In [1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```
executed in 933ms, finished 00:10:00 2019-02-12

In [2]:
```python
np.random.seed(114514)
```
executed in 4ms, finished 00:10:00 2019-02-12

2.4

In [3]:
```python
points = [0, 1, 2, 3, 5, 5, 7, 8, 9, 10]
```
executed in 7ms, finished 00:10:00 2019-02-12

In [4]:
```python
mean = np.mean(points)
std = np.std(points)
```
executed in 7ms, finished 00:10:00 2019-02-12

In [5]:
```python
mean, std
```
executed in 13ms, finished 00:10:01 2019-02-12

Out[5]:
```
(5.0, 3.286335345030997)
```

In [6]:
```python
std_points = [(point - mean) / std for point in points]
```
executed in 7ms, finished 00:10:01 2019-02-12

標準得点

In [7]:
```python
std_points
```
executed in 12ms, finished 00:10:01 2019-02-12

Out[7]:
```
[-1.5214515486254614,
 -1.217161238900369,
 -0.9128709291752768,
 -0.6085806194501845,
 0.0,
 0.0,
 0.6085806194501845,
 0.9128709291752768,
 1.217161238900369,
 1.5214515486254614]
```

In [8]:
```python
np.mean(std_points), np.std(std_points)
```
executed in 17ms, finished 00:10:01 2019-02-12

Out[8]:
```
(2.220446049250313e-17, 0.9999999999999999)
```

へんさち

In [9]:
```python
hensachi  =  [10 * point + 50 for point in std_points]
```
executed in 83ms, finished 00:10:01 2019-02-12

In [10]:
```
hensachi
```
executed in 7ms, finished 00:10:01 2019-02-12

Out[10]:
```
[34.78548451374539,
 37.82838761099631,
 40.87129070824723,
 43.91419380549816,
 50.0,
 50.0,
 56.08580619450184,
 59.12870929175277,
 62.17161238900369,
 65.21451548625461]
```

In [11]:
```
np.mean(hensachi), np.std(hensachi)
```
executed in 7ms, finished 00:10:01 2019-02-12

Out[11]:
```
(50.0, 9.999999999999998)
```

3.1

データは教科書のまえがきの最後のリンクからがんばって探すと見つかります

In [12]:
```
senkyo = pd.read_csv('./1-0d-1.csv', encoding='shift-jis')
```
executed in 20ms, finished 00:10:01 2019-02-12

In [13]:
```
senkyo.head()
```
executed in 20ms, finished 00:10:01 2019-02-12

Out[13]:

	都道府県	自民得票率	持家比率
0	北海道	41.4	52.8
1	青　森	76.3	71.2
2	岩　手	59.2	72.6
3	宮　城	51.8	63.7
4	秋　田	52.5	81.3

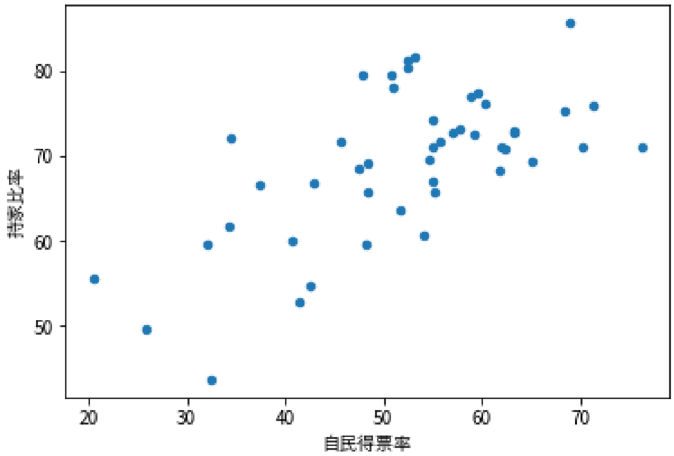
散布図

In [14]:

```
senkyo.plot.scatter('自民得票率', '持家比率')
```

executed in 274ms, finished 00:10:01 2019-02-12

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x8841d68>



相関係数

In [15]:

```
senkyo.corr()
```

executed in 14ms, finished 00:10:01 2019-02-12

Out[15]:

	自民得票率	持家比率
自民得票率	1.000000	0.638724
持家比率	0.638724	1.000000

電卓でやるなら、相関係数 = 共分散 ÷ (分散1×分散2) とすればよい。

教科書的にはとても弱い相関？散布図見た感じは相関はありそう

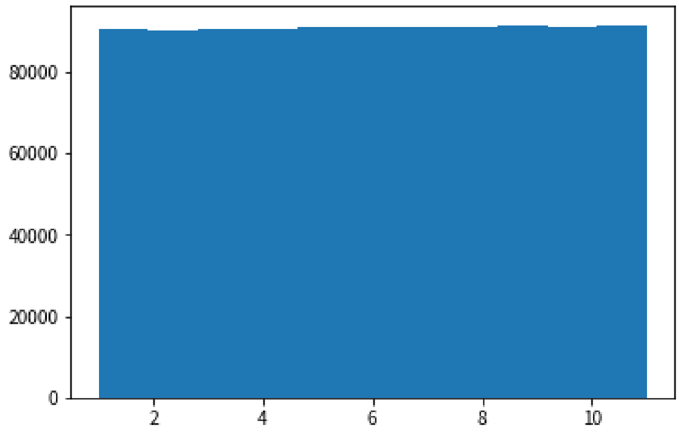
3.4

i)

np.random.randintで楽をします。

In [16]:
```
plt.hist(np.random.randint(1, high=12, size=1000000), bins=11)
```
executed in 242ms, finished 00:10:01 2019-02-12

