1 `restart;maple_mode(1);cas_setup(0,0,0,1,0,1e-10,10,[1,50,0,25],0,0,0); #radians,pas de cmplx, pas de  Sqrt`

Warning: some commands like cube might change arguments order

Menu

2 `time(p:=nextprime(10^50));`

0.005

Menu

3 `time(isprime(p));`

0.07

Menu

4 `time(is_pseudoprime(p));`

0.0026

Menu

5 le temps de isprime est trop long pour avoir ete utilise pour
trouver le nombre premier avec nextprime. La doc confirme bien que
nextprime donne un pseudopremier.

6 `i:=20;n:=nextprime(10^i)*nextprime(20^i);`

(20, 104857600000000000040894555000000000000000003549)

Menu

7 `ifactor(n);`

Evaluation time: 1.64

$$10000000000000000039 \cdot 104857600000000000000000091$$

Menu

8 a partir de i=30 ca ne repond plus?

9 `p:=nextprime(=nextprime(10^30)*nextprime(20^30));`

1073741824000000000000000000061203284109000000000000000000000000008409

Menu

10 `ifactor(p-1); #ca marche souvent`

$$2^3 \cdot 3 \cdot 389 \cdot 733 \cdot 1569043746222576048238799828476023929007518023499814708952772 41$$

Menu

11 `pari();`

All PARI functions are now defined with the pari_ prefix.
PARI functions are also defined without prefix except:
abs acos acosh arg asin asinh atan atanh binomial bitand bitor bitxor ceil charpoly concat conj content cos cosh divis
Note that p-adic numbers must have O argument quoted e.g. 905/7+O('7^3')
Type ?pari for short help
Inside xcas, try Help->Manuals->PARI for HTML help

Menu

12 `pari_isprime(p,1);`

Evaluation time: 9.66

2	7	1
3	2	1
389	2	1
733	2	1
1569043746222576048238799828476023929007518023499814708952772 41	2	2 3 5 7 56467 6553084925887974620 8

Menu

13 Les grands nombres premiers apparaissant dans le certificat sont eux
m^eme certifi'es, ce qui explique les crochets emboit'es.

14 On a cree n avec de petits facteurs, on arrive a le factoriser

```
15 i:=0;l:=[];
   while i<1 do
   n:=1;for j from 1 to 10 do n:=n*(1+rand(10000)) od;
   if is_pseudoprime(n+1)>0 then p:=n+1;i++; fi;
   od;
```

(0, [], 1) Menu

```
16 Divn:=transpose(ifactors(p-1)[2]);
```

2	3	5	7	11	13	17	19	127	131	167	977	1091	4211	5009
10	8	2	2	1	1	1	1	1	1	1	1	1	1	1

Menu

```
17 divn:=Divn[1];
```

[2 3 5 7 11 13 17 19 127 131 167 977 1091 4211 5009] Menu

```
18 expn:=Divn[2];
```

[10 8 2 2 1 1 1 1 1 1 1 1 1 1 1] Menu

```
19 On cherche maintenant le certificat. Pour chaque premier divisant p-1 on trouve
   un element d'ordre la puissance maximale  de ce diviseur qui divise p-1. On
   utilisera factors et powmod
```

```
20 certifs:=[];
   for i in divn do
   a:=2;
   while powermod(a,(p-1)/i,p)=1 do a:=1+rand(p-1) od;
   certifs:=[op(certifs),a];
   od;
```

Menu

```
21 g:=1;
```

1 Menu

```
22 for i from 1 to dim(divn) do g:=mods(g*powmod(certifs[i],(p-1)/(divn[i]^expn[i]),p),p) od;
```

1170037421196655289142157921790713 8 Menu

```
23 # seq(powmod(g,i,p),i=divisors(p-1));# NON! trop de diviseurs!
```

Syntax compatibility mode maple
Parse error line 2 at/

undef Menu

```
24 p:=nextprime(10^13);i:=0;l:=[];
```

(10000000000037 , 0, []) Menu

```
25 while i<10 do
   if is_pseudoprime(4*p+1)>0 then l:=[op(l),4*p+1];i++; fi;
   p:=nextprime(p);
   od:l;
```

Done, [40000000000733 40000000002629 40000000011053 40000000016309 40000000017917 400(Menu

```
26 p:=nextprime(10^13+100);
```

