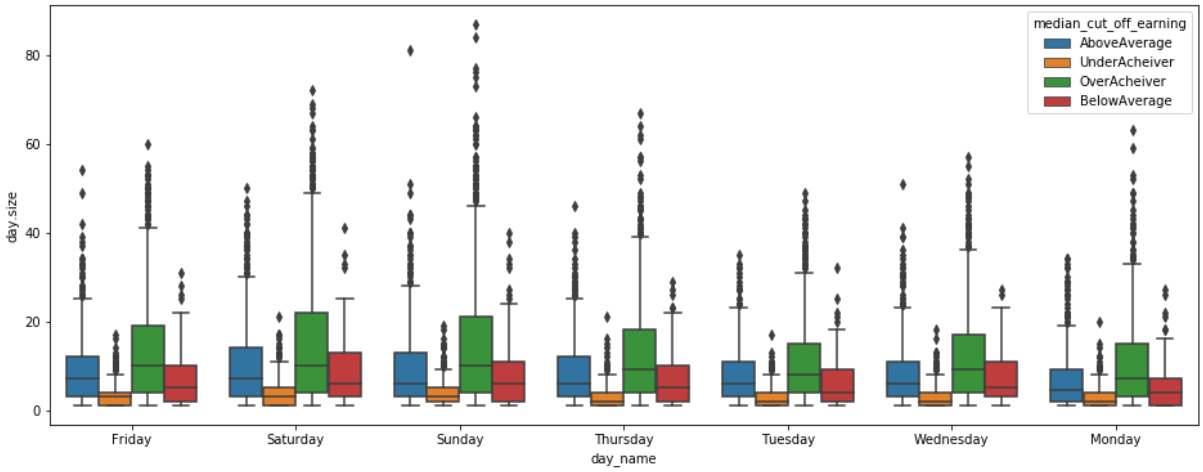


In [52]:
```
time_grouped = full_df.groupby(['driver_id', 'day_name', 'time_of_day'])
time_grouped.columns =time_grouped.columns.map('.'.join).str.strip('.')
time_grouped = time_grouped.reset_index(drop=False)
time_grouped = time_grouped[time_grouped["driver_id"].isin(no_ride_drive
```

In [53]:
```
merge_df = grouped_filtered[['driver_id', 'median_cut_off_earning']]
time_grouped_merged= time_grouped.merge(merge_df, on="driver_id")
```

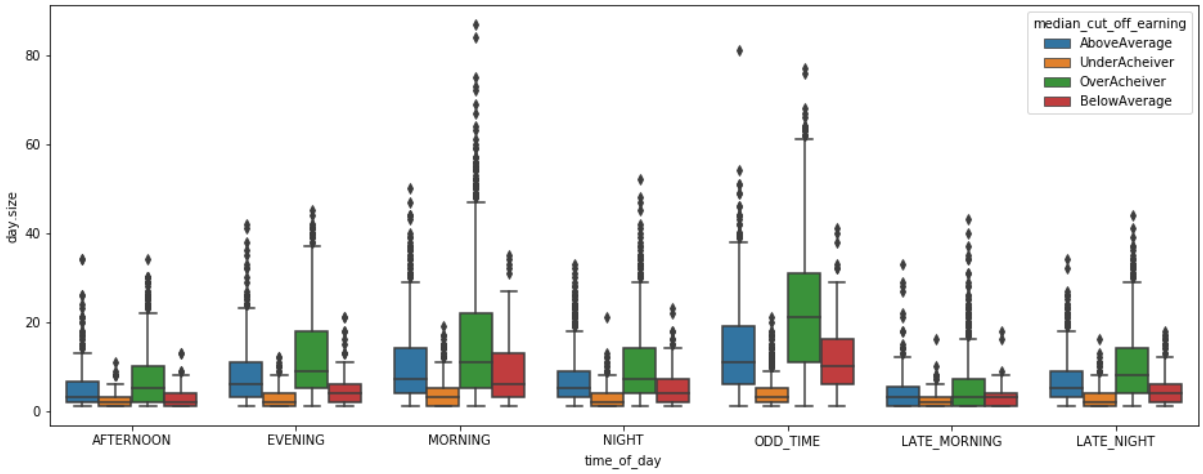
In [54]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=time_grouped_merged, x="day_name", y="day.size", hue="m
```

Out[54]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e55620b8>
```



In [189]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=time_grouped_merged, x="time_of_day", y="day.size", hue=
```

Out[189]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1d9975c50>
```



In [55]:
```
top_5 = grouped_filtered.sort_values("trip_cost.sum", ascending=False)["
```