Out[16]:
```
(array([90409., 90334., 90417., 90458., 90968., 91163., 91183., 90845.,
        91567., 91191., 91465.]),
 array([ 1.        ,  1.90909091,  2.81818182,  3.72727273,  4.63636364,
         5.54545455,  6.45454545,  7.36363636,  8.27272727,  9.18181818,
        10.09090909, 11.        ]),
 <a list of 11 Patch objects>)
```



ii)

indexは0から始まるので、乱数は0以上10以下でやります。

In [17]:
```
talls = pd.DataFrame({
    'male': [71, 68, 66, 67, 70, 71, 70, 73, 72, 65, 66],
    'female': [69, 64, 65, 63, 65, 62, 65, 64, 66, 59, 62]})
talls
```
executed in 14ms, finished 00:10:01 2019-02-12

Out[17]:

	male	female
0	71	69
1	68	64
2	66	65
3	67	63
4	70	65
5	71	62
6	70	65
7	73	64
8	72	66
9	65	59
10	66	62

In [18]:
```
def boostrap(talls, n_iter):
    result = []
    for _ in range(n_iter):
        data = pd.DataFrame()
        for _ in range(11):
            idx = np.random.randint(0, high=11)
            data = data.append(talls[idx: idx + 1])
        result += [data.corr().values[0, 1]]
    return result
```
executed in 17ms, finished 00:10:01 2019-02-12

arrayとかでやったほうがたぶん計算は速いです

相関係数

In [19]:
```
boostrap(talls, 1)
```
executed in 50ms, finished 00:10:01 2019-02-12

Out[19]:
```
[0.35481884404496294]
```

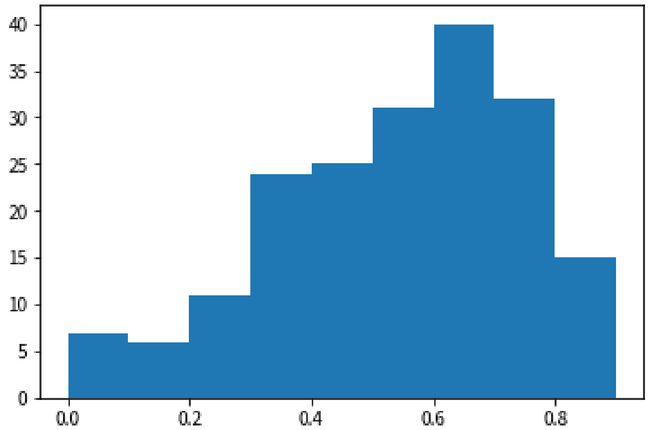
次にヒストグラムにするとおり、1回だけやったときの値はかなりブレます。

iii)

200回

In [20]:
```
plt.hist(boostrap(talls, 200), bins=np.arange(0, 1, 0.1))
```
executed in 1.80s, finished 00:10:03 2019-02-12

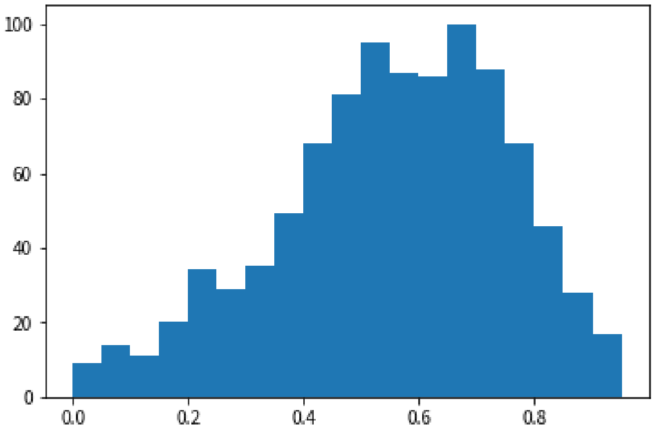
Out[20]:
```
(array([ 7.,  6., 11., 24., 25., 31., 40., 32., 15.]),
 array([0. , 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9]),
 <a list of 9 Patch objects>)
```



1000回

In [21]:
```python
plt.hist(boostrap(talls, 1000), bins=np.arange(0, 1, 0.05))
```
executed in 5.11s, finished 00:10:08 2019-02-12

Out[21]:
```
(array([  9.,  14.,  11.,  20.,  34.,  29.,  35.,  49.,  68.,  81.,  95.,
         87.,  86., 100.,  88.,  68.,  46.,  28.,  17.]),
 array([0.  , 0.05, 0.1 , 0.15, 0.2 , 0.25, 0.3 , 0.35, 0.4 , 0.45, 0.5 ,
        0.55, 0.6 , 0.65, 0.7 , 0.75, 0.8 , 0.85, 0.9 , 0.95]),
 <a list of 19 Patch objects>)
```



ブーストラップでできた分布がどういう分布になるみたいな法則とかあるんですかね？