作业1: 数据探索性分析与数据预处理

二、 Oakland Crime Statistics 2011 to 2016

1、数据说明

In [21]:
```
%matplotlib inline
import matplotlib
import matplotlib.pyplot as plt
import pandas as pd
import tqdm
import numpy as np
from sklearn.linear_model import LinearRegression
import scipy.stats as stats
import warnings
warnings.filterwarnings('ignore')
```

载入数据

In [50]:
```
path_list = []
for i in range(2011, 2012):
    path_list.append("./crime/oakland-crime-statistics-2011-to-2016/records
data = []
for path in path_list:
    data.append(pd.read_csv(path))
data = pd.concat(data)
```

数据的属性

In [51]:
```
print('属性类别数:', len(data.columns))
print('总行数:', len(data))
print('示例数据:')
data.head(5)
```

属性类别数： 10
总行数： 180016
示例数据：

Out[51]:

	Agency	Create Time	Location	Area Id	Beat	Priority	Incident Type Id	Incident Type Description	I
0	OP	2011-01-01T00:00:00.000	ST&SAN PABLO AV	1.0	06X	1.0	PDOA	POSSIBLE DEAD PERSON	LOP
1	OP	2011-01-01T00:01:11.000	ST&HANNAH ST	1.0	07X	1.0	415GS	415 GUNSHOTS	LOP
2	OP	2011-01-01T00:01:25.000	ST&MARKET ST	1.0	10Y	2.0	415GS	415 GUNSHOTS	LOP
3	OP	2011-01-01T00:01:35.000	PRENTISS ST	2.0	21Y	2.0	415GS	415 GUNSHOTS	LOP
4	OP	2011-01-01T00:02:10.000	AV&FOOTHILL BLVD	2.0	20X	1.0	415GS	415 GUNSHOTS	LOP

2、数值摘要

In [52]:

```
num_fields = data.select_dtypes(include=np.number).columns.values
nom_fields = data.select_dtypes(exclude=np.number).columns.values
print('标称属性:', nom_fields)
print('数值属性:', num_fields)
```

```
标称属性: ['Agency' 'Create Time' 'Location' 'Beat' 'Incident Type Id'
 'Incident Type Description' 'Event Number' 'Closed Time']
数值属性: ['Area Id' 'Priority']
```

1）标称属性

以“Location”属性为例，进行频数统计，其余标称属性类似。

In [53]:

```
field = 'Location'
print('频数统计:')
data[field].value_counts()
```

频数统计：

Out[53]:
```
INTERNATIONAL BLVD            3866
MACARTHUR BLVD                3129
AV&INTERNATIONAL BLVD         3067
BROADWAY                      2132
FOOTHILL BLVD                 1791
                              ...
20TH ACRE RD&MACARTHUR BLVD      1
81ST 27TH ST                     1
FAIRFAX 93RD AV                  1
54TH ROSEDALE AV                 1
13TH ST&WEBSTER ST               1
Name: Location, Length: 32505, dtype: int64
```

2）数值属性

In [54]:
```
data.describe()
```

Out[54]:

	Area Id	Priority
count	179112.000000	180015.000000
mean	1.740648	1.796111
std	0.746468	0.402916
min	1.000000	0.000000
25%	1.000000	2.000000
50%	2.000000	2.000000
75%	2.000000	2.000000
max	3.000000	2.000000

5数概括

Priority: 0, 2, 2, 2, 2

Zip Codes: 55, 4560, 13704, 22280, 33120

缺失值数量统计

In [56]:
```
print('null of Priority:',data['Priority'].isnull().sum())
print('null of Area Id:',data['Area Id'].isnull().sum())
```

```
null of Priority: 1
null of Area Id: 904
```

