test1

March 18, 2023

[ ]:
```
import numpy as np
import matplotlib.pyplot as plt
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```
#arr = np.random.normal(2, 3, 1000) #DOES NOT FOLLOW BENFORD'S LAW
#arr = np.random.uniform(2, 3, 1000) #DOES NOT FOLLOW BENFORD'S LAW
#arr= np.random.randint(1, 1000, 1000) #DOES NOT FOLLOW BENFORD'S LAW
# arr = np.random.exponential(2, 1000) #FOLLOWS BENFORD'S LAW
# arr = np.random.lognormal(2, 3, 1000) #FOLLOWS BENFORD'S LAW
arr = np.random.poisson(2, 1000) #FOLLOWS BENFORD'S LAW
```

[ ]:
```
ndigits = 10
p_ndigits = np.log(1 + 1/np.arange(1, ndigits))/np.log(ndigits)
a = np.zeros(ndigits)
for i in arr:
    a[int(str(i).replace('0.', '').replace('-', '')[0])] += 1
```

a = [a[(i+1)%ndigits]/ndigits for i in range(ndigits)]

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plt.figure(figsize=(10, 8))
plt.bar(range(1, ndigits), a[1:]/np.sum(a), width=1)
plt.stem(range(1, ndigits), p_ndigits, linefmt='r-', markerfmt='ro',␣
 ↪basefmt='r-')
plt.xticks(range(1, ndigits))
plt.show()
```

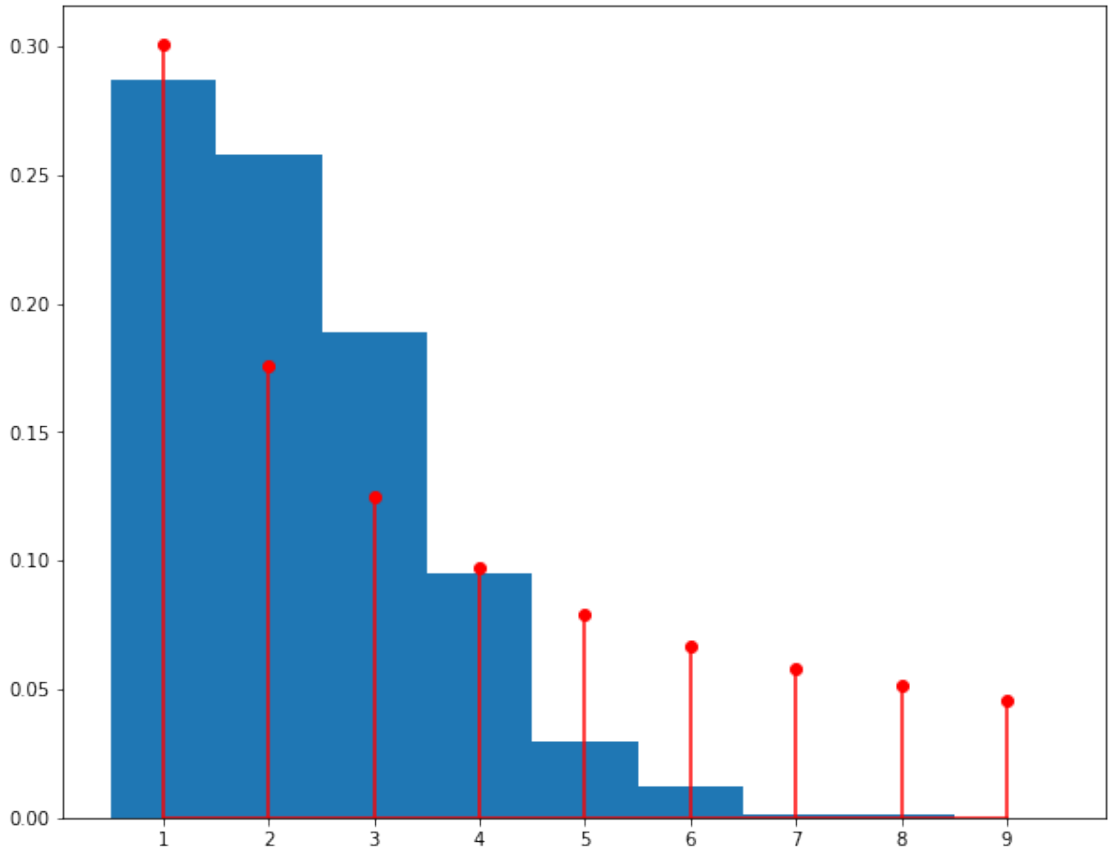

[ ]:
```
a
```

[ ]: array([127., 287., 258., 189., 95., 30., 12., 1., 1., 0.])

[ ]:
```
def benford_law_test(arr, ndigits=10):
    a = np.zeros(ndigits)
    for i in arr:
        a[int(str(i).replace('0.', '').replace('-', '')[0])] += 1

