Random Forest

1. 数据分析

- 数据读取
- 数据大小
- 数据统计指标

```
# 数据读取
import pandas as pd

features = pd.read_csv('data/temps.csv')
features.head(5)
```

	year	month	day	week	temp_2	temp_1	average	actual	friend
0	2016	1	1	Fri	45	45	45.6	45	29
1	2016	1	2	Sat	44	45	45.7	44	61
2	2016	1	3	Sun	45	44	45.8	41	56
3	2016	1	4	Mon	44	41	45.9	40	53
4	2016	1	5	Tues	41	40	46.0	44	41

数据表中

- year,moth,day,week分别表示的具体的时间
- temp_2：前天的最高温度值
- temp_1：昨天的最高温度值
- average：在历史中，每年这一天的平均最高温度值
- actual：这就是我们的标签值了，当天的真实最高温度
- friend：这一列可能是凑热闹的，你的朋友猜测的可能值，咱们不管它就好了

```
# 数据大小
print('The shape of our features is:', features.shape)
```

```
The shape of our features is: (348, 9)
```

结果显示：The shape of our features is: (348, 9)，表示我们的数据一共有348条记录，每个样本有9个特征。

```
# 数据统计指标
features.describe()
```

	year	month	day	temp_2	temp_1	average	actual	friend
count	348.0	348.000000	348.000000	348.000000	348.000000	348.000000	348.000000	348.000000
mean	2016.0	6.477011	15.514368	62.511494	62.560345	59.760632	62.543103	60.034483
std	0.0	3.498380	8.772982	11.813019	11.767406	10.527306	11.794146	15.626179
min	2016.0	1.000000	1.000000	35.000000	35.000000	45.100000	35.000000	28.000000
25%	2016.0	3.000000	8.000000	54.000000	54.000000	49.975000	54.000000	47.750000
50%	2016.0	6.000000	15.000000	62.500000	62.500000	58.200000	62.500000	60.000000
75%	2016.0	10.000000	23.000000	71.000000	71.000000	69.025000	71.000000	71.000000
max	2016.0	12.000000	31.000000	92.000000	92.000000	77.400000	92.000000	95.000000

其中包括了各个列的数量，如果有缺失数据，数量就有所减少，这里因为并不存在缺失值，所以各个列的数量值就都是348了，均值，标准差，最大最小值等指标在这里就都显示出来了。

2. 数据预处理

- 数据格式转换
- 缺失值处理
- 原始数据展示
- 标准化/归一化

时间数据格式转换

```
# 处理时间数据
import datetime

# 分别得到年，月，日
years = features['year']
months = features['month']
days = features['day']

# datetime格式
dates = [str(int(year)) + '-' + str(int(month)) + '-' + str(int(day)) for year, month, day in zip(years, months,
days)]
dates = [datetime.datetime.strptime(date, '%Y-%m-%d') for date in dates]
```

```
dates[:5]
```

```
[datetime.datetime(2016, 1, 1, 0, 0),
 datetime.datetime(2016, 1, 2, 0, 0),
 datetime.datetime(2016, 1, 3, 0, 0),
 datetime.datetime(2016, 1, 4, 0, 0),
 datetime.datetime(2016, 1, 5, 0, 0)]
```

One-Hot Encoding

原始数据:

week
Mon
Tue
Wed
Thu
Fri

编码转换后:

Mon	Tue	Wed	Thu	Fri
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

```
# 独热编码
features = pd.get_dummies(features)
features.head(5)
```

