Exercise 1

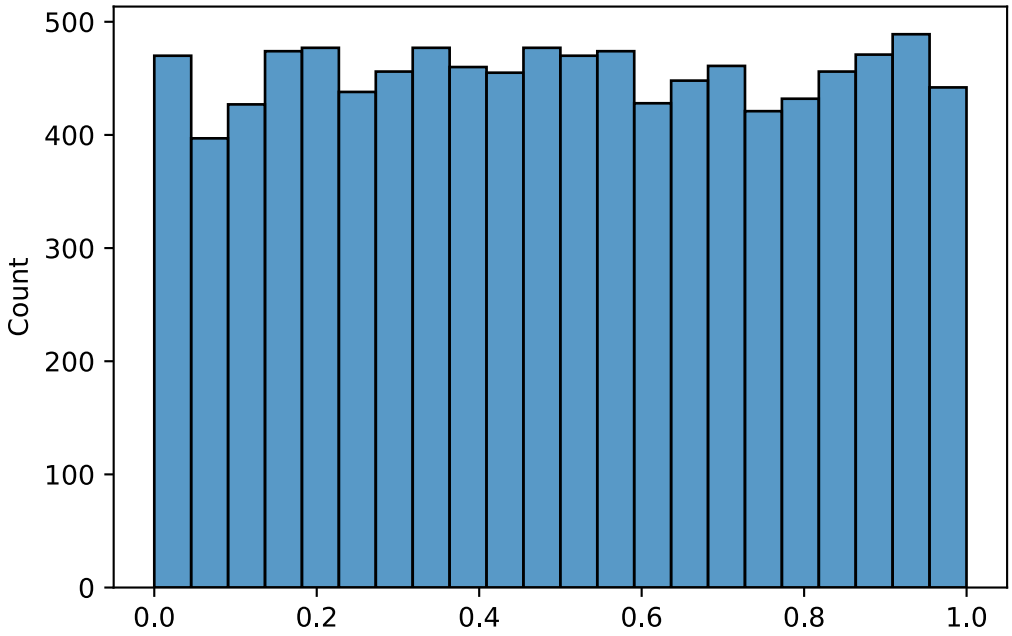
In [ ]:
```
%load_ext autoreload
%autoreload 2
```

In [ ]:
```
from src.my_random.tests import *
from src.my_random.gen import *
import scipy.stats as stats
```

Good example compared to Scipy's uniform generation

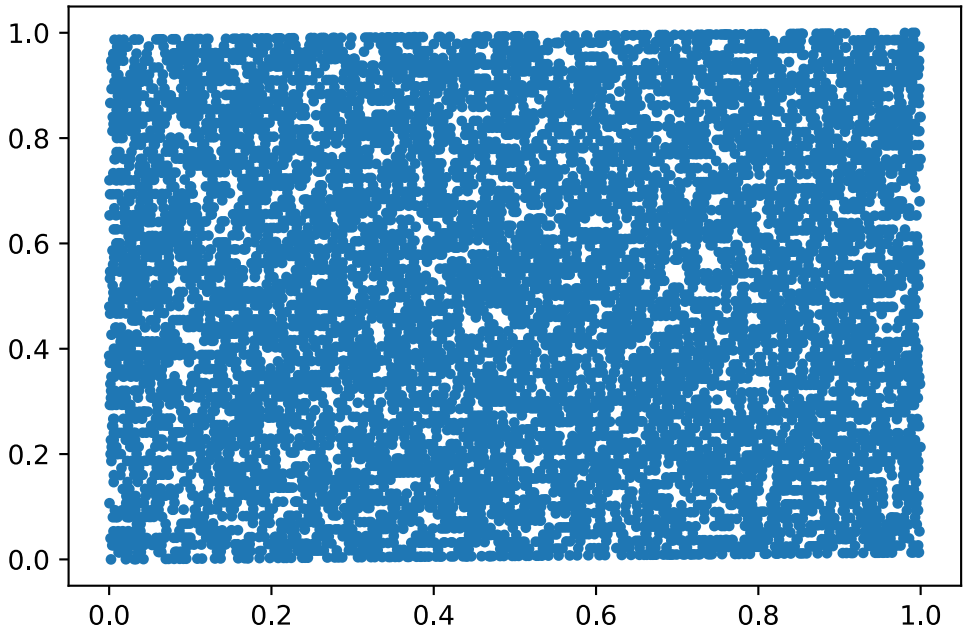
In [ ]:
```
u_lcg = [k for k in lcg(M=2**16+1, a=75, c=74, n=10_000, x=10)]
sns.histplot(u_lcg)
```