    return a[1:]/np.sum(a)

def ideal_benford_law(ndigits=10):
    return np.log(1 + 1/np.arange(1, ndigits))/np.log(ndigits)
```

[ ]:
```
all_a = []
for i in range(1000):
    arr = np.random.normal(2, 3, 1000)
    all_a.append(benford_law_test(arr)[0])
    #assert np.allclose(a, b, atol=0.05)
```

[ ]:
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all_a = np.asarray(all_a)
```

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plt.hist(all_a, bins=10)
```
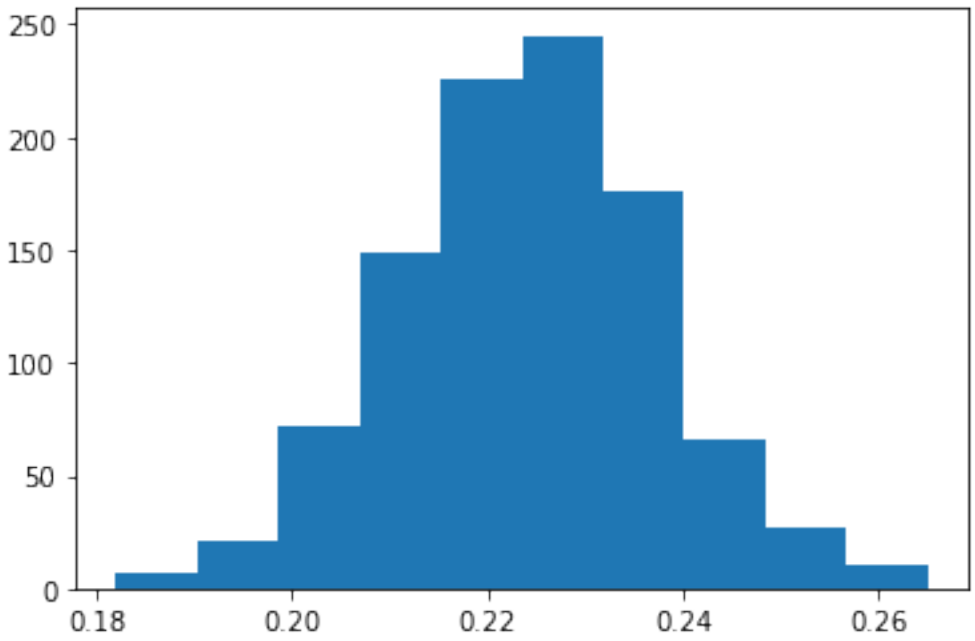

[ ]:
```
(array([  7.,  21.,  72., 149., 226., 245., 176.,  66.,  27.,  11.]),
 array([0.182 , 0.1903, 0.1986, 0.2069, 0.2152, 0.2235, 0.2318, 0.2401,
        0.2484, 0.2567, 0.265 ]),
 <BarContainer object of 10 artists>)
```



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