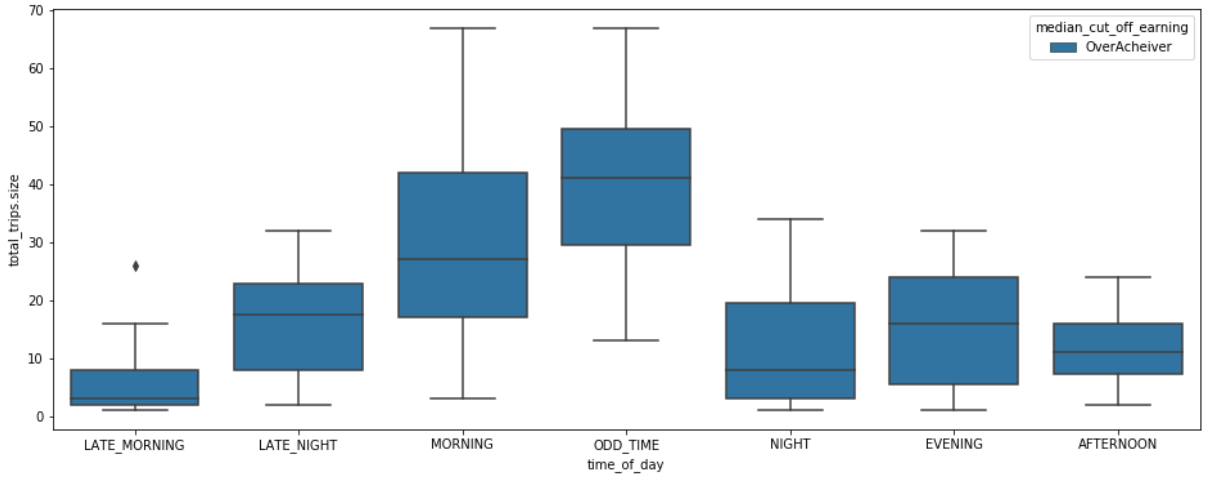
In [56]:
```
time_merged_top5 = time_grouped_merged[time_grouped_merged.driver_id.isi
```

In [57]:
```
time_merged_top5.shape
```

Out[57]:
```
(198, 72)
```

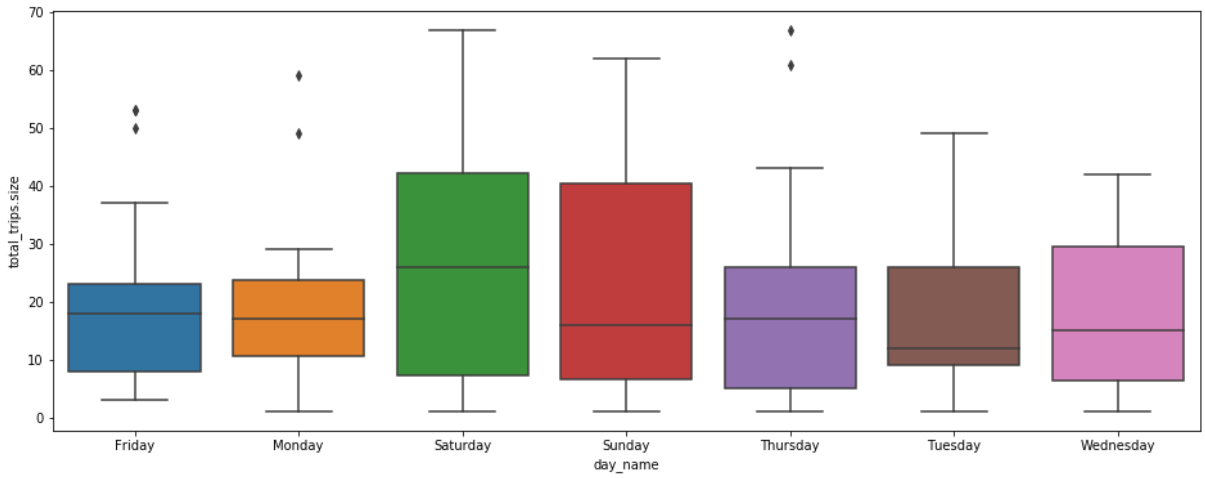
In [188]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=time_merged_top5, x="time_of_day", y="total_trips.size"
```

Out[188]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1dc20c550>
```



In [59]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=time_merged_top5, x="day_name", y="total_trips.size")
```

Out[59]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e4bb9b00>
```



In [60]:
```
time_grouped_merged.columns
```

Out[60]:
```
Index(['driver_id', 'day_name', 'time_of_day', 'ride_distance.mean',
       'ride_distance.median', 'ride_distance.size', 'ride_distance.su
m',
       'ride_duration.mean', 'ride_duration.median', 'ride_duration.siz
e',
       'ride_duration.sum', 'ride_prime_time.mean', 'ride_prime_time.me
dian',
       'ride_prime_time.size', 'ride_prime_time.sum', 'trip_cost.mean',
       'trip_cost.median', 'trip_cost.size', 'trip_cost.sum',
       'cumulative_ride_distance.mean', 'cumulative_ride_distance.media
n',
       'cumulative_ride_distance.size', 'cumulative_ride_distance.sum',
       'cumulative_ride_duration.mean', 'cumulative_ride_duration.media
n',
       'cumulative_ride_duration.size', 'cumulative_ride_duration.sum',
       'cumulative_ride_prime_time.mean', 'cumulative_ride_prime_time.m
edian',
       'cumulative_ride_prime_time.size', 'cumulative_ride_prime_time.s
um',
       'cumulative_trip_cost.mean', 'cumulative_trip_cost.median',
       'cumulative_trip_cost.size', 'cumulative_trip_cost.sum',
       'total_trips.mean', 'total_trips.median', 'total_trips.size',
       'total_trips.sum', 'time_to_accept.mean', 'time_to_accept.media
n',
       'time_to_accept.size', 'time_to_accept.sum', 'time_to_arrive.mea
n',
       'time_to_arrive.median', 'time_to_arrive.size', 'time_to_arrive.
sum',
       'time_for_customer_to_arrive.mean',
       'time_for_customer_to_arrive.median',
       'time_for_customer_to_arrive.size', 'time_for_customer_to_arriv
e.sum',
       'time_at_lyft.mean', 'time_at_lyft.median', 'time_at_lyft.size',
       'time_at_lyft.sum', 'prime_time_percent.mean',
       'prime_time_percent.median', 'prime_time_percent.size',
       'prime_time_percent.sum', 'month.mean', 'month.median', 'month.s
ize',
       'month.sum', 'day.mean', 'day.median', 'day.size', 'day.sum',
       'is_weekend_rush.mean', 'is_weekend_rush.median',
       'is_weekend_rush.size', 'is_weekend_rush.sum',
       'median_cut_off_earning'],
      dtype='object')
```