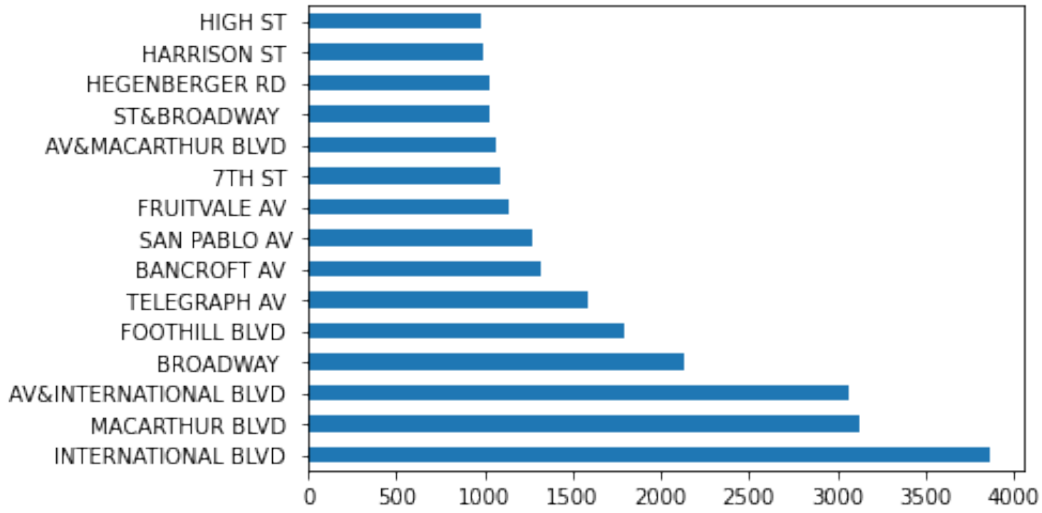
3、数据可视化

1）标称属性

同样以“Location”属性为例，绘制直方图检查数据分布，其余标称属性类似。

In [57]:
```
field = 'Location'
data[field].value_counts().head(15).plot.barh()
```