10000000000129 Menu

```
27 g:=pari_znprimroot(p);
```

7 % 10000000000129 Menu

```
28 pari_znlog(3,Mod(g,p)); #il reussit
```

2552475531946 Menu

```
29 ifactor(p-1);
```

$2^{7} \cdot 3 \cdot 98867 \cdot 263401$ Menu

```
30 p-1 a de petits facteurs premiers, on peut donc resoudre le probleme
   du log discret. Dans le cas suivant ca ne marche plus.
```

```
31 p:=l[3];
```

40000000011053 Menu

```
32 g:=pari_znprimroot(p);
```

```
33 #pari_znlog(3,Mod(g,p)); #depasse la memoire max de pari
   Syntax compatibility mode maple
   Parse error line 2 at/
                          undef                          Menu
34 ----------------------------------EXERCICE----------------------------------------
35 p:=l[3];
                     40000000011053                      Menu
36 b,e pas trop petits par rapport a p, pour que le modulo p melange
   vraiment.
37 message:="ABCDA, Remarquez que des lettres identiques ne sont pas codees de la meme maniere!";asc(message
   "ABCDA, Remarquez que des lettres identiques ne sont pas codees de la meme maniere!" , [65  66  67  68
                                                                                          Menu
38 asc(messsage)-[seq(65,i=1..length(message))];
   [-65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -65  -6
                                                                                          Menu
39 b:=12345;e:=54321; igcd(e,p-1); B:=powmod(b,e,p);
                  ( 12345,  54321,  1,  33473253573817  )  Menu
40 l:=asc(message);k:=[seq(rand(50),i=1..length(message))];
   [65  66  67  68  65  44  32  82  101  109  97  114  113  117  101  122  32  113  117  101  32
                                                                                          Menu
41 C:=[seq([(b^k[i]) mod p,(l[i]*B^k[i]) mod p],i=1..length(message))];#le message crypte
```

1112550120652	1712465384039
9285222567600	20568860851465
10304518854412	5530469661717
12345	31144114074766
15764341295284	22853646682761
26072565355155	24716418195292
20640365499672	31403166870846
18276441706461	23740747885750
10304518854412	24131591326474
23119392340457	3004317636486
18689839150260	8253956815539
18689839150260	8253956815539
9008468196307	31350325693608
1881365963625	196945846564
25099884345130	15950384136745
18276441706461	23740747885750
1881365963625	36640389256496
10304518854412	37158880861940
5312023043230	11247923060337
18072155013312	7462318873458
20753577694059	3027232228382
15764341295284	29996329018557
3060797962643	38087767443751

```
42 ee:=p-1-e;#c'est -e [p-1] qui nous interesse
```

```
                                39999999956731                                Menu
```

```
43 L'astuce est que (B^k)=((b^e)^k) qui vaut par commutativit'e  des la
   composition des application B:x->x^k et A:x->x^e  ((b^k)^e).
Le principe a retenir, est qu'en crypto on a juste besoin
d'operations A,B qui  commutent, et que la donnee de A de donne pas
A^(-1)
```

```
44 decrypt:=[seq(irem(powmod(C[i][1],ee,p)*C[i][2],p),i=1..length(message))];
```

```
[65  66  67  68  65  44  32  82  101  109  97  114  113  117  101  122  32  113  117  101  32   Menu
```

```
45 char(decrypt);
```

```
                ABCDA, Remarquez que des lettres identiques ne sont pas codees de la meme maniere!   Menu
```

```
46 ----------------------------------------Exercice----------------------------------------------------
```

```
47 8*2+7 mod 7; (8*2+7) mod 7; #Attention mod est prioritaire sous xcas
```