In [61]:
```
median_earning
```

Out[61]:
```
2287.137490039199
```

In [62]:
```
avg_earning
```

Out[62]:
```
2465.165132499584
```

In [63]:
```
grouped_filtered["median_cut_off_earning"].value_counts()
```

Out[63]:
```
UnderAcheiver    391
OverAcheiver     282
AboveAverage     187
BelowAverage      77
Name: median_cut_off_earning, dtype: int64
```

In [64]:
```
underacheived = grouped_filtered[grouped_filtered["median_cut_off_earnin
```

In [65]:
```
underacheived.shape
```

Out[65]:
```
(391, 73)
```

In [66]:
```
below = grouped_filtered[grouped_filtered["trip_cost.sum"] < median_earn
above = grouped_filtered[grouped_filtered["trip_cost.sum"] > median_earn
overacheive_less_duration = above[(above["time_at_lyft.mean"] < 50) & (a
below_average_more_duration = below[(below["time_at_lyft.mean"] >= 50) &
```

In [67]:
```
overacheive_less_duration.shape
```

Out[67]:
```
(23, 73)
```

In [68]:
```
below_average_more_duration.shape
```

Out[68]:
```
(37, 73)
```

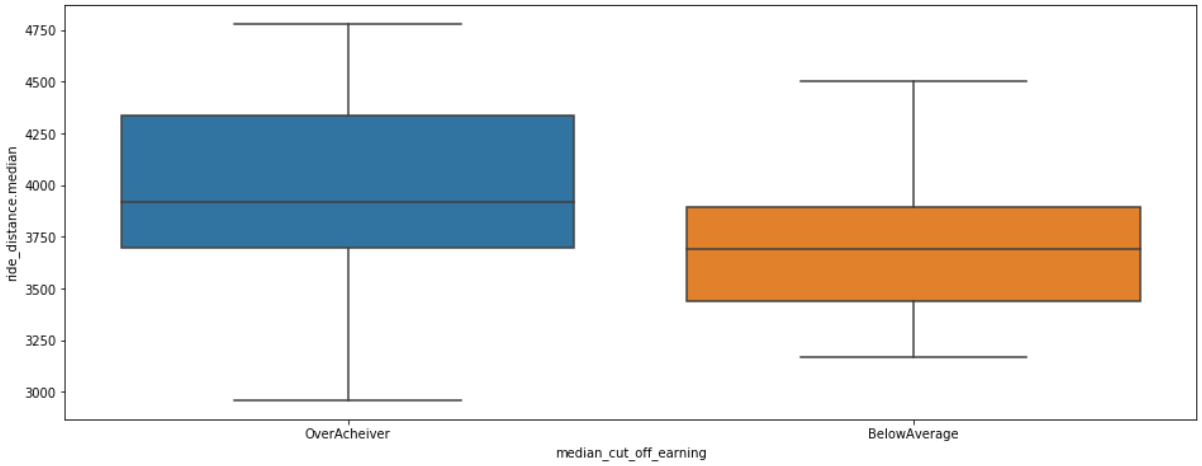
In [69]:
```
combined = pd.concat([overacheive_less_duration,below_average_more_durat
# Now remove off the passive riders
combined = combined[combined.driver_id.isin(passive_riders)==False]
```

In [70]:
```
combined["median_cut_off_earning"].value_counts()
```

Out[70]:
```
BelowAverage    28
OverAcheiver    23
Name: median_cut_off_earning, dtype: int64
```

In [71]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=combined, x="median_cut_off_earning", y="ride_distance.
```

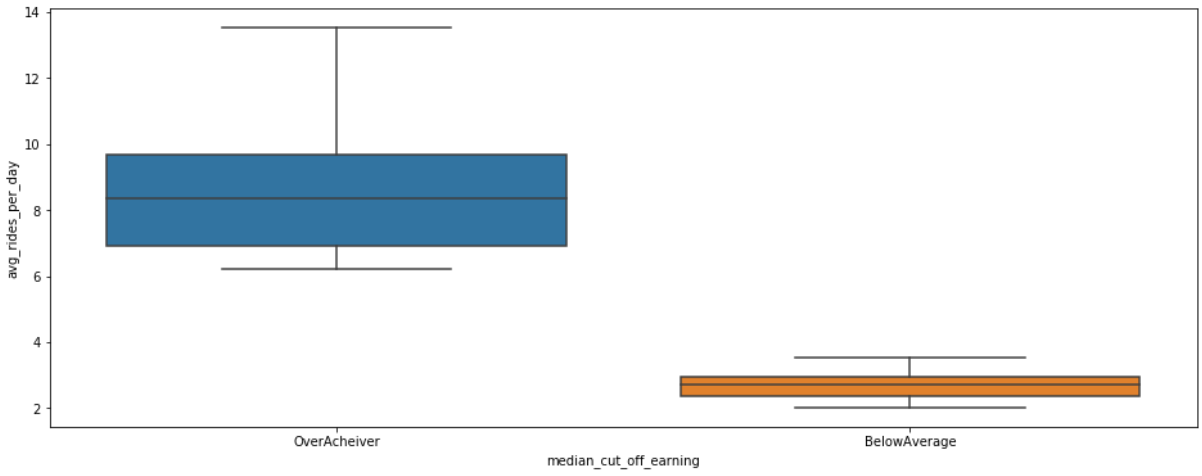
Out[71]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd1e494b470>



In [72]:
```
## Taking longer trips instead of shorter trips
```

In [73]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=combined, x="median_cut_off_earning", y="avg_rides_per_
```

