In [1]:
```python
#练习1：  线性回归

#单变量线性回归

#数据为城市人口与食品车利润的关系表

import pandas as pd
```

In [2]:
```python
#加载数据  数据为城市人口与利润的对应关系
df = pd.read_csv('ex1data1.txt', names=['population', 'profit'])
df.head(10)
```

Out[2]:

	population	profit
0	6.1101	17.5920
1	5.5277	9.1302
2	8.5186	13.6620
3	7.0032	11.8540
4	5.8598	6.8233
5	8.3829	11.8860
6	7.4764	4.3483
7	8.5781	12.0000
8	6.4862	6.5987
9	5.0546	3.8166

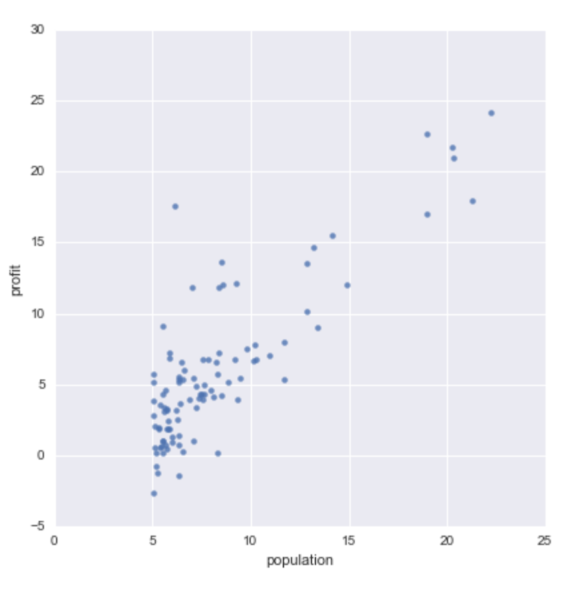
In [3]:
```python
import numpy as np
print(np.any(df.isnull()) == True)

df.count() #发现数据完整,不需要进行数据清洗
```

```
False
```

Out[3]:
```
population    97
profit        97
dtype: int64
```

In [4]:
```python
#画出散点图
%matplotlib inline

import seaborn as sns

sns.lmplot('population', 'profit', df, size=6, fit_reg=False)
```

Out[4]: `<seaborn.axisgrid.FacetGrid at 0x1136ddba8>`



In [5]:
```python
#批量梯度下降

import sys
sys.path.append('..')

#加载自己的ml模块
from ml import linear_regression as lr
from ml import  general as general
```

代价函数

$$J(\theta) = \frac{1}{2m}\sum_{i=1}^{m}\left(h_\theta(x^{(i)}) - y^{(i)}\right)^2$$

In [6]:
```python
#得到feature和target


X = general.get_X(df) #get_X的处理为：  在feature前加了全为1的一列

print(X.shape, type(X))



y = general.get_y(df) #get_y的处理为：直接得到结果列  充当target

print(y.shape, type(y))
```

```
(97, 2) <class 'numpy.ndarray'>
(97,) <class 'numpy.ndarray'>
```