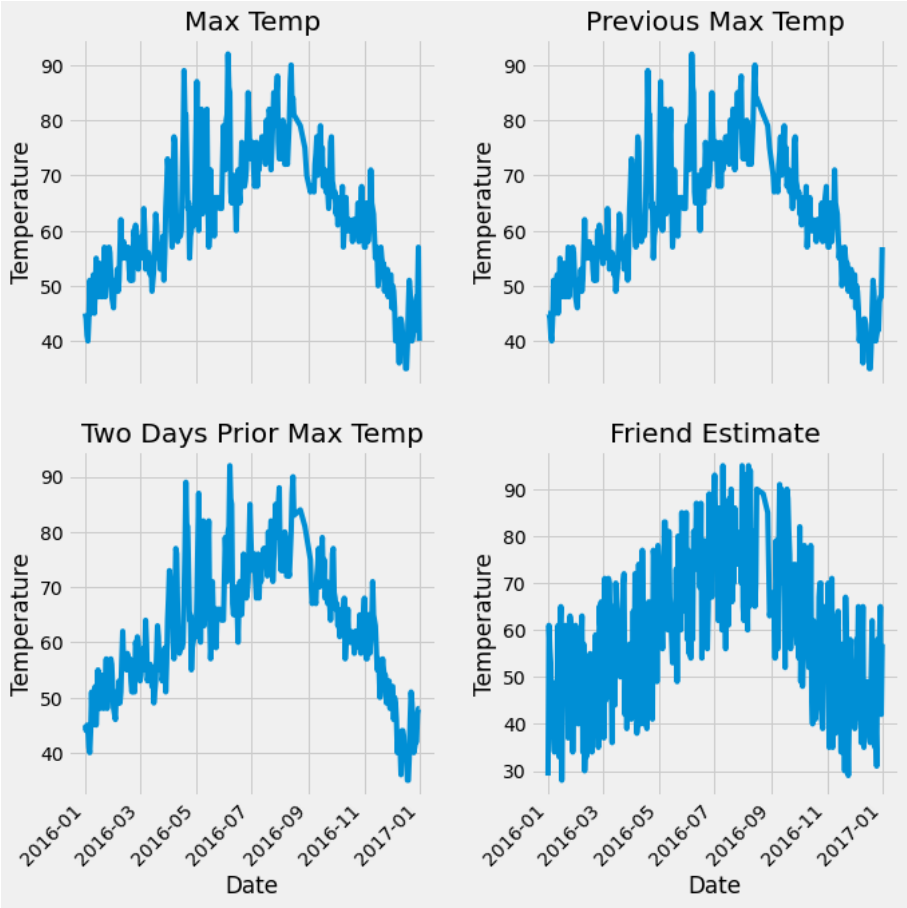
	year	month	day	temp_2	temp_1	average	actual	friend	week_Fri	week_Mon	week_Sat	week_Sun	w
0	2016	1	1	45	45	45.6	45	29	1	0	0	0	0
1	2016	1	2	44	45	45.7	44	61	0	0	1	0	0
2	2016	1	3	45	44	45.8	41	56	0	0	0	1	0
3	2016	1	4	44	41	45.9	40	53	0	1	0	0	0
4	2016	1	5	41	40	46.0	44	41	0	0	0	0	0

```
# 编码后数据大小
print('Shape of features after one-hot encoding:', features.shape)
```

```
Shape of features after one-hot encoding: (348, 15)
```

原始数据展示

```
# 准备画图
import matplotlib.pyplot as plt

%matplotlib inline

# 指定默认风格
plt.style.use('fivethirtyeight')

# 设置布局
fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(nrows=2, ncols=2, figsize = (10,10))
fig.autofmt_xdate(rotation = 45)

# 标签值
ax1.plot(dates, features['actual'])
ax1.set_xlabel(''); ax1.set_ylabel('Temperature'); ax1.set_title('Max Temp')

# 昨天
ax2.plot(dates, features['temp_1'])
ax2.set_xlabel(''); ax2.set_ylabel('Temperature'); ax2.set_title('Previous Max Temp')

# 前天
ax3.plot(dates, features['temp_2'])
ax3.set_xlabel('Date'); ax3.set_ylabel('Temperature'); ax3.set_title('Two Days Prior Max Temp')

# 我的逗逼朋友
ax4.plot(dates, features['friend'])
ax4.set_xlabel('Date'); ax4.set_ylabel('Temperature'); ax4.set_title('Friend Estimate')

plt.tight_layout(pad=2)
```



3. 数据集处理

- 特征/标签划分
- 训练集/测试集划分

```
## 特征/标签划分
# 数据与标签
```

```
import numpy as np

# 标签
labels = np.array(features['actual'])

# 在特征中去掉标签
features= features.drop('actual', axis = 1)

# 名字单独保存一下，以备后患
feature_list = list(features.columns)

# 转换成合适的格式
features = np.array(features)
```

```
# 训练集/测试集划分
from sklearn.model_selection import train_test_split

train_features, test_features, train_labels, test_labels = train_test_split(features, labels, test_size = 0.25,
                                random_state = 42)
```

```
print('训练集特征:', train_features.shape)
print('训练集标签:', train_labels.shape)
print('测试集特征:', test_features.shape)
print('测试集标签:', test_labels.shape)
```

```
训练集特征: (261, 14)
训练集标签: (261,)
测试集特征: (87, 14)
测试集标签: (87,)
```