Out[73]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd1e48dc5f8>



In [74]:
```
below.shape
```

Out[74]: (468, 73)

In [75]:
```
below.isna().apply(lambda x: sum(x))
```

Out[75]:
```
driver_id                  0
ride_distance.mean         0
ride_distance.median       0
ride_distance.size         0
ride_distance.sum          0
                         ..
is_weekend_rush.sum        0
earnings_per_day          80
avg_rides_per_day         80
median_cut_off_earning     0
mean_cut_off_earning       0
Length: 73, dtype: int64
```

In [76]:
```
below["time_at_lyft.mean"]
```

Out[76]:
```
1       90.0
2       83.0
7       51.0
10      55.0
11      88.0
        ...
1008    63.0
1012    90.0
1013     NaN
1015     NaN
1017    80.0
Name: time_at_lyft.mean, Length: 468, dtype: float64
```

In [77]:
```
min(full_df["picked_up_time"])
```

Out[77]:
```
Timestamp('2016-03-28 13:02:39')
```

In [78]:
```
max(full_df["picked_up_time"])
```

Out[78]:
```
Timestamp('2016-06-27 07:02:06')
```

In [79]:
```
min(full_df["driver_onboard_date"])
```

Out[79]:
```
Timestamp('2016-03-28 00:00:00-0700', tz='US/Pacific')
```

In [80]:
```
max(full_df["driver_onboard_date"])
```

Out[80]:
```
Timestamp('2016-05-15 00:00:00-0700', tz='US/Pacific')
```

In [81]:
```
full_df.columns
```

Out[81]:
```
Index(['driver_id', 'ride_id', 'ride_distance', 'ride_duration',
       'ride_prime_time', 'trip_cost', 'cumulative_ride_distance',
       'cumulative_ride_duration', 'cumulative_ride_prime_time',
       'cumulative_trip_cost', 'total_trips', 'driver_onboard_date',
       'accepted_at_time', 'arrived_at_time', 'dropped_off_time',
       'picked_up_time', 'requested_at_time', 'time_to_accept',
       'time_to_arrive', 'time_for_customer_to_arrive', 'time_at_lyft',
       'prime_time_percent', 'time_of_day', 'month', 'day', 'is_weekend
_rush',
       'day_name'],
      dtype='object')
```

Initial Survival Analysis Projected lifetime

In [82]:
```
fetimes_df = full_df[['driver_id', 'time_at_lyft', 'ride_distance', 'ride_
```

In [83]:
```
life_grouped = lifetimes_df.groupby('driver_id').agg({"sum", "mean", "me
life_grouped.columns =life_grouped.columns.map('.'.join).str.strip('.')
life_grouped = life_grouped.reset_index(drop=False)
```

In [84]:
```
life_grouped_no_na = life_grouped.dropna(subset=['time_at_lyft.mean'])
```

Our definition of death is riders with no ride in this 3 month interval

In [85]:
```
ith_no_ride -> Failure
ed_no_na["event_observed"] = life_grouped_no_na["driver_id"].apply(lambda
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:2: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
```

In [86]:
```
life_grouped_no_na["avg_ride_per_day_in_tenure"] = life_grouped_no_na.ap
life_grouped_no_na["avg_cost_per_ride_in_tenure"] = life_grouped_no_na.a
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:1: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  """Entry point for launching an IPython kernel.
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:2: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
```

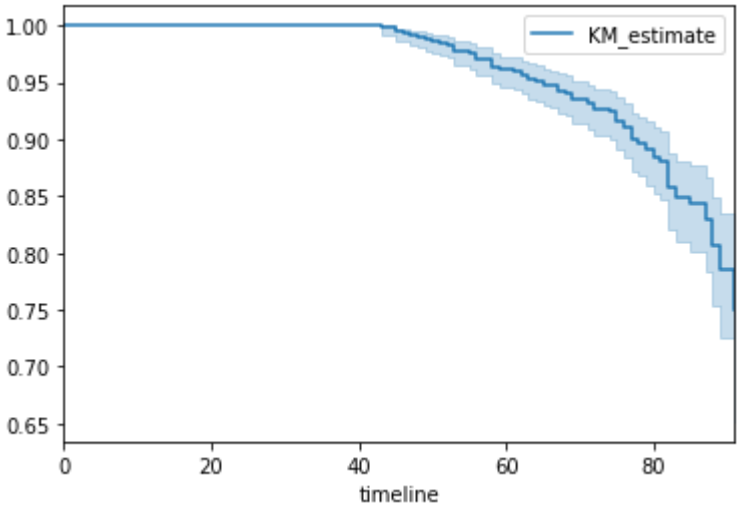
In [87]:
```
lf_df = life_grouped_no_na[['driver_id', 'event_observed','time_at_lyft.
```

In [88]:
```
from lifelines import KaplanMeierFitter
T = lf_df["time_at_lyft.mean"]
event_observed = lf_df["event_observed"]
kmf = KaplanMeierFitter()
kmf.fit(T, event_observed)
```

