PROGRAM TITLE: RANDOM NUMBER GENERATOR (2 methods)

PROGRAM CLASSIFICATION: General

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PURPOSE: To provide a basis for random choice within a program.

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Program No: FM - 110
Orig. Date: 1 Dec 59
Programmer: H. R. Knitter

Program Title: Random Number Generator (2 methods).

Purpose: To provide a basis for random choice within a program.

Method 1: A set of transformations are performed on a given number N so that the resultant N' is sufficiently "unpredictable". A double length number N is formed, then $N' = (N^{1.5})$ least sig. bits plus $(N^{1.5})$ most sig. bits where overflow is ignored.

Procedure: The following are the necessary orders:

```
SQR n
MPY n
STO n
XAR -
ADD n
TOV next instr.
STO n
```

Where n is the name of the location for N and where the resultant N' will be found.

Output: The output is a number $0 < N' < 1$ at binary 0.

Limitations: This method has a reasonably large cycle time for all numbers tested as the original N. Good results were obtained using +10.4732.0+24.0461.0 which had a cycle greater than 45,000 repetitions. This method degenerates when N = 0 but this fortunately, seems to generate in only rare cases. This method is not recommended for advanced scientific determinations (e.g. using Monte Carlo methods) since the only test other than cycle length, has been distribution, which was sufficiently square between 0 and 1.

Note: To obtain a random number A such that $0 \leq A < B$ where B is a given maximum, multiply the original random number N (at binary 0) by B. The resultant number A will be random and have the same scaling as B.

Method 2: The method used is the one suggested in the Journal of the Assoc. for Computing Mach., Oct 59, page 527. The method essentially defines a new random number N_j as $[N_{j-1} + N_{j-k}]_{MOD\ 1}$ at binary 0.

Procedure: A transfer to the initial location (L_0) will initiate the generation of a new random number which will be in the accumulator upon return.

Note: Same note as in method 1 above.

Because of method 1's short length and simplicity, a program tape for this method will not be distributed. The number FM-110 refers to method 2.

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[Journal, Assoc. Comp. Mach., Oct 59, pg 527]

```
6740.0 +15.7760.0  SAX
       +64.6740.0 ✓CTL

6741.0 +66.6750.0 ✓CTV
       +57.7762.0  TRA

6742.0 +01.7773.0  ADD     1 @ 39
       +42.7772.1  STA     store Return

6743.0 +00.7777.0  CLA     n - list position
       +01.7774.0  ADD     λo for list

6744.0 +42.7771.0  STA     (λa)
       +53.0000.0  TOV

6745.0 +00.7777.0  CLA     n
       +01.7776.0  ADD     1 @ 18, 38

6746.0 +33.7775.0  EXT     n mod 8
       +60.6757.0 ✓STO     n

6747.0 +01.7774.0  ADD     λo
       +42.7770.1  STA     (λb)


6750.0 +42.7772.0  STA     (λb)
       +00.0000.0  CLA   }
                         }
6751.0 +01.0000.0  ADD   } [λa] + [λb] → [λb] mod 1 @ 0
       +53.7772.0  TOV   }
                         }
6752.0 +60.0000.0  STO   }
       +57[7765.0]✓TRA   — EXIT

6753.0 +00.0000.0  ---
       -00.0000.1  ---     1 @ 39

6754.0 +00.6760.0  ---
       -00.6760.0  ---     λo

6755.0 +00.0017.0  ---
       -00.0017.0  ---     Mask

6756.0 +00.0001.0  ---
       -00.0001.0  ---     1 @ 18, 38

6757.0 +00.0004.0  ---
       -00.0004.0  ---     n
```

J 2

FM-111

List of "previous" 16 random numbers

6760.0	+15.0237.0	---
	-77.1477.1	---
6761.0	+06.2665.0	---
	+61.1755.1	---
6762.0	+43.3362.1	---
	+16.3662.1	---
6763.0	+11.6754.1	---
	+11.7061.1	---
6764.0	+72.2703.1	---
	+10.0655.1	---
6765.0	+32.5326.0	---
	+55.7347.1	---
6766.0	+57.3733.0	---
	+70.0042.1	---
6767.0	+07.1401.1	---
	-06.6127.1	---
6770.0	+01.5200.1	---
	-05.7266.1	---
6771.0	+11.1550.1	---
	+67.3735.1	---
6772.0	+66.3535.0	---
	+35.6727.0	---
6773.0	+73.2415.1	---
	+66.4365.0	---
6774.0	+66.4456.0	---
	-23.2217.0	---
6775.0	+40.7614.0	---
	-16.3650.1	---
6776.0	+50.6361.0	---
	+65.3027.1	---
6777.0	+05.3301.0	---
	-21.7305.0	---