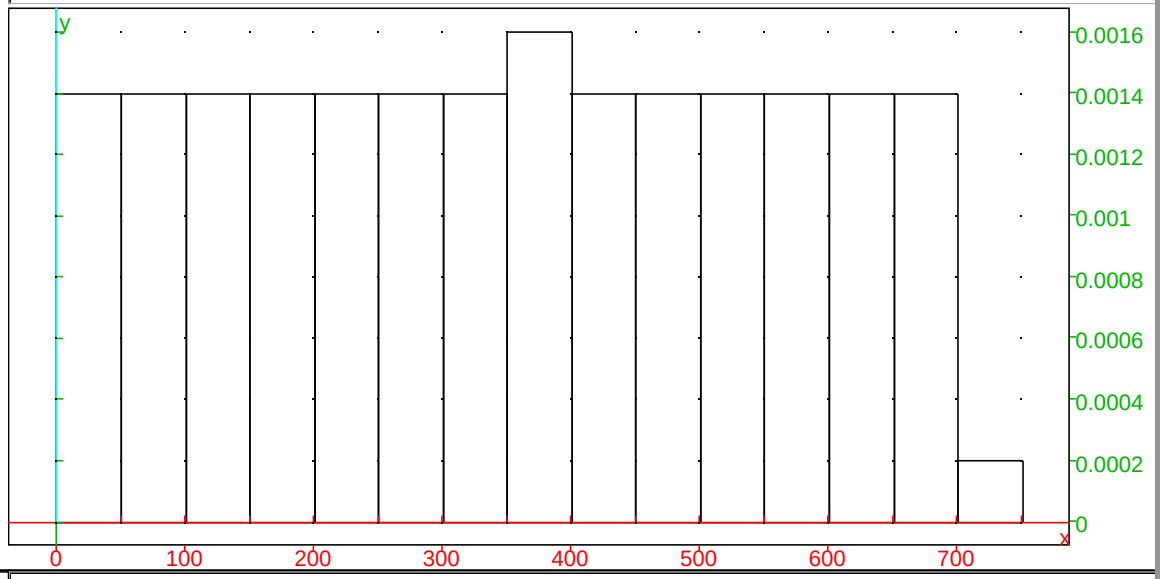
```
                                    ( 16,  2  )                               Menu
```

```
48 Si a=1, on a x_n=x_0+n.c [m], on fait donc par exemple: c=7,x0=1
```

```
49 l:=[seq((n*7+1) mod 1001,n=1..100)];
```

```
[8  15  22  29  36  43  50  57  64  71  78  85  92  99  106  113  120  127  134  141  148  155   Menu
```

```
50 histogram(classes(l,0,1001/20)); #C'est tout a fait plat. Trop!
```




```
51 Remplacer les crochets par des incolades cree un ensemble, ce qui simplifie
   automatiquement les elements egaux
```

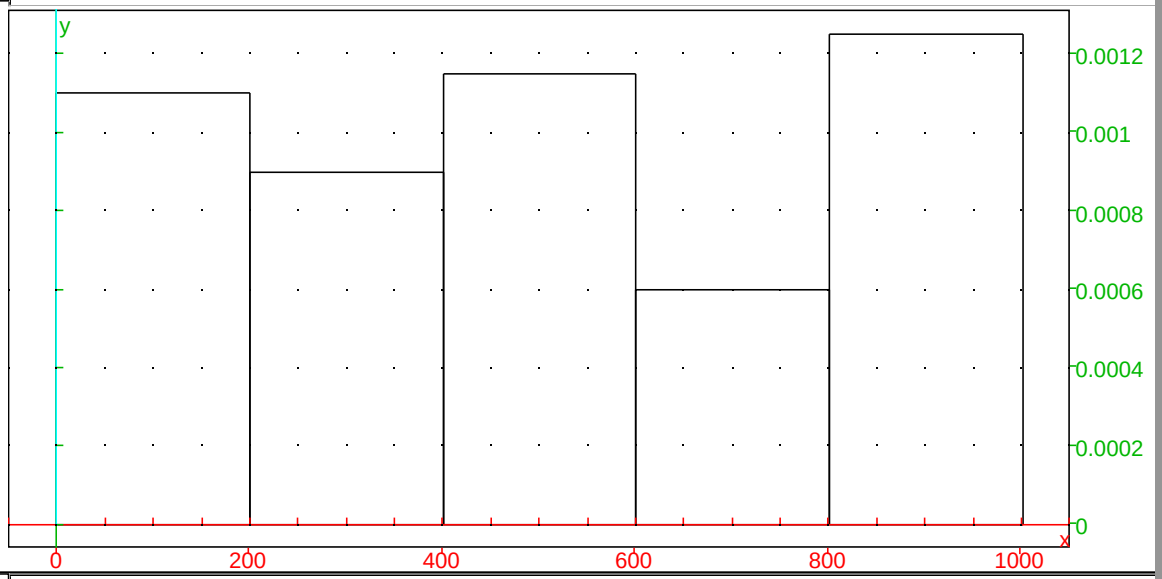
```
52 nops(l);nops({op(l)}); #ils sont tous distincts
```

```
                                   ( 100,  100  )                             Menu
```