Out[88]:
```
<lifelines.KaplanMeierFitter: fitted with 937 observations, 854 censore
d>
```

In [89]:
```
kmf.plot_survival_function()
```

Out[89]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e361e1d0>
```



Higher number of suspensions, need to increase the "failed" cases through a different assumption

In [94]:
```
lf_df_cph = lf_df[['time_at_lyft.mean', 'event_observed','avg_ride_per_d
from lifelines import CoxPHFitter
cph = CoxPHFitter()
cph.fit(lf_df_cph, duration_col="time_at_lyft.mean", event_col="event_ob
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/lifelines/util
s/__init__.py:1040: ConvergenceWarning: Column avg_cost_per_ride_in_ten
ure have very low variance when conditioned on death event present or n
ot. This may harm convergence. This could be a form of 'complete separa
tion'. For example, try the following code:

>>> events = df['event_observed'].astype(bool)
>>> print(df.loc[events, 'avg_cost_per_ride_in_tenure'].var())
>>> print(df.loc[~events, 'avg_cost_per_ride_in_tenure'].var())

A very low variance means that the column avg_cost_per_ride_in_tenure c
ompletely determines whether a subject dies or not. See https://stats.s
tackexchange.com/questions/11109/how-to-deal-with-perfect-separation-in
-logistic-regression (https://stats.stackexchange.com/questions/11109/h
ow-to-deal-with-perfect-separation-in-logistic-regression)
  warnings.warn(dedent(warning_text), ConvergenceWarning)
/home/mancunian92/anaconda3/lib/python3.6/site-packages/lifelines/fitte
rs/coxph_fitter.py:570: ConvergenceWarning: Newton-Rhaphson failed to c
onverge sufficiently in 50 steps.
  "Newton-Rhaphson failed to converge sufficiently in %d steps." % max_
steps, ConvergenceWarning
```

Out[94]:
```
<lifelines.CoxPHFitter: fitted with 937 observations, 854 censored>
```

In [95]:
```
lf_df_cph.isna().apply(lambda x: sum(x))
```

Out[95]:
```
time_at_lyft.mean              0
event_observed                 0
avg_ride_per_day_in_tenure     0
avg_cost_per_ride_in_tenure    0
dtype: int64
```

In [96]:
```
cph.print_summary()
```

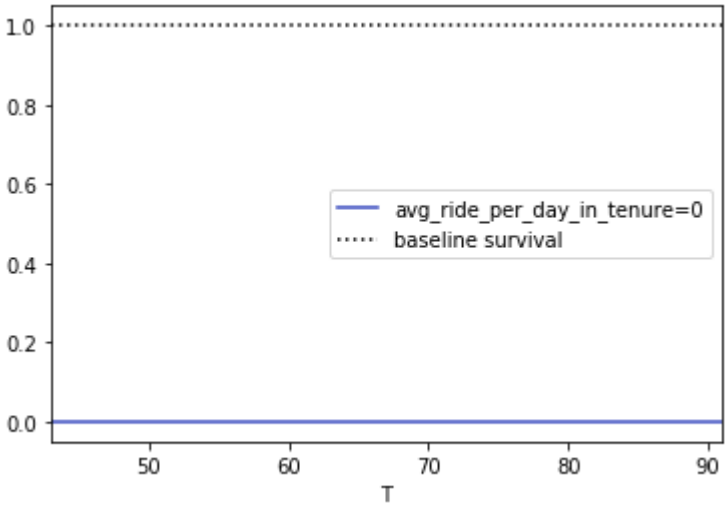
```
<lifelines.CoxPHFitter: fitted with 937 observations, 854 censored>
      duration col = 'time_at_lyft.mean'
         event col = 'event_observed'
number of subjects = 937
  number of events = 83
partial log-likelihood = -291.03
  time fit was run = 2019-09-15 19:39:17 UTC

---
                                coef exp(coef)  se(coef)  coef lower 95%
coef upper 95% exp(coef) lower 95% exp(coef) upper 95%
avg_ride_per_day_in_tenure  -16.60      0.00      9.95          -36.10
2.91                 0.00                18.38
avg_cost_per_ride_in_tenure   0.36      1.43      0.81           -1.23
1.95                 0.29                7.06

                                  z    p  -log2(p)
avg_ride_per_day_in_tenure  -1.67 0.10      3.39
avg_cost_per_ride_in_tenure  0.44 0.66      0.60
---
Concordance = 0.96
Log-likelihood ratio test = 420.86 on 2 df, -log2(p)=303.58
```

In [97]:
```
cph.plot_covariate_groups('avg_ride_per_day_in_tenure', range(0,1,3), cm
```

Out[97]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e486dd68>
```



In [98]:
```
# We need another definition of failed drivers .. so that it includes mo
```

In [99]:
```
full_df["day"].unique()
```

Out[99]:
```
array([23., 30., 21., 19., 17.,  2., 25., 10., 13., 16., 20., 22.,  1.,
        9., 27.,  6.,  5.,  7., 15.,  3., 24., 12., 14., 18., 28., 26.,
       29.,  8., 31.,  4., 11., nan])
```

In [100]:
```
full_df["month"].unique()
```

Out[100]:
```
array([ 4.,  3.,  6.,  5., nan])
```

In [101]:
```
sm_df = full_df.groupby(['driver_id', 'month', 'day']).size().reset_inde
```