In [7]:
```python
#初始化theta  预测函数的参数
theta = np.zeros(X.shape[1])
```

In [8]:
```python
lr.cost(theta, X,y) #计算代价
```

Out[8]: `32.072733877455669`

批量梯度下降算法

$$\theta_j := \theta_j - \alpha\frac{\partial}{\partial\theta_j}J(\theta).$$

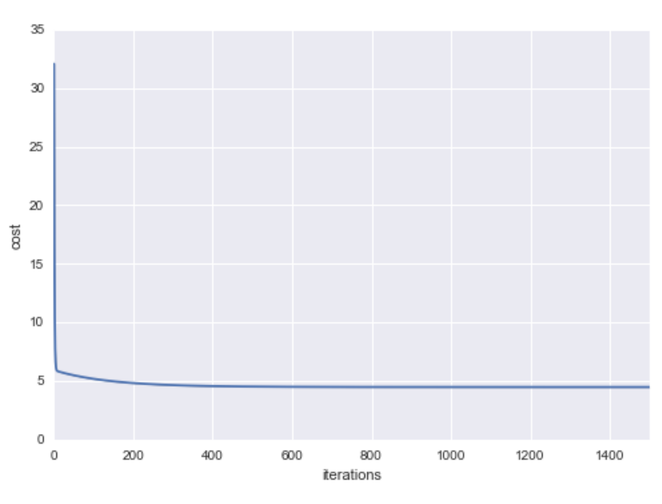
In [9]:
```python
iterations = 1500 #迭代总次数
alpha = 0.02   #步长

#运行批量梯度下降算法 cost_data 是每一次迭代的代价
final_theta, cost_data = lr.batch_gradient_decent(theta, X, y, iterations, alpha)
```

In [10]:
```python
# 计算最终的代价
lr.cost(final_theta, X,y)
```

Out[10]: `4.4769997149122185`

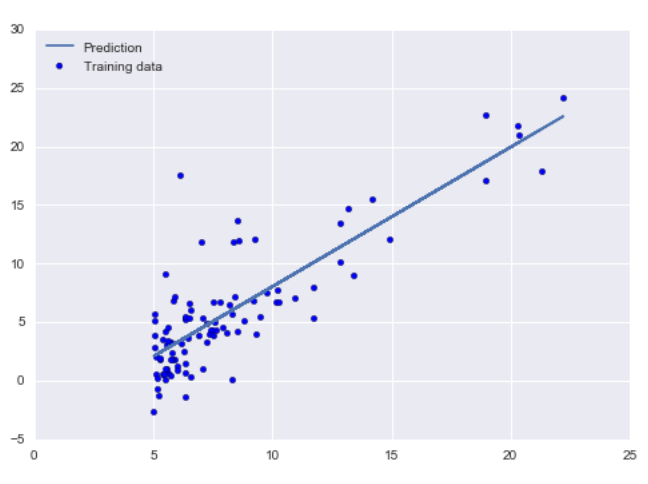
In [11]:
```python
ax = sns.tsplot(cost_data, time=np.arange(iterations+1))
ax.set_xlabel('iterations')
ax.set_ylabel('cost')
```

Out[11]: `<matplotlib.text.Text at 0x11ef31ef0>`



In [12]:
```python
b = final_theta[0]
m = final_theta[1]

import matplotlib.pyplot  as plt

plt.scatter(df.population, df.profit, label="Training data")
plt.plot(df.population, df.population*m + b, label="Prediction")
# 预测的函数：  y = m * x + b
plt.legend(loc=2)
```

Out[12]: `<matplotlib.legend.Legend at 0x11eff6ef0>`



In [13]:
```python
##多变量线性回归

#数据为房子 面积, 卧室数 与 价格的关系表

data = pd.read_csv('ex1data2.txt', names=['square','bedrooms','price'])
data.head(10)
```

Out[13]:

	square	bedrooms	price
0	2104	3	399900
1	1600	3	329900
2	2400	3	369000
3	1416	2	232000
4	3000	4	539900
5	1985	4	299900
6	1534	3	314900
7	1427	3	198999
8	1380	3	212000
9	1494	3	242500

In [14]:
```python
#特征缩放 Xn = (Xn-Un)/Sn
data = general.normalize_feature(data)
data.head(10)
```

Out[14]:

	square	bedrooms	price
0	0.130010	-0.223675	0.475747
1	-0.504190	-0.223675	-0.084074
2	0.502476	-0.223675	0.228626
3	-0.735723	-1.537767	-0.867025
4	1.257476	1.090417	1.595389
5	-0.019732	1.090417	-0.323998
6	-0.587240	-0.223675	-0.204036
7	-0.721881	-0.223675	-1.130948
8	-0.781023	-0.223675	-1.026973
9	-0.637573	-0.223675	-0.783051

