In [194]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from datetime import datetime
import itertools
import copy
import json
import math
from collections import OrderedDict
import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

In [195]:

```
df = pd.read_csv("/Users/sreechandanakurella/Documents/Data Mining/Project-2/201707-citibike-tripdata.cs
df.head()
```

Out[195]:

	tripduration	starttime	stoptime	start station id	start station name	start station latitude	start station longitude	end station id	end station name	end station latitude	end station longitude	bik
0	364	2017-07-01 00:00:00	2017-07-01 00:06:05	539	Metropolitan Ave & Bedford Ave	40.715348	-73.960241	3107	Bedford Ave & Nassau Ave	40.723117	-73.952123	14
1	2142	2017-07-01 00:00:03	2017-07-01 00:35:46	293	Lafayette St & E 8 St	40.730207	-73.991026	3425	2 Ave & E 104 St	40.789211	-73.943708	19
2	328	2017-07-01 00:00:08	2017-07-01 00:05:37	3242	Schermerhorn St & Court St	40.691029	-73.991834	3397	Court St & Nelson St	40.676395	-73.998699	27
3	2530	2017-07-01 00:00:11	2017-07-01 00:42:22	2002	Wythe Ave & Metropolitan Ave	40.716887	-73.963198	398	Atlantic Ave & Furman St	40.691652	-73.999979	26
4	2534	2017-07-01 00:00:15	2017-07-01 00:42:29	2002	Wythe Ave & Metropolitan Ave	40.716887	-73.963198	398	Atlantic Ave & Furman St	40.691652	-73.999979	29

In [196]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1735599 entries, 0 to 1735598
Data columns (total 15 columns):
 #   Column                   Dtype  
---  ------                   -----  
 0   tripduration             int64  
 1   starttime                object 
 2   stoptime                 object 
 3   start station id         int64  
 4   start station name       object 
 5   start station latitude   float64
 6   start station longitude  float64
 7   end station id           int64  
 8   end station name         object 
 9   end station latitude     float64
 10  end station longitude    float64
 11  bikeid                   int64  
 12  usertype                 object 
 13  birth year               float64
 14  gender                   int64  
dtypes: float64(5), int64(5), object(5)
memory usage: 198.6+ MB
```

In [197]:

```
df.shape
```

Out[197]:

```
(1735599, 15)
```

In [198]:

```
df.isnull().sum()
```

Out[198]:

```
tripduration                     0
starttime                        0
stoptime                         0
start station id                 0
start station name               0
start station latitude           0
start station longitude          0
end station id                   0
end station name                 0
end station latitude             0
end station longitude            0
bikeid                           0
usertype                         0
birth year                  228596
gender                           0
dtype: int64
```

In [199]:

```
df = df.dropna(axis=1, how='any')
df.shape
```

Out[199]:

```
(1735599, 14)
```

In [200]:

```
df = df[df['tripduration'] <= 24*60*60*20]
```

In [201]:

```
x1 = len(df['start station id'].unique())
y1 = len(df[['start station id', 'start station name']].drop_duplicates())
x2 = len(df['end station id'].unique())
y2 = len(df[['end station id', 'end station name']].drop_duplicates())

x1 == y1 and x2 == y2
```

Out[201]:

```
True
```

In [202]:

```
x1 = len(df['start station id'].unique())
y2 = len(df[['start station id', 'start station latitude']].drop_duplicates())
x2 = len(df['end station id'].unique())
y2 = len(df[['end station id', 'end station latitude']].drop_duplicates())

x1 == y1 and x2 == y2
```

Out[202]:

```
True
```

In [203]:

```
x1 = len(df['start station id'].unique())
y2 = len(df[['start station id', 'start station longitude']].drop_duplicates())
x2 = len(df['end station id'].unique())
y2 = len(df[['end station id', 'end station longitude']].drop_duplicates())

x1 == y1 and x2 == y2
```

Out[203]:

```
True
```

In [204]:

```
t1 = df[['start station id', 'start station name', 'start station latitude', 'start station longitude']]
            .drop_duplicates().rename(columns = {'start station id':'station id', \
                                                 'start station name':'station name', \
                                                 'start station latitude':'station latitude',
                                                 'start station longitude': 'station longitude'})
t2 = df[['end station id', 'end station name', 'end station latitude', 'end station longitude']] \
        .drop_duplicates().rename(columns = {'end station id':'station id', \
                                             'end station name':'station name', \
                                             'end station latitude':'station latitude', \
                                             'end station longitude': 'station longitude'})
df_loc = pd.concat([t1, t2]).drop_duplicates()
```

In [205]:

```
df = df[df['start station id']!=3036]
df = df[df['end station id']!=3036]
df_loc = df_loc[df_loc['station id']!=3036]
df_loc.head()
```

Out[205]:

	station id	station name	station latitude	station longitude
0	539	Metropolitan Ave & Bedford Ave	40.715348	-73.960241
1	293	Lafayette St & E 8 St	40.730207	-73.991026
2	3242	Schermerhorn St & Court St	40.691029	-73.991834
3	2002	Wythe Ave & Metropolitan Ave	40.716887	-73.963198
5	361	Allen St & Hester St	40.716059	-73.991908

In [206]:

```
df['starttime'] = pd.to_datetime(df['starttime'], format='%Y-%m-%d %H:%M:%S')
df['stoptime'] =pd.to_datetime(df['stoptime'], format='%Y-%m-%d %H:%M:%S')
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1735591 entries, 0 to 1735598
Data columns (total 14 columns):
 #   Column                   Dtype         
---  ------                   -----         
 0   tripduration             int64         
 1   starttime                datetime64[ns]
 2   stoptime                 datetime64[ns]
 3   start station id         int64         
 4   start station name       object        
 5   start station latitude   float64       
 6   start station longitude  float64       
 7   end station id           int64         
 8   end station name         object        
 9   end station latitude     float64       
 10  end station longitude    float64       
 11  bikeid                   int64         
 12  usertype                 object        
 13  gender                   int64         
dtypes: datetime64[ns](2), float64(4), int64(5), object(3)
memory usage: 198.6+ MB
```

In [207]:

```
def gen_time_segment(dt):
    if dt.minute < 30:
        minute = "%02d" % 0
    else:
        minute = "%02d" % 30
    return "{}-{}-{} {}:{}".format(dt.year, dt.month, dt.day, dt.hour, minute)

df['start_seg'] = [gen_time_segment(dt) for dt in df['starttime']]
df['stop_seg'] = [gen_time_segment(dt) for dt in df['stoptime']]

df[['start station id', 'starttime', 'start_seg', 'end station id', 'stoptime', 'stop_seg']].head()
```

Out[207]:

	start station id	starttime	start_seg	end station id	stoptime	stop_seg
0	539	2017-07-01 00:00:00	2017-7-1 0:00	3107	2017-07-01 00:06:05	2017-7-1 0:00
1	293	2017-07-01 00:00:03	2017-7-1 0:00	3425	2017-07-01 00:35:46	2017-7-1 0:30
2	3242	2017-07-01 00:00:08	2017-7-1 0:00	3397	2017-07-01 00:05:37	2017-7-1 0:00
3	2002	2017-07-01 00:00:11	2017-7-1 0:00	398	2017-07-01 00:42:22	2017-7-1 0:30
4	2002	2017-07-01 00:00:15	2017-7-1 0:00	398	2017-07-01 00:42:29	2017-7-1 0:30

In [208]:

```
inflow = df[['end station id', 'stop_seg']] \
            .groupby(['end station id', 'stop_seg']) \
            .size().reset_index(name='counts') \
            .rename(columns={'end station id':'station id','stop_seg':'time', 'counts':'in_flow_count'})

outflow = df[['start station id', 'start_seg']] \
            .groupby(['start station id', 'start_seg']) \
            .size().reset_index(name='counts') \
            .rename(columns={'start station id':'station id','start_seg':'time', 'counts':'out_flow_coun
```

In [209]:

```
station_id_list = list(df_loc['station id'])