In [102]:
```
min_date = min(full_df["requested_at_time"])
```

In [103]:
```
max_date = max(full_df["requested_at_time"])
```

In [104]:
```
sm_df[(sm_df.day ==min_date.day) & (sm_df.month == min_date.month)].shap
```

Out[104]:
```
0
```

In [105]:
```
def calculateMaxStreakAndTotalDaysUsed(driverId, df, min_date, max_date)
    # Returns a array if they ridden a ride in that day or not.
    currentStreak = 0
    maxStreak = 0
    totalDaysUsed = 0
    drv_df = full_df[full_df.driver_id==driverId]
    drv_df = drv_df.groupby(['month', 'day']).size().reset_index(drop=Fa
    drv_df.columns = ['month', 'day', 'cnt']
    if drv_df.shape[0] == 0:
       return (0,0)
    check_date = min_date
    while(check_date < max_date):
        if (drv_df[(drv_df.day ==check_date.day) & (drv_df.month == chec
            # This has rows
            currentStreak+=1
            totalDaysUsed+=1
        else:
            if currentStreak > maxStreak:
                maxStreak=currentStreak
            currentStreak=0
        check_date = check_date + timedelta(days=1)
    return maxStreak, totalDaysUsed
```

In [106]:
```
grouped_filtered["tuples"] = grouped_filtered["driver_id"].apply(lambda x
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:1: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  """Entry point for launching an IPython kernel.
```

In [107]:
```
grouped_filtered["maxStreak"] = grouped_filtered["tuples"].apply(lambda x
grouped_filtered["totalDaysAppUsed"] = grouped_filtered["tuples"].apply(
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:1: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  """Entry point for launching an IPython kernel.
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:2: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
```

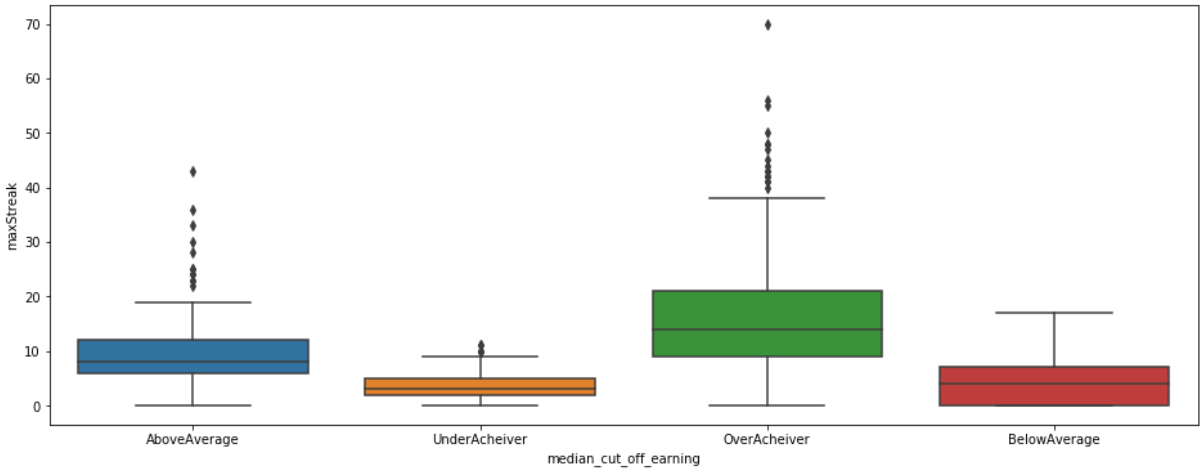
In [108]:
```
grouped_filtered.columns
```

Out[108]:
```
Index(['driver_id', 'ride_distance.mean', 'ride_distance.median',
       'ride_distance.size', 'ride_distance.sum', 'ride_duration.mean',
       'ride_duration.median', 'ride_duration.size', 'ride_duration.su
m',
       'ride_prime_time.mean', 'ride_prime_time.median',
       'ride_prime_time.size', 'ride_prime_time.sum', 'trip_cost.mean',
       'trip_cost.median', 'trip_cost.size', 'trip_cost.sum',
       'cumulative_ride_distance.mean', 'cumulative_ride_distance.media
n',
       'cumulative_ride_distance.size', 'cumulative_ride_distance.sum',
       'cumulative_ride_duration.mean', 'cumulative_ride_duration.media
n',
       'cumulative_ride_duration.size', 'cumulative_ride_duration.sum',
       'cumulative_ride_prime_time.mean', 'cumulative_ride_prime_time.m
edian',
       'cumulative_ride_prime_time.size', 'cumulative_ride_prime_time.s
um',
       'cumulative_trip_cost.mean', 'cumulative_trip_cost.median',
       'cumulative_trip_cost.size', 'cumulative_trip_cost.sum',
       'total_trips.mean', 'total_trips.median', 'total_trips.size',
       'total_trips.sum', 'time_to_accept.mean', 'time_to_accept.media
n',
       'time_to_accept.size', 'time_to_accept.sum', 'time_to_arrive.mea
n',
       'time_to_arrive.median', 'time_to_arrive.size', 'time_to_arrive.
sum',
       'time_for_customer_to_arrive.mean',
       'time_for_customer_to_arrive.median',
       'time_for_customer_to_arrive.size', 'time_for_customer_to_arriv
e.sum',
       'time_at_lyft.mean', 'time_at_lyft.median', 'time_at_lyft.size',
       'time_at_lyft.sum', 'prime_time_percent.mean',
       'prime_time_percent.median', 'prime_time_percent.size',
       'prime_time_percent.sum', 'month.mean', 'month.median', 'month.s
ize',
       'month.sum', 'day.mean', 'day.median', 'day.size', 'day.sum',
       'is_weekend_rush.mean', 'is_weekend_rush.median',
       'is_weekend_rush.size', 'is_weekend_rush.sum', 'earnings_per_da
y',
       'avg_rides_per_day', 'median_cut_off_earning', 'mean_cut_off_ear
ning',
       'tuples', 'maxStreak', 'totalDaysAppUsed'],
      dtype='object')
```