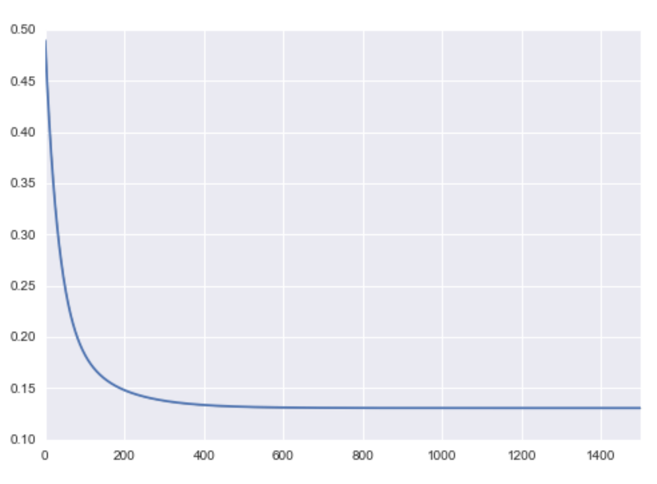
In [15]:
```python
##多变量梯度下降

X = general.get_X(data)
y = general.get_y(data)
```

In [16]:
```python
#设置参数

theta = np.zeros(X.shape[1])

alpha = 0.01
iterations = 1500
```

In [17]:
```python
final_theta, cost_data = lr.batch_gradient_decent(theta,X,y, iterations,alpha)
```

In [18]:
```python
sns.tsplot(time=np.arange(len(cost_data)), data=cost_data)
```

Out[18]: `<matplotlib.axes._subplots.AxesSubplot at 0x11efbd710>`



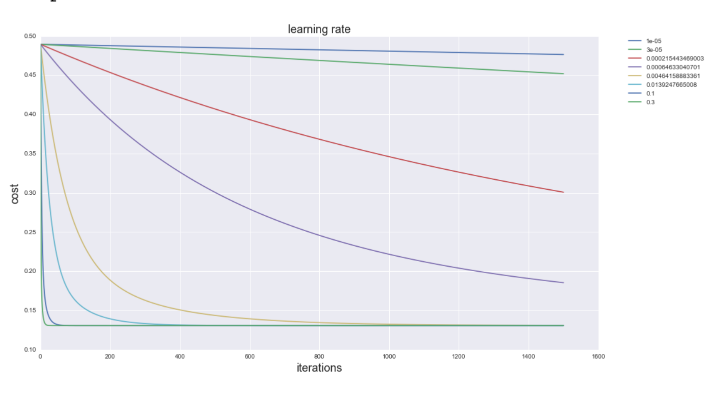
In [19]:
```python
#预测

#element = [1,1650,3] # todo 需要对element进行特征缩放变换 才能得到真实的预测值
#price = lr.predict(element, final_theta)

#print(price)
```

In [20]:
```python
##学习速率

## 迭代的次数 与 代价函数  在何时收敛
base = np.logspace(-1, -5, num=4)
candidate = np.sort(np.concatenate((base, base*3)))
print(candidate)
```

```
[  1.00000000e-05   3.00000000e-05   2.15443469e-04   6.46330407e-04
   4.64158883e-03   1.39247665e-02   1.00000000e-01   3.00000000e-01]
```

In [21]:
```python
iterations=1500

fig, ax = plt.subplots(figsize=(16, 9))

# aipha 学习速率
for alpha in candidate:
    _, cost_data = lr.batch_gradient_decent(theta, X, y, iterations, alpha)
    ax.plot(np.arange(iterations+1), cost_data, label=alpha)

ax.set_xlabel('iterations', fontsize=18)
ax.set_ylabel('cost', fontsize=18)
ax.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
ax.set_title('learning rate', fontsize=18)
```

Out[21]: `<matplotlib.text.Text at 0x1264a9e48>`



In [22]:
```python
##正规方程   pinv(X'*X)*X'*y

#正规方程只能用于线性模型
#正规方程不能用于 - 不可逆的矩阵  而产生这种矩阵的原因是  特征之间不独立, 或者特征数量大于训练集数量
```