Out[57]: <AxesSubplot:>

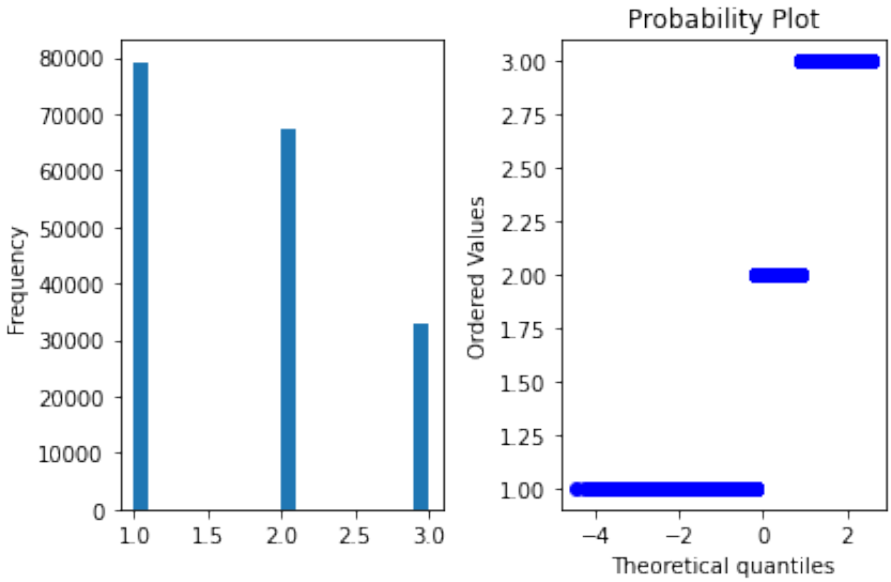


2) 数值属性

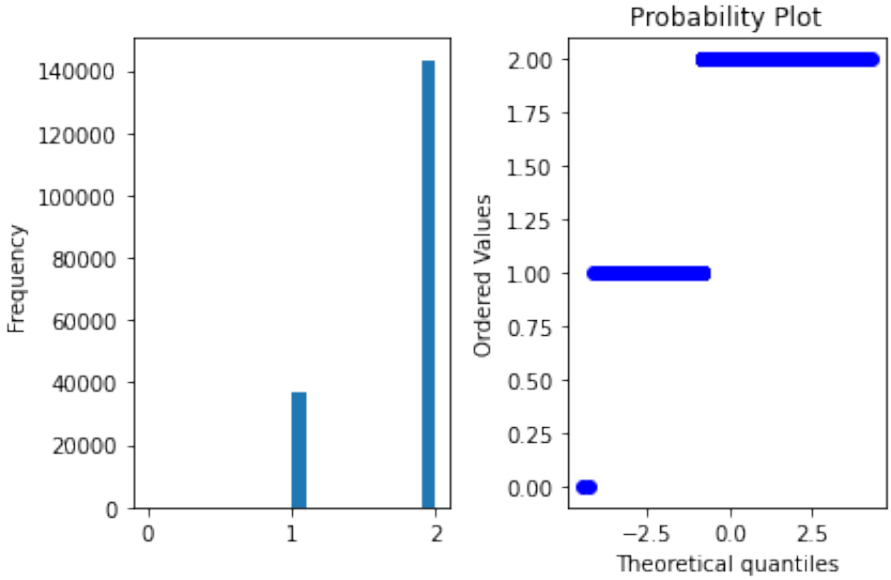
绘制直方图和Q-Q图检查数据分布，并绘制盒图检查离群点。

In [58]:
```
for field in num_fields:
    print(field, '直方图和Q-Q图:')
    plt.subplot(1, 2, 1)
    data[field].plot.hist(bins=20)
    plt.subplot(1, 2, 2)
    stats.probplot(data[field], plot=plt)
    plt.tight_layout()  # 调整整体空白
    plt.show()
```

Area Id 直方图和Q-Q图：



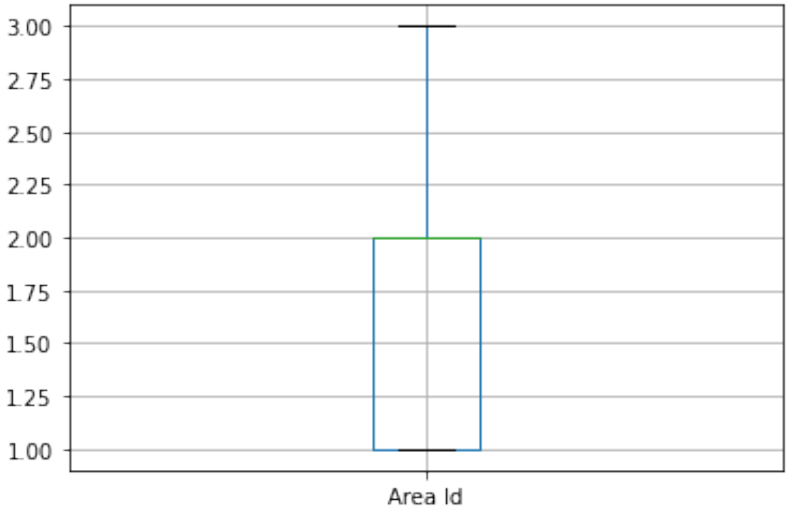
Priority 直方图和Q-Q图：

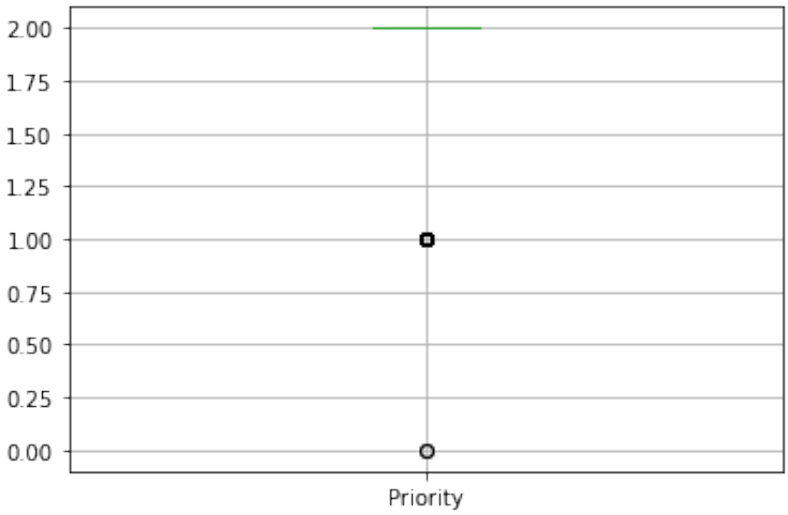


盒图

In [59]:

```
for field in num_fields:
    data.boxplot(field)
    plt.show()
```