In [109]:
```
cols_to_merge = grouped_filtered[['driver_id', 'maxStreak', 'totalDaysAp
time_grouped_merged = time_grouped_merged.merge(cols_to_merge, on="drive
```

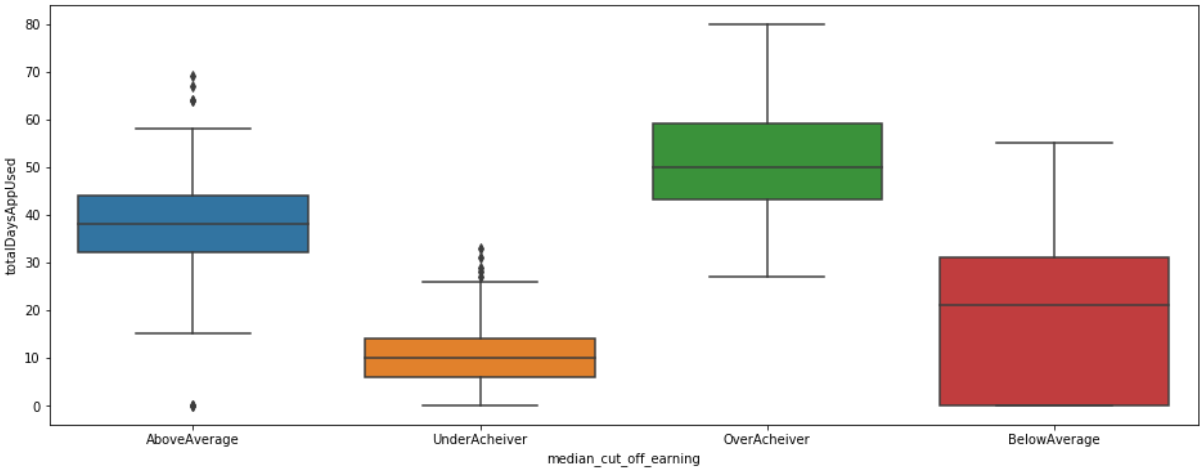
In [110]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="maxStr
```

Out[110]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e3405518>
```



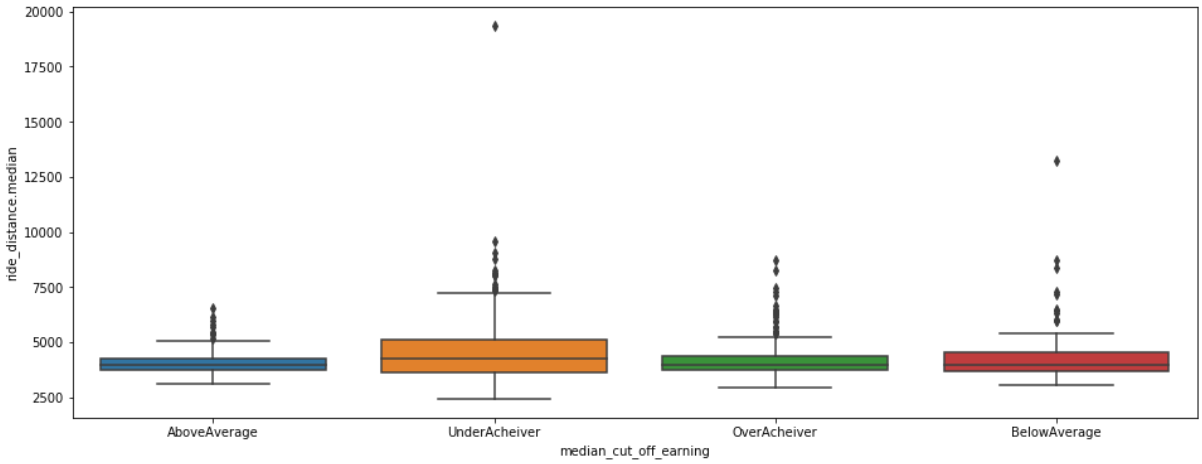
In [111]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="totalD
```

Out[111]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1e486dcf8>
```



In [194]:
```
plt.figure(figsize=(16, 6))
sns.boxplot(data=grouped_filtered, x="median_cut_off_earning", y="ride_d
```

Out[194]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd1d9762b00>
```



There is a clear distinction in rewards (money made in app) to total days

In [112]:
```
grouped_filtered["active_percent"] = (grouped_filtered["totalDaysAppUsed
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:1: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  """Entry point for launching an IPython kernel.
```

In [113]:
```
river_id", "ride_distance.sum", "ride_duration.sum", "ride_prime_time.mea
_df_iter_1.apply(lambda x: True if ((x["active_percent"] <= 0.2) & (x["ti
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:2: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
```

In [114]:
```
# We want to add the drivers with no ride here as well . Filling in the
failed_cases_no_rides = grouped_full[grouped_full["driver_id"].isin(no_r
```

In [115]:
```
# Filling in the defaults for
failed_cases_no_rides['ride_distance.sum'] = 0
failed_cases_no_rides['ride_duration.sum'] = 0
failed_cases_no_rides['ride_prime_time.mean']=0
failed_cases_no_rides['is_weekend_rush.mean']=0
failed_cases_no_rides['time_to_arrive.median']=0
failed_cases_no_rides['earnings_per_day']=0
failed_cases_no_rides['avg_rides_per_day']=0
failed_cases_no_rides['maxStreak']=0
failed_cases_no_rides['active_percent']=0
failed_cases_no_rides['event_observed']=True
```

In [116]:
```
lf_df_1_merged = pd.concat([lf_df_iter_1, failed_cases_no_rides])
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:1: FutureWarning: Sorting because non-concatenation axis is not
aligned. A future version
of pandas will change to not sort by default.