# Create combinations of time series and station ids
time_seg_list = list(pd.date_range("2017-07-01 00:00:00", "2017-07-31 23:30:00", freq="30min"))
template = pd.DataFrame(list(itertools.product(station_id_list, time_seg_list)), \
                        columns=["station id", "time"])

# Merge in/out flow information & Add zeros to missing data according to every time segment
df_flow = pd.merge(inflow, outflow, on=['station id', 'time'], how='outer')
df_flow['time'] = pd.to_datetime(df_flow['time'], format='%Y-%m-%d %H:%M')
df_flow = df_flow.merge(template, on=["station id", "time"], how="right").fillna(0)
df_flow.head()
```

Out[209]:

	station id	time	in_flow_count	out_flow_count
0	539	2017-07-01 00:00:00	1.0	1.0
1	539	2017-07-01 00:30:00	0.0	5.0
2	539	2017-07-01 01:00:00	0.0	0.0
3	539	2017-07-01 01:30:00	0.0	0.0
4	539	2017-07-01 02:00:00	1.0	3.0

In [210]:

```
pip install apyori
```

```
Requirement already satisfied: apyori in /Users/sreechandanakurella/anaconda3/lib/python3.1
0/site-packages (1.1.2)
Note: you may need to restart the kernel to use updated packages.
```

In [211]:

```
from apyori import apriori

def apriori_find_association_rules(dataset, minsup, minconf):
    records = list(apriori(dataset, min_support=minsup, min_confidence=minconf))
    return records

def apriori_show_mining_results(records):
    ap = []
    for record in records:
        converted_record = record._replace(ordered_statistics=[x._asdict() for x in record.ordered_stati
        ap.append(converted_record._asdict())

    print("Frequent Itemsets:\n------------------")
    for ptn in ap:
        print('({})  support = {}'.format(", ".join(ptn["items"]), round(ptn["support"], 3)))
    print()
    print("Rules:\n------")
    for ptn in ap:
        for rule in ptn["ordered_statistics"]:
            head = rule["items_base"]
            tail = rule["items_add"]
            if len(head) == 0 or len(tail) == 0:
                continue
            confidence = rule["confidence"]
            print('({}) ==> ({})  confidence = {}'.format(', '.join(head), ', '.join(tail), round(confid
    print()
```

Find Rules between in-flow and out-flow of Station 519

In [212]:

```
dat = df_flow[df_flow['station id'] == 519][['in_flow_count', 'out_flow_count']]
dat.head(5)
```

Out[212]:

	in_flow_count	out_flow_count
255936	3.0	1.0
255937	1.0	1.0
255938	2.0	2.0
255939	1.0	2.0
255940	0.0	1.0

In [213]:

```
pd.isnull(dat).sum()
```

Out[213]:

```
in_flow_count     0
out_flow_count    0
dtype: int64
```

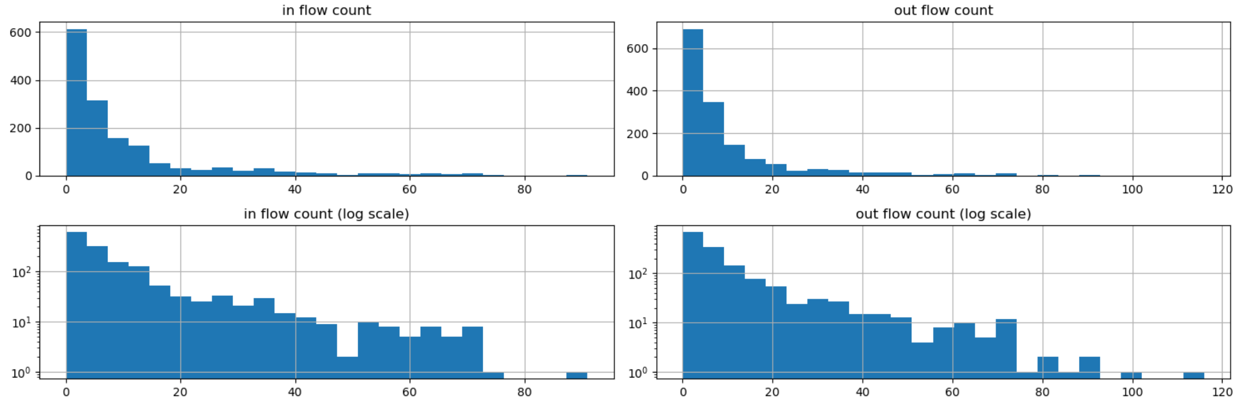
In [214]:

```
print("Min: {}\nMax: {}".format(dat.values.min(), dat.values.max()))
```

```
Min: 0.0
Max: 116.0
```

In [215]:

```
fig, axes = plt.subplots(nrows=2, ncols=2, figsize=(15,5))

ax = plt.subplot(2, 2, 1)
dat['in_flow_count'].hist(bins=25)
ax.set_title("in flow count")

ax = plt.subplot(2, 2, 2)
dat['out_flow_count'].hist(bins=25)
ax.set_title("out flow count")

ax = plt.subplot(2, 2, 3)
ax.set_yscale('log')
dat['in_flow_count'].hist(bins=25)
ax.set_title("in flow count (log scale)")

ax = plt.subplot(2, 2, 4)
ax.set_yscale('log')
dat['out_flow_count'].hist(bins=25)
ax.set_title("out flow count (log scale)")

fig.tight_layout()
```



In [216]:

```
dat_1 = copy.deepcopy(dat)
```

In [217]:

```
dat_1['in_flow_count'] = pd.cut(dat_1['in_flow_count'], bins = 5, \
                                labels = ["in.level-1", "in.level-2", "in.level-3", \
                                          "in.level-4", "in.level-5"]).astype(str)
pd.cut(dat['in_flow_count'], bins = 5).value_counts()
```

Out[217]:

```
(-0.091, 18.2]    1263
(18.2, 36.4]       141
(36.4, 54.6]        48
(54.6, 72.8]        34
(72.8, 91.0]         2
Name: in_flow_count, dtype: int64
```

In [218]:

```
dat_1['out_flow_count'] = pd.cut(dat_1['out_flow_count'], bins = 5, \
                                labels = ["out.level-1", "out.level-2", "out.level-3", \
                                          "out.level-4", "out.level-5"]).astype(str)
pd.cut(dat['out_flow_count'], bins = 5).value_counts()
```

Out[218]:

```
(-0.116, 23.2]    1317
(23.2, 46.4]       111
(46.4, 69.6]        40
(69.6, 92.8]        18
(92.8, 116.0]        2
Name: out_flow_count, dtype: int64
```

In [219]:

```
dat_2 = copy.deepcopy(dat)
```

In [220]:

```
dat_2['in_flow_count'] = pd.qcut(dat_2['in_flow_count'], q = 5, \
                                 labels = ["in.zero", "in.extreme-low", "in.low", \
                                           "in.medium", "in.high"]).astype(str)
pd.qcut(dat['in_flow_count'], q = 5).value_counts()
```

Out[220]:

```
(-0.001, 1.0]    403
(3.0, 7.0]       315
(7.0, 14.0]      283
(14.0, 91.0]     278
(1.0, 3.0]       209
Name: in_flow_count, dtype: int64
```

In [221]:

```
dat_2['out_flow_count'] = pd.qcut(dat_2['out_flow_count'], q = 5, \
                                 labels = ["out.zero", "out.extreme-low", "out.low", \
                                           "out.medium", "out.high"]).astype(str)
pd.qcut(dat['out_flow_count'], q = 5).value_counts()
```

Out[221]:

```
(-0.001, 1.0]    423
(3.0, 7.0]       307
(7.0, 14.0]      292
(14.0, 116.0]    284
(1.0, 3.0]       182
Name: out_flow_count, dtype: int64
```

In [222]:

```
%%time
print("Apriori\n********")
ap = apriori_find_association_rules(dat_1.values.tolist(), 0.1, 0.2)
```

```
Apriori
********
CPU times: user 1.37 ms, sys: 298 µs, total: 1.67 ms
Wall time: 1.97 ms
```

In [223]:

```
apriori_show_mining_results(ap)
```

```
Frequent Itemsets:
------------------
(in.level-1)  support = 0.849
(out.level-1)  support = 0.885
(out.level-1, in.level-1)  support = 0.847

Rules:
------
(in.level-1) ==> (out.level-1)  confidence = 0.998
(out.level-1) ==> (in.level-1)  confidence = 0.957
```

In [224]:

```
%%time
print("Apriori\n********")
ap = apriori_find_association_rules(dat_2.values.tolist(), 0.1, 0.2)
```

```
Apriori
********
CPU times: user 1.58 ms, sys: 150 µs, total: 1.73 ms
Wall time: 1.92 ms
```

In [225]:

```
apriori_show_mining_results(ap)
```

```
Frequent Itemsets:
------------------
(in.low)  support = 0.212
(in.zero)  support = 0.271
(out.low)  support = 0.206
(out.zero)  support = 0.284
(out.high, in.high)  support = 0.164
(in.medium, out.medium)  support = 0.101
(out.zero, in.zero)  support = 0.222

Rules:
------
(in.high) ==> (out.high)  confidence = 0.878
(out.high) ==> (in.high)  confidence = 0.859
(in.medium) ==> (out.medium)  confidence = 0.53
(out.medium) ==> (in.medium)  confidence = 0.514
(in.zero) ==> (out.zero)  confidence = 0.821
(out.zero) ==> (in.zero)  confidence = 0.783
```

Find Rules between Time of a Day and Flows of station 519

In [226]:

```
dat = df_flow[df_flow['station id'] == 519][['time', 'in_flow_count', 'out_flow_count']]
dat['flow_count'] = dat['in_flow_count'] + dat['out_flow_count']
dat['time'] = ["{:02d}:{:02d}".format(dt.hour, dt.minute) for dt in dat['time']]
dat = dat[['time', 'flow_count']]
dat.head(5)
```

Out[226]:

	time	flow_count
255936	00:00	4.0
255937	00:30	2.0
255938	01:00	4.0
255939	01:30	3.0
255940	02:00	1.0

In [227]:

```
dat_1 = copy.deepcopy(dat)
```

In [228]:

```
dat_1['time'] = ["{:02d}:00~{:02d}:00".format(math.floor(int(dt.split('~')[0].split(':')[0])/2)*2, math.
dat_1['time'] = dat_1['time'].astype(str)
```

In [229]:

```
dat_1['flow_count'] = pd.qcut(dat_1['flow_count'], q = 3, \
                                labels = ["low", "medium", "high"]).astype(str)

pd.qcut(dat['flow_count'], q = 3).value_counts()
```

Out[229]:

```
(-0.001, 5.0]    521
(17.0, 185.0]    486
(5.0, 17.0]      481
Name: flow_count, dtype: int64
```

In [230]:

```
dat_2 = copy.deepcopy(dat)
```

In [231]:

```
mapping = ["Night"] * 6 + ["Morning"] * 5 + ["Noon"] * 2 + ["Afternoon"] * 3 + ["Evening"] * 6 + ["Night

# Filter out rows with invalid time data
dat_2 = dat_2[dat_2['time'].str.match(r'^\d{2}:\d{2}$')]

dat_2['time'] = [mapping[math.floor(datetime.strptime(dt, '%H:%M').hour)] for dt in dat_2['time']]
```

In [232]:

```
dat_2['flow_count'] = pd.qcut(dat_2['flow_count'], q = 3, \
                              labels = ["low", "medium", "high"]).astype(str)

pd.qcut(dat['flow_count'], q = 3).value_counts()
```

Out[232]:

```
(-0.001, 5.0]     521
(17.0, 185.0]     486
(5.0, 17.0]       481
Name: flow_count, dtype: int64
```

In [233]:

```
%%time
print("Apriori\n********")
ap = apriori_find_association_rules(dat_1.values.tolist(), 0.05, 0.6)
```

```
Apriori
********
CPU times: user 1.71 ms, sys: 313 µs, total: 2.02 ms
Wall time: 1.77 ms
```

In [234]:

```
apriori_show_mining_results(ap)
```

```
Frequent Itemsets:
------------------
(low, 00:00~02:00)  support = 0.075
(02:00~04:00, low)  support = 0.083
(04:00~06:00, low)  support = 0.071
(high, 08:00~10:00)  support = 0.053
(medium, 12:00~14:00)  support = 0.055
(16:00~18:00, high)  support = 0.065
(18:00~20:00, high)  support = 0.054

Rules:
------
(00:00~02:00) ==> (low)  confidence = 0.903
(02:00~04:00) ==> (low)  confidence = 0.992
(04:00~06:00) ==> (low)  confidence = 0.855
(08:00~10:00) ==> (high)  confidence = 0.637
(12:00~14:00) ==> (medium)  confidence = 0.661
(16:00~18:00) ==> (high)  confidence = 0.774
(18:00~20:00) ==> (high)  confidence = 0.645
```

In [235]:

```
%%time
print("Apriori\n********")
ap = apriori_find_association_rules(dat_2.values.tolist(), 0.05, 0.6)
```

```
Apriori
********
CPU times: user 1.9 ms, sys: 81 µs, total: 1.98 ms
Wall time: 2.17 ms
```

In [236]:

```
apriori_show_mining_results(ap)
```

```
Frequent Itemsets:
------------------
(Night, low)  support = 0.279
(Noon, medium)  support = 0.052

Rules:
------
(Night) ==> (low)  confidence = 0.837
(low) ==> (Night)  confidence = 0.797
(Noon) ==> (medium)  confidence = 0.621
```

Find Rules between Station Locations and Their Daily Flows

In [237]:

```
dat = pd.merge(df_flow, df_loc, on=['station id'], how='left')
dat['flow_count'] = dat['in_flow_count'] + dat['out_flow_count']
dat['day'] = [dt.day for dt in dat['time']]
dat = dat.groupby(['station latitude', 'station longitude', "day"], as_index=False) \
            .agg({'flow_count': 'sum'})
dat = dat[['station latitude', 'station longitude', 'flow_count']]
dat.head(5)
```

Out[237]:

	station latitude	station longitude	flow_count
0	40.6554	-74.010628	0.0
1	40.6554	-74.010628	0.0
2	40.6554	-74.010628	0.0
3	40.6554	-74.010628	0.0
4	40.6554	-74.010628	0.0

In [238]:

```
pd.cut(dat['station latitude'], bins = 5).value_counts()
```

Out[238]:

```
(40.715, 40.745]    5425
(40.685, 40.715]    4805
(40.745, 40.774]    3968
(40.655, 40.685]    2945
(40.774, 40.804]    2480
Name: station latitude, dtype: int64
```

In [239]:

```
pd.cut(dat['station longitude'], bins = 5).value_counts()
```

Out[239]:

```
(-74.012, -73.985]    7626
(-73.985, -73.957]    7347
(-73.957, -73.93]     3875
(-74.04, -74.012]      651
(-74.067, -74.04]      124
Name: station longitude, dtype: int64
```

In [240]:

```
dat_1 = copy.deepcopy(dat)
```

In [241]:

```
dat_1['station latitude'] = pd.cut(dat_1['station latitude'], bins = 5).astype(str)
dat_1['station latitude'] = "latitude = " + dat_1['station latitude']
dat_1['station longitude'] = pd.cut(dat_1['station longitude'], bins = 5).astype(str)
dat_1['station longitude'] = "longitude = "+ dat_1['station longitude']
```

In [242]:

```
dat_1['flow_count'] = pd.qcut(dat_1['flow_count'], q = 5, \
                              labels = ["extreme-low", "low", "medium", "high", "extreme-high"]).astype(s
pd.qcut(dat['flow_count'], q = 5).value_counts()
```

Out[242]:

```
(-0.001, 51.0]     3943
(51.0, 96.0]       3939
(163.0, 286.0]     3923
(286.0, 1532.0]    3919
(96.0, 163.0]      3899
Name: flow_count, dtype: int64
```

In [243]:

```
pd.qcut(dat['station latitude'], q = 5).value_counts()
```

Out[243]:

```
(40.654, 40.691]    3937
(40.691, 40.715]    3937
(40.735, 40.762]    3937
(40.715, 40.735]    3906
(40.762, 40.804]    3906
Name: station latitude, dtype: int64
```

In [244]:

```
pd.qcut(dat['station longitude'], q = 5).value_counts()
```

Out[244]:

```
(-74.068, -73.998]    3937
(-73.998, -73.987]    3937
(-73.976, -73.957]    3937
(-73.987, -73.976]    3906
(-73.957, -73.93]     3906
Name: station longitude, dtype: int64
```

In [245]:

```
dat_2 = copy.deepcopy(dat)
```

In [246]:

```
dat_2['station latitude'] = pd.qcut(dat_2['station latitude'], q = 5).astype(str)
dat_2['station latitude'] = "latitude = " + dat_2['station latitude']
dat_2['station longitude'] = pd.qcut(dat_2['station longitude'], q = 5).astype(str)
dat_2['station longitude'] = "longitude = "+ dat_2['station longitude']
```

In [247]:

```
dat_2['flow_count'] = pd.qcut(dat_2['flow_count'], q = 5, \
                              labels = ["extreme-low", "low", "medium", "high", "extreme-high"]).astype(s
pd.qcut(dat['flow_count'], q = 5).value_counts()
```

Out[247]:

```
(-0.001, 51.0]     3943
(51.0, 96.0]       3939
(163.0, 286.0]     3923
(286.0, 1532.0]    3919
(96.0, 163.0]      3899
Name: flow_count, dtype: int64
```

In [248]:

```
%%time
print("Apriori\n********")
ap = apriori_find_association_rules(dat_1.values.tolist(), 0.08, 0.4)
```

```
Apriori
********
CPU times: user 22.2 ms, sys: 1.49 ms, total: 23.7 ms
Wall time: 23 ms
```

In [249]:

```
apriori_show_mining_results(ap)
```

```
Frequent Itemsets:
------------------
(latitude = (40.715, 40.745], extreme-high)  support = 0.106
(longitude = (-74.012, -73.985], extreme-high)  support = 0.128
(longitude = (-74.012, -73.985], high)  support = 0.105
(longitude = (-74.012, -73.985], latitude = (40.715, 40.745])  support = 0.142
(longitude = (-73.985, -73.957], latitude = (40.745, 40.774])  support = 0.1
(low, longitude = (-73.985, -73.957])  support = 0.094
(medium, longitude = (-73.985, -73.957])  support = 0.097

Rules:
------
(extreme-high) ==> (latitude = (40.715, 40.745])  confidence = 0.529
(extreme-high) ==> (longitude = (-74.012, -73.985])  confidence = 0.64
(high) ==> (longitude = (-74.012, -73.985])  confidence = 0.526
(latitude = (40.715, 40.745]) ==> (longitude = (-74.012, -73.985])  confidence = 0.514
(latitude = (40.745, 40.774]) ==> (longitude = (-73.985, -73.957])  confidence = 0.492
(low) ==> (longitude = (-73.985, -73.957])  confidence = 0.469
(medium) ==> (longitude = (-73.985, -73.957])  confidence = 0.488
```

In [250]:

```
%%time
print("Apriori\n********")
ap = apriori_find_association_rules(dat_2.values.tolist(), 0.08, 0.4)
```

```
Apriori
********
CPU times: user 23.4 ms, sys: 1.26 ms, total: 24.7 ms
Wall time: 24.1 ms
```

In [251]:

```
apriori_show_mining_results(ap)
```

```
Frequent Itemsets:
------------------
(extreme-high, latitude = (40.735, 40.762])  support = 0.09
(extreme-low, latitude = (40.654, 40.691])  support = 0.081

Rules:
------
(extreme-high) ==> (latitude = (40.735, 40.762])  confidence = 0.451
(latitude = (40.735, 40.762]) ==> (extreme-high)  confidence = 0.449
(extreme-low) ==> (latitude = (40.654, 40.691])  confidence = 0.403
(latitude = (40.654, 40.691]) ==> (extreme-low)  confidence = 0.404
```