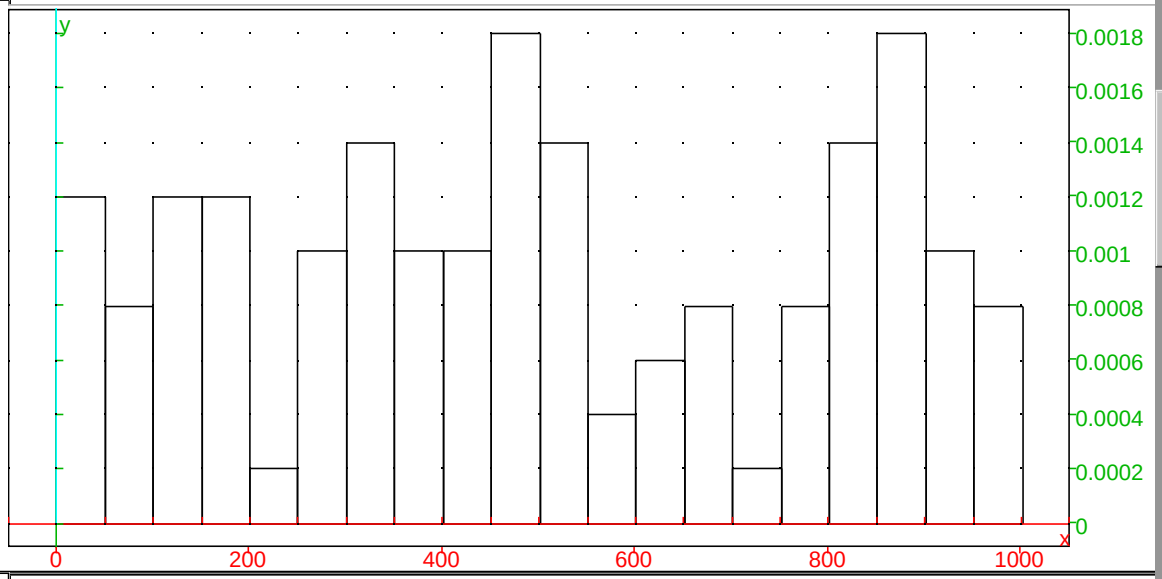
```
53 l:=[seq(rand(1001),n=1..100)];
```

```
[896  774  541  303  453  464  177  281  74  885  147  182  25  939  66  814  975  112  76  333
```

54 histogram(classes(l,0,1001/5));



55 histogram(classes(l,0,1001/20));



56 nops(l);nops({op(l)});#il y a bien des anniversaires identiques

(100, 93) Menu

57 On a en fait 1001^100 suites possibles, et 1001!/901! suites dont
tous les termes sont distincts.

58 1001!/901!/1001.^100;

0.00599058972 Menu

59 x:=1; a:=237;c:=54321;m:=10^4; l:=[];

(1, 237, 54321, 10000, []) Menu

60 for i from 1 to 500 do x:=(a*x+c) mod m; l:=[op(l),x] ; od:

Done Menu

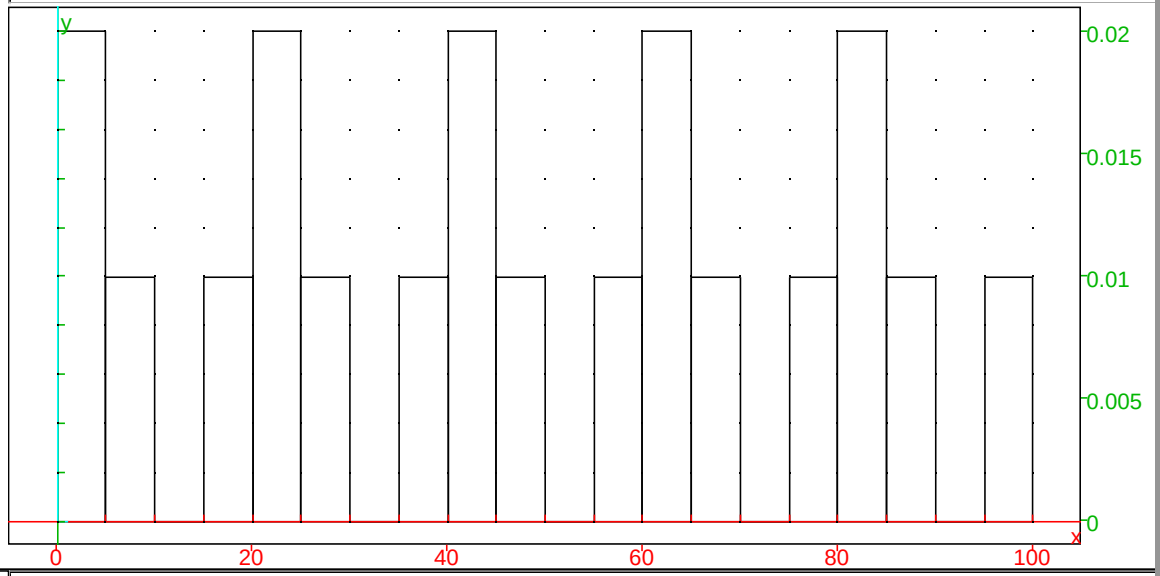
61 l1:=[seq(i mod 10^2,i=l)];