4、缺失数据处理

属性缺失值统计

In [60]:
```
missing_data = data.isnull().sum()
# missing_data = missing_data[missing_data != 0]
missing_data
```

Out[60]:
```
Agency                          1
Create Time                     1
Location                        0
Area Id                       904
Beat                          520
Priority                        1
Incident Type Id                1
Incident Type Description       1
Event Number                    1
Closed Time                     7
dtype: int64
```

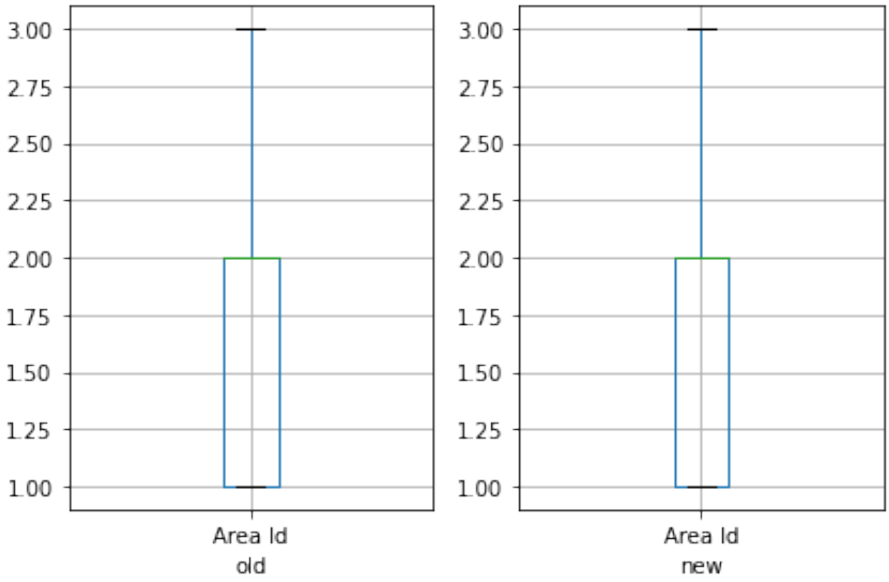
1）将缺失部分剔除

In [61]:
```
print('原始数据行数:', len(data))
drop_data = data.dropna(how='any')
print('将缺失部分剔除后数据行数:', len(drop_data))
```

原始数据行数： 180016
将缺失部分剔除后数据行数： 178771

In [65]:
```
print('以 Area Id 属性为例，通过盒图对比新旧数据:')
field = 'Area Id'
plt.subplot(1, 2, 1)
data.boxplot(field)
plt.xlabel('old')
plt.subplot(1, 2, 2)
drop_data.boxplot(field)
plt.xlabel('new')
plt.tight_layout()  # 调整整体空白
plt.show()
```