In [23]:
```python
data = pd.read_csv('ex1data2.txt', names=['square','bedrooms','price'])


X = general.get_X(data)
y = general.get_y(data)


theta = np.zeros(X.shape[1])

theta = lr.normal_eqn(X, y)

theta
```

Out[23]: `array([ 89597.9095428 ,    139.21067402,   -8738.01911233])`

In [24]:
```python
#预测
element = [1,1650,3]
price = lr.predict(element,theta)

price
```

Out[24]: `293081.46433489537`

In [25]:
```python
# tensorflow 的优化器 比较

# tensorflow 入门: https://github.com/xxg1413/Tensorflow/tree/master/tutorial

import tensorflow as tf
```

In [26]:
```python
raw_data = pd.read_csv('ex1data2.txt', names=['square', 'bedrooms', 'price'])
data = general.normalize_feature(raw_data)

data.head(10)
```

Out[26]:

	square	bedrooms	price
0	0.130010	-0.223675	0.475747
1	-0.504190	-0.223675	-0.084074
2	0.502476	-0.223675	0.228626
3	-0.735723	-1.537767	-0.867025
4	1.257476	1.090417	1.595389
5	-0.019732	1.090417	-0.323998
6	-0.587240	-0.223675	-0.204036
7	-0.721881	-0.223675	-1.130948
8	-0.781023	-0.223675	-1.026973
9	-0.637573	-0.223675	-0.783051

In [27]:
```python
X_data = general.get_X(data)
y_data = general.get_y(data)

print(X_data.shape)
print(y_data.shape)

#注意：tensorflow不接受(47,)这种形式,需要reshape
y_data = general.get_y(data).reshape(len(X_data), 1)
print(X_data.shape)
print(y_data.shape)
```

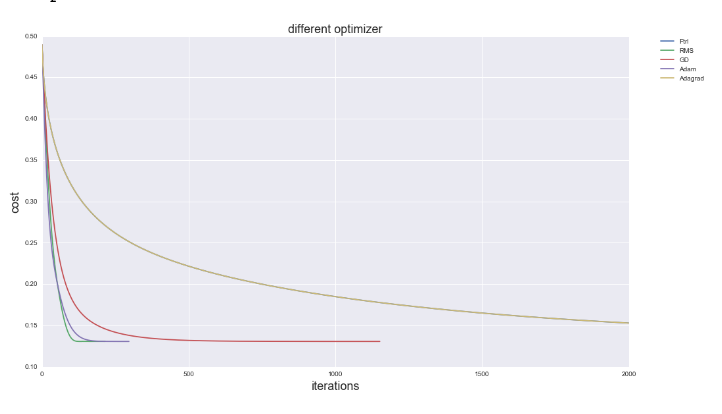
```
(47, 3)
(47,)
(47, 3)
(47, 1)
```

In [28]:
```python
iterations = 2000
alpha = 0.01
```

In [29]:
```python
#优化器
optimizer_dict={'GD': tf.train.GradientDescentOptimizer,
                'Adagrad': tf.train.AdagradOptimizer,
                'Adam': tf.train.AdamOptimizer,
                'Ftrl': tf.train.FtrlOptimizer,
                'RMS': tf.train.RMSPropOptimizer
               }
results = []
for name in optimizer_dict:
    res = lr.linear_regression(X_data, y_data, alpha, iterations, optimizer=optimizer_dict[name])
    res['name'] = name
    results.append(res) #保存所有优化器的结果
```

In [30]:
```python
fig, ax = plt.subplots(figsize=(16, 9))

for res in results:
    loss_data = res['loss']

    ax.plot(np.arange(len(loss_data)), loss_data, label=res['name'])

ax.set_xlabel('iterations', fontsize=18)
ax.set_ylabel('cost', fontsize=18)

ax.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
ax.set_title('different optimizer', fontsize=18)
```

Out[30]: `<matplotlib.text.Text at 0x127b07f98>`



In [ ]:
```python
#练习1 完
```