[58 67 0 21 98 47 60 41 38 27 20 61 78 7 80 81 18 87 40 1 58 67 0 21 98 Menu

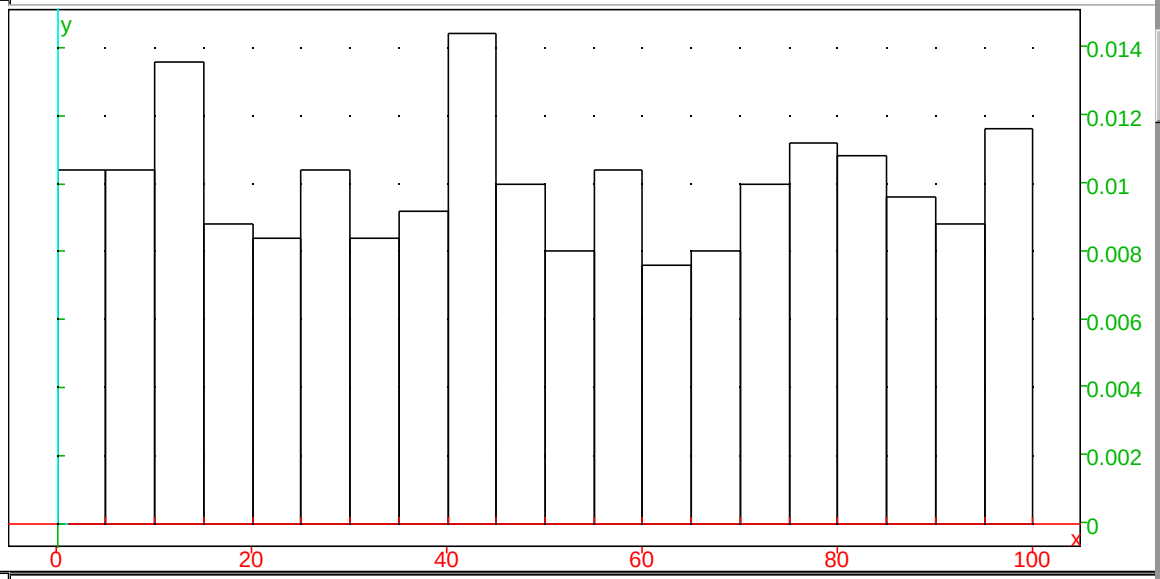
62 l2:=[seq(trunc(i/10^2),i=l)];

[45 45 67 22 6 97 43 76 52 57 16 82 21 5 44 60 55 20 89 31 92 84 10 13 7

```
63 histogram(classes(l1,0,5));
```