4. 建立模型

- 导入算法
- 建模
- 训练

```
# 导入算法
from sklearn.ensemble import RandomForestRegressor

# 建模
rf = RandomForestRegressor(n_estimators= 1000, random_state=42)

# 训练
rf.fit(train_features, train_labels)
```

```
RandomForestRegressor(n_estimators=1000, random_state=42)
```

5. 结果测试

- 预测结果
- 评估
- 可视化展示

```
## 预测结果
predictions = rf.predict(test_features)
```

MAPE指标：平均绝对百分误差

```
## 评估
# 计算误差
errors = abs(predictions - test_labels)

# mean absolute percentage error (MAPE)
mape = 100 * (errors / test_labels)

print ('MAPE:',np.mean(mape))
```

```
MAPE: 6.011244187972058
```

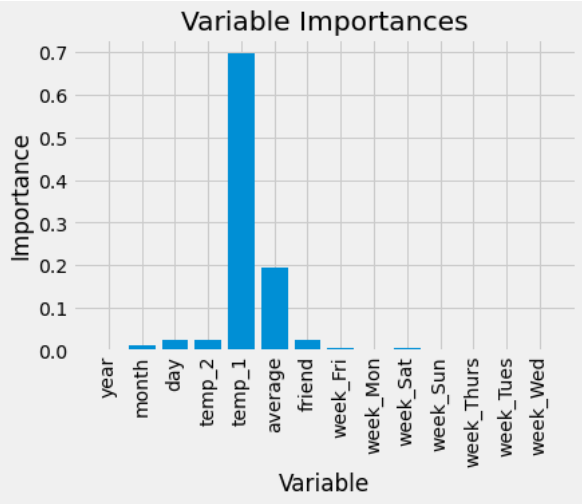
得到特征重要性

```
## 评估
# 得到特征重要性
importances = list(rf.feature_importances_)

# 转换格式
feature_importances = [(feature, round(importance, 2)) for feature, importance in zip(feature_list, importances)]

# 排序
feature_importances = sorted(feature_importances, key = lambda x: x[1], reverse = True)

# 对应进行打印
[print('Variable: {:20} Importance: {}'.format(*pair)) for pair in feature_importances]
```

```
Variable: temp_1               Importance: 0.7
Variable: average              Importance: 0.19
Variable: day                  Importance: 0.03
Variable: temp_2               Importance: 0.02
Variable: friend               Importance: 0.02
Variable: month                Importance: 0.01
Variable: year                 Importance: 0.0
Variable: week_Fri             Importance: 0.0
Variable: week_Mon             Importance: 0.0
Variable: week_Sat             Importance: 0.0
Variable: week_Sun             Importance: 0.0
Variable: week_Thurs           Importance: 0.0
Variable: week_Tues            Importance: 0.0
Variable: week_Wed             Importance: 0.0
```

```
[None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None,
 None]
```

```
## 画特征重要性图
# 转换成list格式
x_values = list(range(len(importances)))

# 绘图
plt.bar(x_values, importances, orientation = 'vertical')

# x轴名字
plt.xticks(x_values, feature_list, rotation='vertical')

# 图名
plt.ylabel('Importance'); plt.xlabel('Variable'); plt.title('Variable Importances');
```



用最重要的两个特征进行训练并测试

```
# 选择最重要的那两个特征来试一试
rf_most_important = RandomForestRegressor(n_estimators= 1000, random_state=42)

# 拿到这俩特征
important_indices = [feature_list.index('temp_1'), feature_list.index('average')]
train_important = train_features[:, important_indices]
test_important = test_features[:, important_indices]

# 重新训练模型
rf_most_important.fit(train_important, train_labels)

# 预测结果
predictions = rf_most_important.predict(test_important)

errors = abs(predictions - test_labels)

# 评估结果

mape = np.mean(100 * (errors / test_labels))

print('mape:', mape)
```

```
mape: 6.229055723613811
```

```
## 可视化
# 导入所需工具包
from sklearn.tree import export_graphviz
import pydot #pip install pydot

# 拿到其中的一棵树
tree = rf.estimators_[5]

# 导出成dot文件
export_graphviz(tree, out_file = 'tree.dot', feature_names = feature_list, rounded = True, precision = 1)

# 绘图
(graph, ) = pydot.graph_from_dot_file('tree.dot')

# 展示
graph.write_png('tree.png');
```