In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```
executed in 877ms, finished 23:56:25 2019-02-11

In [2]:
```
np.random.seed(114514)
```
executed in 5ms, finished 23:56:25 2019-02-11

2.4

In [3]:
```
points = [0, 1, 2, 3, 5, 5, 7, 8, 9, 10]
```
executed in 8ms, finished 23:56:25 2019-02-11

In [4]:
```
mean = np.mean(points)
std = np.std(points)
```
executed in 6ms, finished 23:56:25 2019-02-11

In [5]:
```
mean, std
```
executed in 8ms, finished 23:56:25 2019-02-11

Out[5]: (5.0, 3.286335345030997)

In [6]:
```
std_points = [(point - mean) / std for point in points]
```
executed in 7ms, finished 23:56:25 2019-02-11

標準得点

In [7]:
```
std_points
```
executed in 8ms, finished 23:56:25 2019-02-11

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

In [8]:
```
np.mean(std_points), np.std(std_points)
```
executed in 9ms, finished 23:56:25 2019-02-11

Out[8]: (2.2204460492503132e-17, 0.9999999999999999)

へんさち

In [9]:
```
hensachi = [10 * point + 50 for point in std_points]
```
executed in 4ms, finished 23:56:25 2019-02-11

In [10]:
```
hensachi
```
executed in 6ms, finished 23:56:25 2019-02-11

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 13ms, finished 23:56:25 2019-02-11

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 23:56:25 2019-02-11

In [13]:
```
senkyo.head()
```
executed in 14ms, finished 23:56:25 2019-02-11

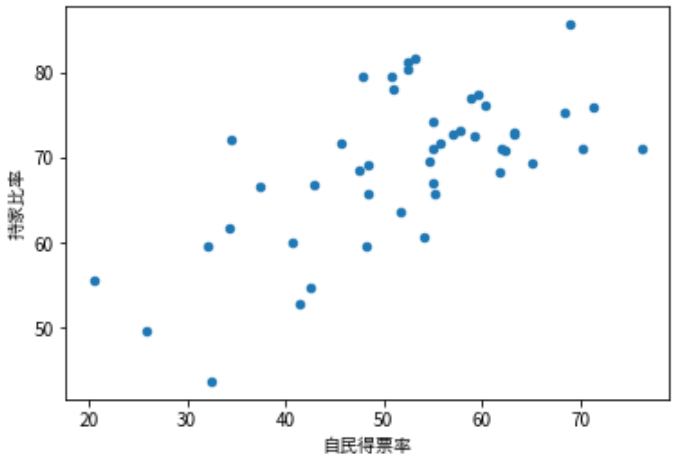
Out[13]:

	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 243ms, finished 23:56:26 2019-02-11

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x8842d68>



相関係数

In [15]:
```
senkyo.corr()
```
executed in 16ms, finished 23:56:26 2019-02-11

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

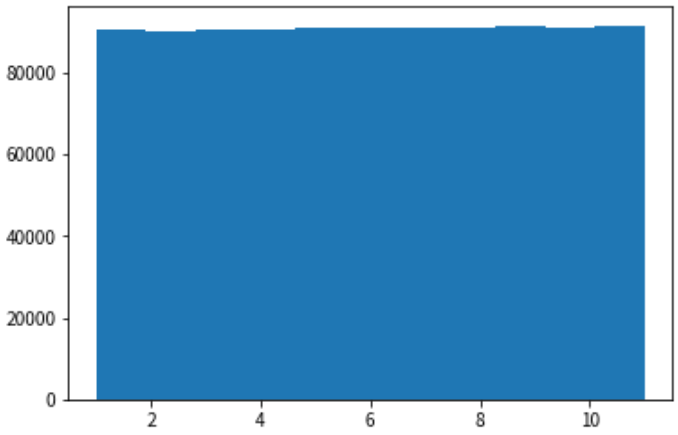
3.4

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 249ms, finished 23:56:26 2019-02-11

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 13ms, finished 23:56:26 2019-02-11

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 6ms, finished 23:56:26 2019-02-11

arrayとかでやったほうがたぶん計算は速いです

In [19]:
```
boostrap(talls, 1)
```

executed in 26ms, finished 23:56:26 2019-02-11

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。

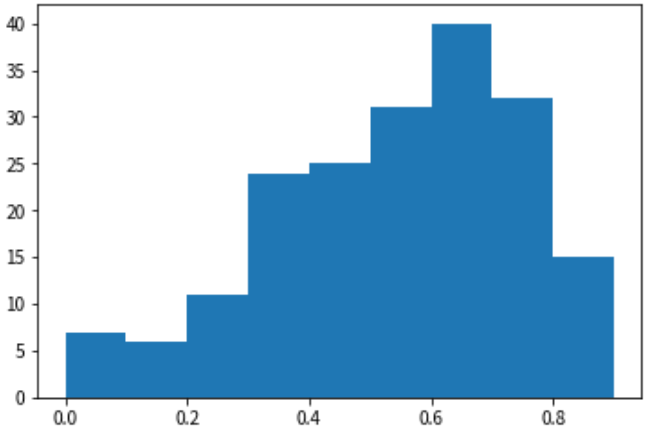
iii)

200回

In [20]:
```
plt.hist(boostrap(talls, 200), bins=np.arange(0, 1, 0.1))
```

executed in 1.34s, finished 23:56:27 2019-02-11

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>)
```

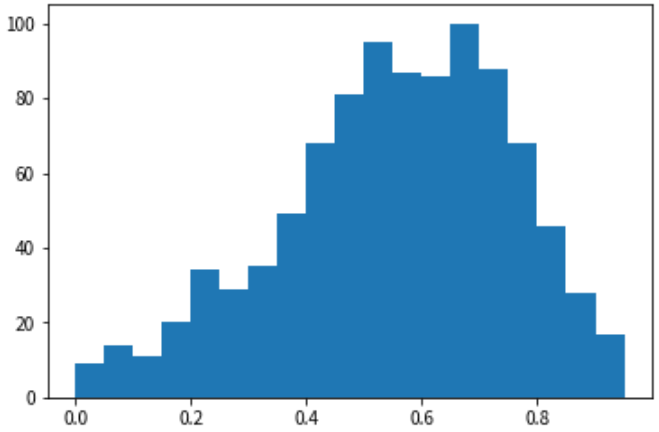


1000回

In [21]:
```
plt.hist(boostrap(talls, 1000), bins=np.arange(0, 1, 0.05))
```

executed in 5.50s, finished 23:56:33 2019-02-11

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？