To accept the future behavior, pass 'sort=False'.

To retain the current behavior and silence the warning, pass 'sort=Tru
e'.

  """Entry point for launching an IPython kernel.
```

In [160]:
```
test_set = lf_df_1_merged[lf_df_1_merged["time_at_lyft.mean"].isna()]
```

In [161]:
```
train_set = lf_df_1_merged.dropna(subset=["time_at_lyft.mean"])
```

In [162]:
```
train_set["time_to_arrive.median"] = train_set["time_to_arrive.median"].
```

```
/home/mancunian92/anaconda3/lib/python3.6/site-packages/ipykernel_launc
her.py:1: SettingWithCopyWarning:
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: http://pandas.pydata.org/pandas-d
ocs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (htt
p://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retur
ning-a-view-versus-a-copy)
  """Entry point for launching an IPython kernel.
```

In [163]:
```
wbf = WeibullFitter().fit(train_set["time_at_lyft.mean"], train_set["eve
```

In [164]:
```
wbf.median_
```

Out[164]:
```
84.39269120112603
```

In [201]:
```
np.nanmedian(grouped_filtered["time_at_lyft.median"])
```

Out[201]:
```
69.0
```

In [165]:
```
 driver, (unconditional survival) will last 85 days. (By this dataset). A
```

In [174]:
```
grouped_filtered.columns
```

Out[174]:
```
Index(['driver_id', 'ride_distance.mean', 'ride_distance.median',
       'ride_distance.size', 'ride_distance.sum', 'ride_duration.mean',
       'ride_duration.median', 'ride_duration.size', 'ride_duration.su
m',
       'ride_prime_time.mean', 'ride_prime_time.median',
       'ride_prime_time.size', 'ride_prime_time.sum', 'trip_cost.mean',
       'trip_cost.median', 'trip_cost.size', 'trip_cost.sum',
       'cumulative_ride_distance.mean', 'cumulative_ride_distance.media
n',
       'cumulative_ride_distance.size', 'cumulative_ride_distance.sum',
       'cumulative_ride_duration.mean', 'cumulative_ride_duration.media
n',
       'cumulative_ride_duration.size', 'cumulative_ride_duration.sum',
       'cumulative_ride_prime_time.mean', 'cumulative_ride_prime_time.m
edian',
       'cumulative_ride_prime_time.size', 'cumulative_ride_prime_time.s
um',
       'cumulative_trip_cost.mean', 'cumulative_trip_cost.median',
       'cumulative_trip_cost.size', 'cumulative_trip_cost.sum',
       'total_trips.mean', 'total_trips.median', 'total_trips.size',
       'total_trips.sum', 'time_to_accept.mean', 'time_to_accept.media
n',
       'time_to_accept.size', 'time_to_accept.sum', 'time_to_arrive.mea
n',
       'time_to_arrive.median', 'time_to_arrive.size', 'time_to_arrive.
sum',
       'time_for_customer_to_arrive.mean',
       'time_for_customer_to_arrive.median',
       'time_for_customer_to_arrive.size', 'time_for_customer_to_arriv
e.sum',
       'time_at_lyft.mean', 'time_at_lyft.median', 'time_at_lyft.size',
       'time_at_lyft.sum', 'prime_time_percent.mean',
       'prime_time_percent.median', 'prime_time_percent.size',
       'prime_time_percent.sum', 'month.mean', 'month.median', 'month.s
ize',
       'month.sum', 'day.mean', 'day.median', 'day.size', 'day.sum',
       'is_weekend_rush.mean', 'is_weekend_rush.median',
       'is_weekend_rush.size', 'is_weekend_rush.sum', 'earnings_per_da
y',
       'avg_rides_per_day', 'median_cut_off_earning', 'mean_cut_off_ear
ning',
       'tuples', 'maxStreak', 'totalDaysAppUsed', 'active_percent'],
      dtype='object')
```

Lifetime value of a customer

In [176]:
```
avg_earnings_per_day = np.mean(grouped_filtered["earnings_per_day"])
```

In [177]:
```
avg_rides = np.mean(grouped_filtered["avg_rides_per_day"])
```

In [178]:
```
avg_value = avg_earnings_per_day * avg_rides
```

In [179]:
```
avg_value
```

Out[179]: 126.0022702453533

In [180]:
```
avg_app_used = np.mean(grouped_filtered["totalDaysAppUsed"])
```

In [182]:
```
# Over a 90 Day span
```

In [181]:
```
avg_value * avg_app_used
```

Out[181]: 3593.149051180192

In [190]:
```
avg_earnings_per_day
```

Out[190]: 38.77044830438618

In [191]:
```
avg_rides
```

Out[191]: 3.2499564940831083

In [192]:
```
avg_app_used
```

Out[192]: 28.516542155816435

In [ ]:
```

```