以 Area Id 属性为例，通过盒图对比新旧数据：

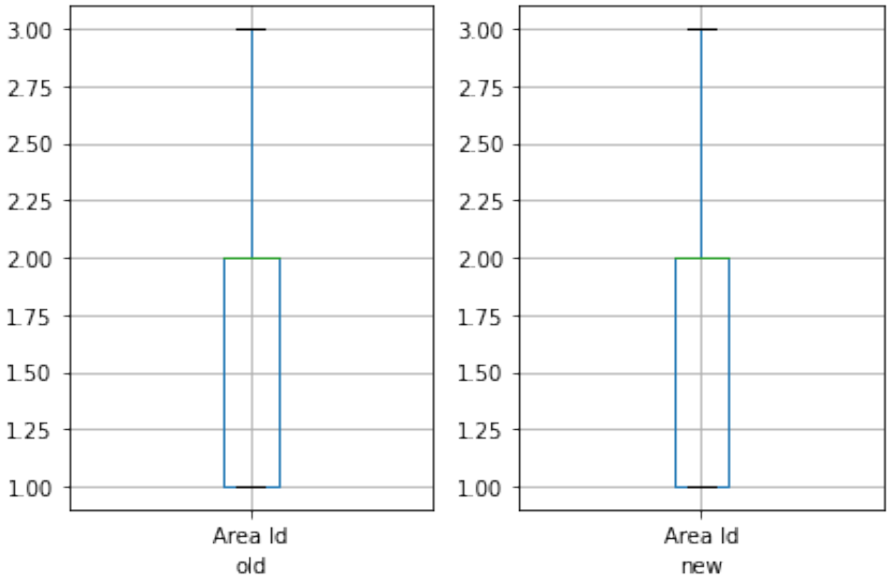


2）用最高频率值填补缺失值

In [66]:
```
print('以 Area Id 属性为例，通过盒图对比新旧数据:')
field = 'Area Id'
mode = data[field].mode()[0]
new_data = data.fillna({field: mode})
print(field, '属性的最高频率值为:', mode)

plt.subplot(1, 2, 1)
data.boxplot(field)
plt.xlabel('old')
plt.subplot(1, 2, 2)
new_data.boxplot(field)
plt.xlabel('new')
plt.tight_layout()  # 调整整体空白
plt.show()
```

以 Area Id 属性为例，通过盒图对比新旧数据:
Area Id 属性的最高频率值为: 1.0



In [67]:
```
data[data[field].isna()][field].head(5)
```

Out[67]:
```
1187   NaN
1933   NaN
4227   NaN
4522   NaN
4567   NaN
Name: Area Id, dtype: float64
```

In [68]:
```
new_data[data[field].isna()][field].head(5)
```

Out[68]:
```
1187    1.0
1933    1.0
4227    1.0
4522    1.0
4567    1.0
Name: Area Id, dtype: float64
```

3）通过属性的相关关系来填补缺失值

In [69]:
```
data.corr()
```

Out[69]:

	Area Id	Priority
Area Id	1.000000	-0.023366
Priority	-0.023366	1.000000

发现标值数据相关性十分弱，因此无法通过相关关系填补缺失值

4）通过数据对象之间的相似性来填补缺失值

In [70]:
```
full_data = data[data['Area Id'].notna()]
new_data = data.copy()
# ['Agency' 'Create Time' 'Location' 'Beat' 'Incident Type Id'
#  'Incident Type Description' 'Event Number' 'Closed Time']
consider_fields = ['Location', 'Event Number', 'Agency']
for i, row in tqdm.tqdm(list(new_data[data['Area Id'].isna()].iterrows())):
    for field in consider_fields:
        tmp_data = full_data[full_data[field]==row[field]]
        if len(tmp_data) > 0:
            new_data['Area Id'][i] = tmp_data['Area Id'].mean()
            break
```

```
100%|██████████| 904/904 [00:15<00:00, 59.89it/s]
```

可视化对比

In [71]:
```
data[data['Area Id'].isna()].head(5)['Area Id']
```

Out[71]:
```
1187   NaN
1933   NaN
4227   NaN
4522   NaN
4567   NaN
Name: Area Id, dtype: float64
```

In [72]:
```
new_data[data['Area Id'].isna()].head(5)['Area Id']
```

Out[72]:
```
1187    1.951096
1933    2.601240
4227    2.000000
4522    3.000000
4567    2.646552
Name: Area Id, dtype: float64
```

In [73]:

```
plt.subplot(1, 2, 1)
data.boxplot('Area Id')
plt.xlabel('old')
plt.subplot(1, 2, 2)
new_data.boxplot('Area Id')
plt.xlabel('new')
plt.tight_layout()  # 调整整体空白
plt.show()
```