

**Equation:  $S_{i+1} = (M * S_i + A) \bmod N$**

**Exercise 1:**

When  $M = 6$ ,  $A = 5$ ,  $N = 11$

Start at seed 0

Seed: 0	--> $(6 * 0 + 5) \% 11$	= 0.4545
Seed: 0.4545	--> $(6 * 0.4545 + 5) \% 11$	= 0.1818
Seed: 0.1818	--> $(6 * 0.1818 + 5) \% 11$	= 0.5455
Seed: 0.5455	--> $(6 * 0.5455 + 5) \% 11$	= 0.7273
Seed: 0.7273	--> $(6 * 0.7273 + 5) \% 11$	= 0.8182
Seed: 0.8182	--> $(6 * 0.8182 + 5) \% 11$	= 0.3636
Seed: 0.3636	--> $(6 * 0.3636 + 5) \% 11$	= 0.6364
Seed: 0.6364	--> $(6 * 0.6364 + 5) \% 11$	= 0.2727
Seed: 0.2727	--> $(6 * 0.2727 + 5) \% 11$	= 0.0909
Seed: 0.0909	--> $(6 * 0.0909 + 5) \% 11$	= 0.0

Start at seed 4

Seed: 4	--> $(6 * 4 + 5) \% 11$	= 0.6364
Seed: 0.6364	--> $(6 * 0.6364 + 5) \% 11$	= 0.2727
Seed: 0.2727	--> $(6 * 0.2727 + 5) \% 11$	= 0.0909
Seed: 0.0909	--> $(6 * 0.0909 + 5) \% 11$	= 0.0
Seed: 0.0	--> $(6 * 0.0 + 5) \% 11$	= 0.4545
Seed: 0.4545	--> $(6 * 0.4545 + 5) \% 11$	= 0.1818
Seed: 0.1818	--> $(6 * 0.1818 + 5) \% 11$	= 0.7273
Seed: 0.7273	--> $(6 * 0.7273 + 5) \% 11$	= 0.8182
Seed: 0.8182	--> $(6 * 0.8182 + 5) \% 11$	= 0.3636
Seed: 0.3636	--> $(6 * 0.3636 + 5) \% 11$	= 0.6364

## Exercise 2:

When  $M = 6$ ,  $A = 3$ ,  $N = 7$

Start at seed 0

$$\text{Seed: } 0 \quad \rightarrow (6 * 0 + 3) \% 7 = 0.4286$$

$$\text{Seed: } 0.4286 \quad \rightarrow (6 * 0.4286 + 3) \% 7 = 0.0$$

Start at seed 1

$$\text{Seed: } 1 \quad \rightarrow (6 * 1 + 3) \% 7 = 0.2857$$

$$\text{Seed: } 0.2857 \quad \rightarrow (6 * 0.2857 + 3) \% 7 = 0.1429$$

Start at seed 4

$$\text{Seed: } 4 \quad \rightarrow (6 * 4 + 3) \% 7 = 0.8571$$

$$\text{Seed: } 0.8571 \quad \rightarrow (6 * 0.8571 + 3) \% 7 = 0.5714$$

Start at seed 5

$$\text{Seed: } 5 \quad \rightarrow (6 * 5 + 3) \% 7 = 0.7153$$

## Probability Problem:

$$P(\{\text{1st ball entering an empty can}\}) = 5/5$$

$$P(\{\text{2nd ball entering an empty can}\}) = 4/5$$

$$P(\{\text{3rd ball entering an empty can}\}) = 3/5$$

$$(5/5) * (4/5) * (3/5) = 60/125 = 12/25 \text{ chance or } 48\% \text{ chance}$$

**Code:**

```
from collections import Counter
import math

numbers = [0]

while True:

    try:
        n = int(input("Enter a natural number (Enter a letter to stop): "))
        numbers.append(n)
    except ValueError:
        break

#calculate the mean

S = sum(numbers)
N = len(numbers)

mean = S / N

print ("The mean is ", mean)

#calculate the median of the numbers
numbers.sort()
print(numbers)

if N%2 == 0:
    #Even number of data
    mone = N/2
    mtwo = (N/2) + 1
    #to read python list cast and shift
    mone=int(mone)-1
    mtwo=int(mtwo)-1
    median = (numbers[mone]+numbers[mtwo])/2
else:
```

```

    #odd number of data
    m=(N+1)/2
    m=int(m)-1
    median=numbers[m]
print("The median is", median)

from collections import Counter
c= Counter(numbers)
mode = c.most_common(1)
Mode = mode[0][0]
print('The Mode is',Mode)

import math
#calculate the standard deviation
y = 0
a=0
for x in numbers:
    y = (x-mean)**2
    a = a+y
    sigma = math.sqrt(a/N)
print ('The standard deviation is',sigma)

```

```

def RNG(M, A, N, seed, repitition):
    data = []
    m = M
    a = A
    n = N
    S = seed

    for count in range(repitition):

        S = (M * S + A) % N

```

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        #confine the randome numbers to the interval of 0-1

    data.append(S/N)

    return data

def mean(data):
    return (sum(data) / len(data))

def PrintRNG(data):
    for n in range(len(data)):
        print('{0:.4g}'.format(data[n]))

#Computer Program
print("-----Programming-----\n")

data = RNG(8601, 4857, 10000, 0, 100)

PrintRNG(data)

print("\nThe mean is ", '{0:.4g}'.format(mean(data)))

# Probability problem
import math

N = 100000 # norm
A = 4857 # adder
M = 8601 #multiplier
S = 0
Sum = 0 # initialize counter
#trial = [] # number of trials
trial = 0

```

```

Can = [0,0,0]
K = int(input('Enter the number of experiments . '))

for k in range(K): # Outer loop
    #S = (2 * k) + k # seed
    for i in range(3):
        S = (M * S + A) % N
        r = S/N # The random number on [0,1)

        Can_Number = math.floor(r * 5 + 1)
        Can[i] = Can_Number

    if ((Can[0] != Can[1]) & (Can[1] != Can[2]) & (Can[0] != Can[2])):
        Sum = Sum + 1
    #trial.append(Can)
prob = Sum/K
print("The probability of the 3 balls being in different cans is ", prob)
#print(trial)

```