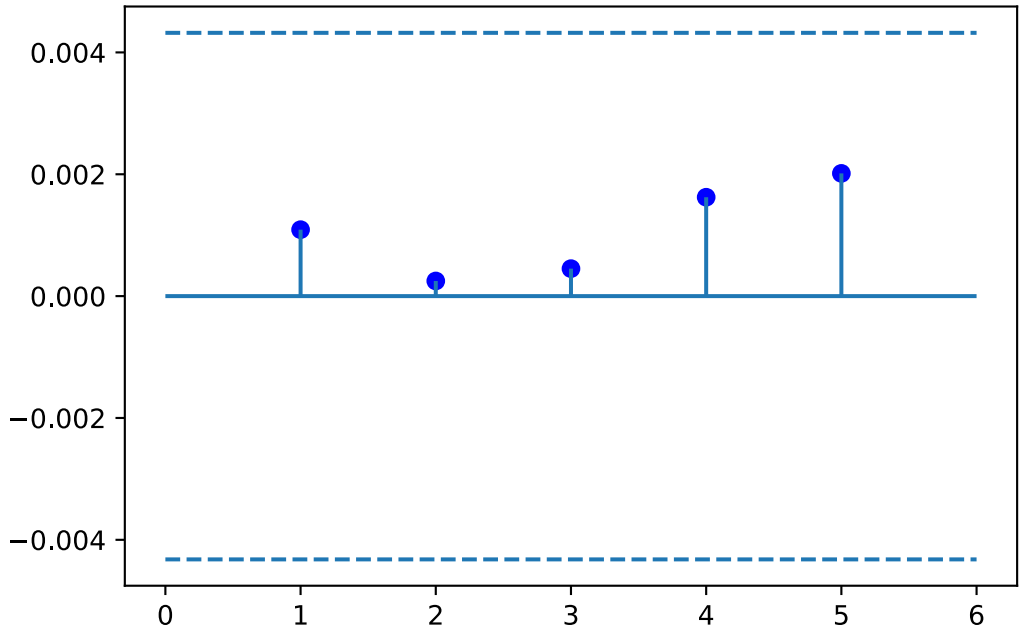
Out[ ]:
```
<AxesSubplot:ylabel='Count'>
```



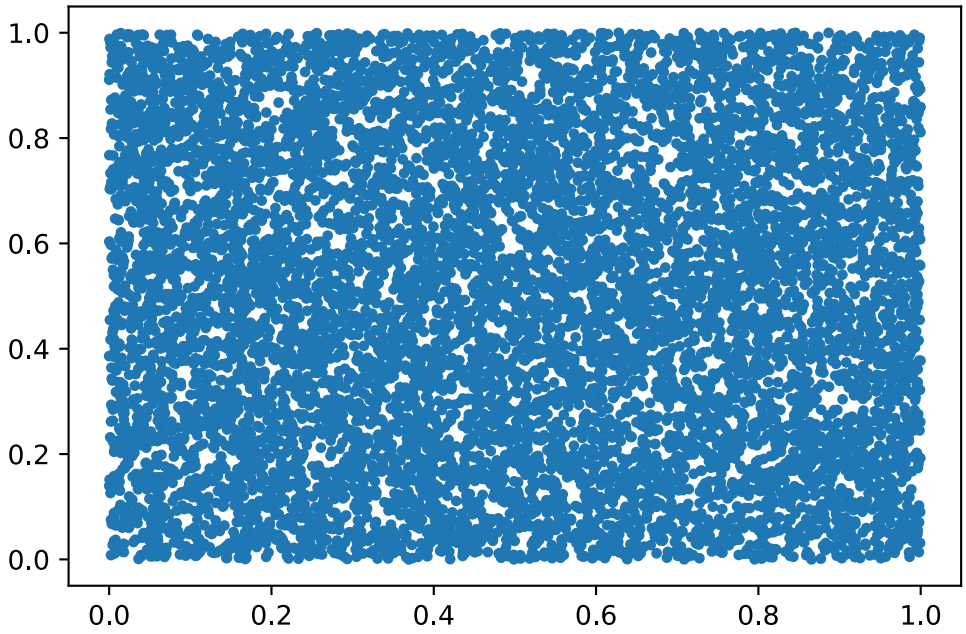
In [ ]:
```
u_scipy = stats.uniform.rvs(size=10_000)
all_test(np.array(u_lcg))
all_test(u_scipy)

# fig, ax = plt.subplots(1, 2)
# sns.histplot(u_lcg, ax=ax[0])
# sns.scatterplot(x = u_lcg[1:], y = u_lcg[:-1], ax=ax[1])
```

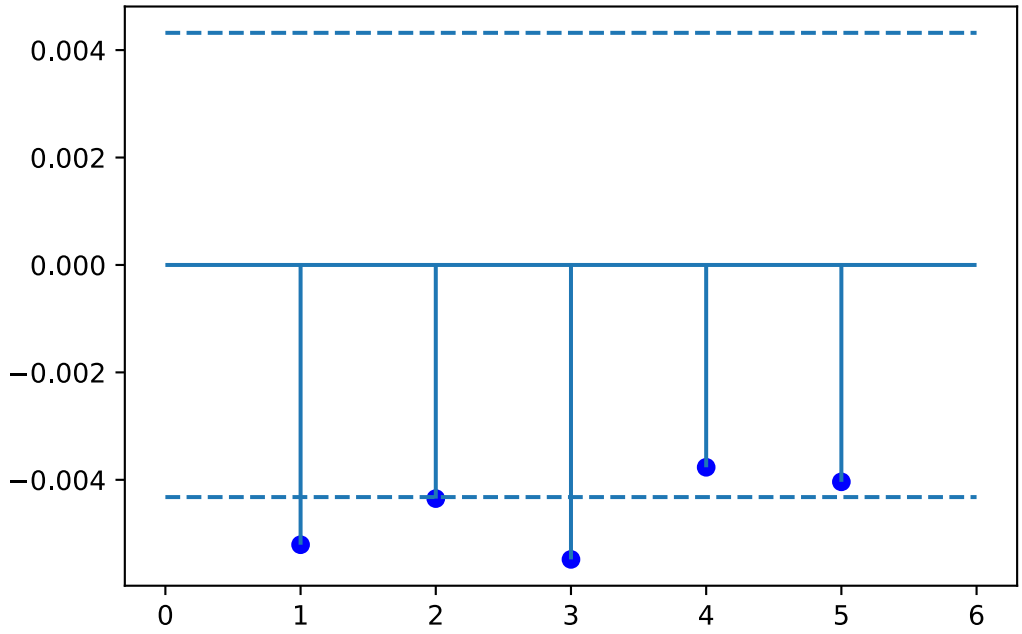
```
5001.0 2499.7499749975 5011
____________Uniform Distribution Tests___________
Chi^2 test with 100 groups:                  p=1.00
Kolmogorov Smirnof:                          T=7.33
_____________Independence Tests_________________
Run Test 1: Above/below Median:              p=0.84
Run Test 2: Up/Down length count Test:       p=0.48
Run Test 3: Up/Down run count Test:          p=0.96
```






```
5001.0 2499.7499749975 5014
_____________Uniform Distribution Tests_____________
Chi^2 test with 100 groups:                  p=0.07
Kolmogorov Smirnof:                          T=7.32
_________________Independence Tests_________________
Run Test 1: Above/below Median:              p=0.79
Run Test 2: Up/Down length count Test:       p=0.13
Run Test 3: Up/Down run count Test:          p=0.63
```



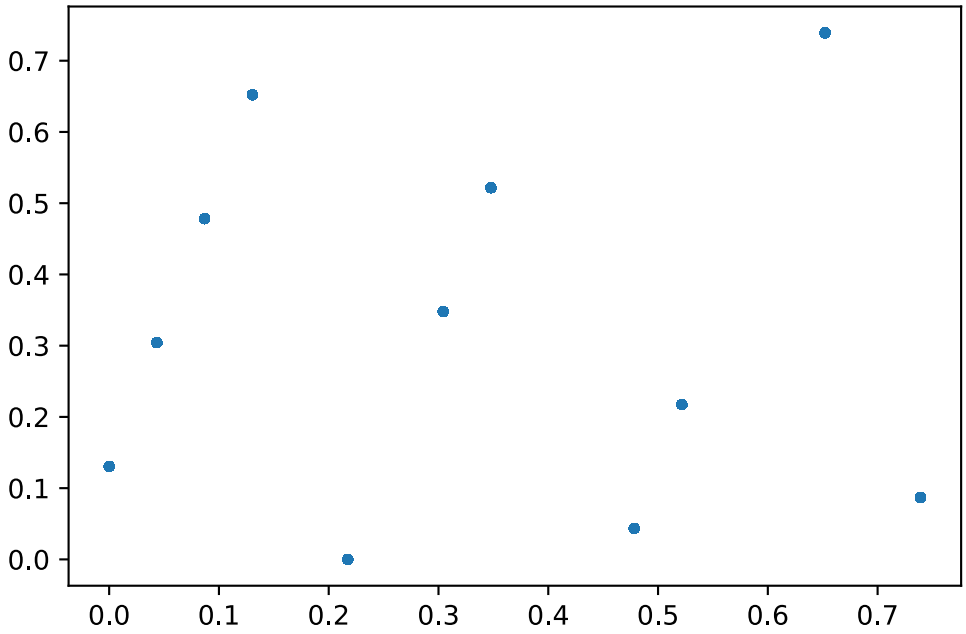


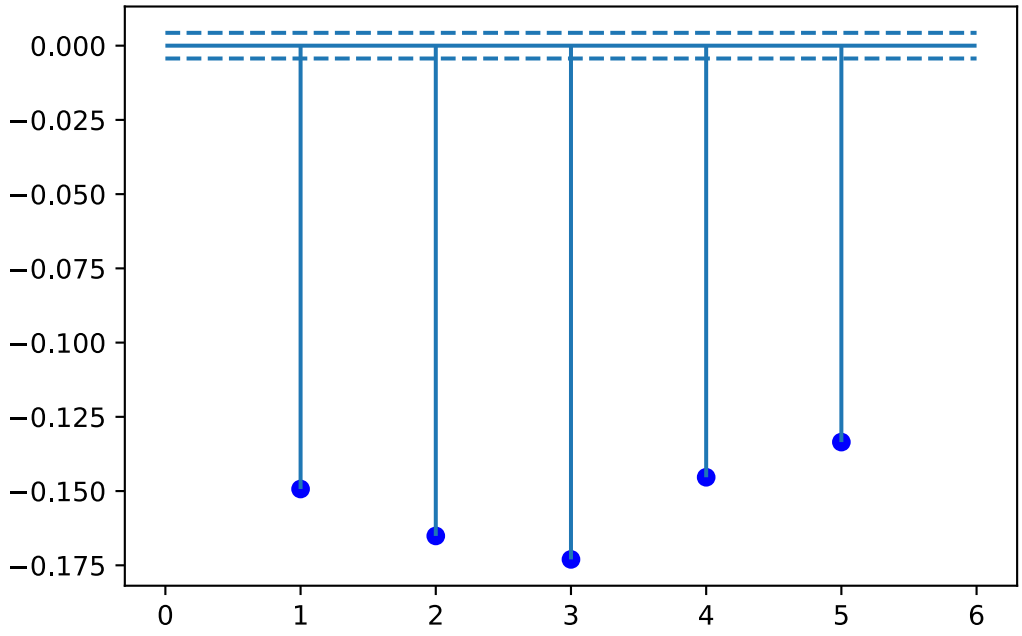
Out[ ]:
```
(0.06879168564234694,
 7.320575964274654,
 0.7948537440906605,
 0.126684966176001,
 0.6295992023085439)
```

Bad Example

In [ ]:
```
u_lcg = [k for k in lcg(M=23, a=75, c=74, n=10_000, x=1)]
all_test(np.array(u_lcg))
```

```
4546.49994500055 2272.4999174978 5455
_____________Uniform Distribution Tests_____________
Chi^2 test with 100 groups:                  p=0.00
Kolmogorov Smirnof:                          T=4.17
_________________Independence Tests_________________
Run Test 1: Above/below Median:              p=0.00
Run Test 2: Up/Down length count Test:       p=0.00
Run Test 3: Up/Down run count Test:          p=0.00
```





Out[ ]: `(0.0, 4.174312922730702, 0.0, 0.0, 0.0)`

In general you would probably need to perform the tests multiple times, since the random number will lie outside the confidence interval about 5% of the time if it was truly random.