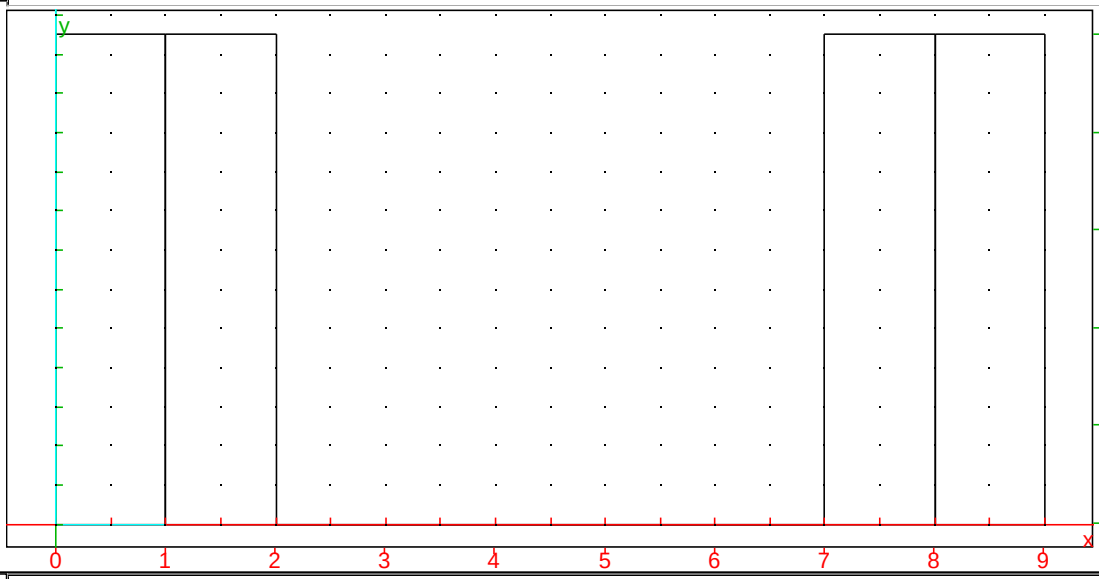



```
64 histogram(classes(l2,0,5));
```




```
65 l1:=[seq(i mod 10,i=l)];
[8 7 0 1 8 7 0 1 8 7 0 1 8 7 0 1 8 7 0 1 8 7 0 1 8 7 0 1 8 7 0 1 8
```

66 histogram(classes(l1,0,1));



67 Si d est un diviseur de m et que $y_n=x_n [d]$, alors $y_{n+1}=ay_n+c [d]$
Donc si d=10^2, les 2 derniers chiffres de x_n ont p'eriode d'au plus d.

68 x:=1; a:=237;c:=54321;m:=10^4-1; l:=[];

(1, 237, 54321, 9999, []) Menu

69 for i from 1 to 500 do x:=(a*x+c) mod m; l:=[op(l),x] ; od:

Done Menu

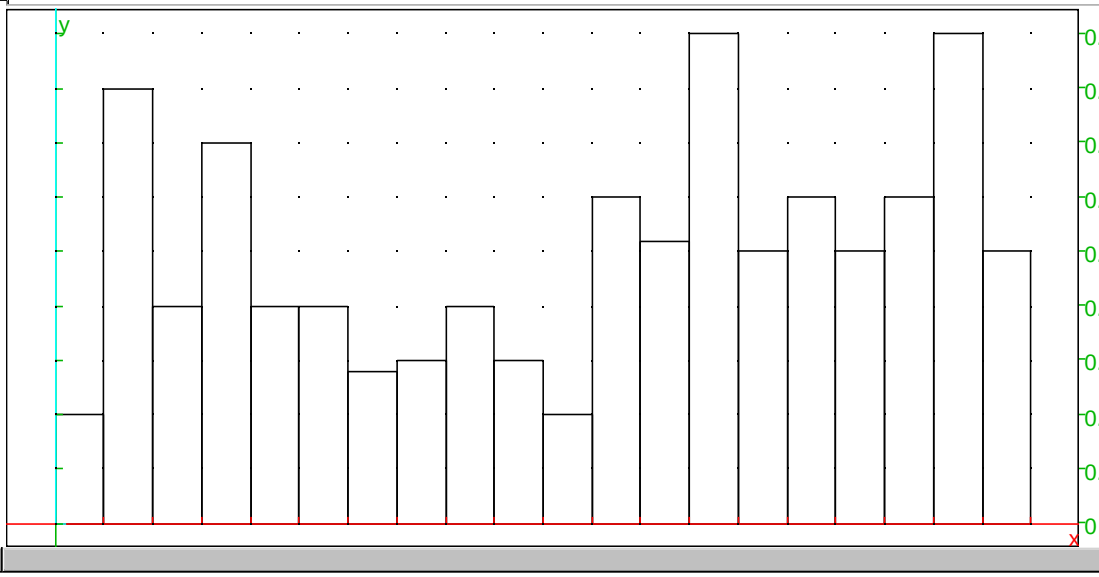
70 l1:=[seq(i mod 10^2,i=l)];

63 65 70 22 31 78 27 68 10 93 68 17 72 91 56 79 62 81 60 61 25 92 6 69 Menu

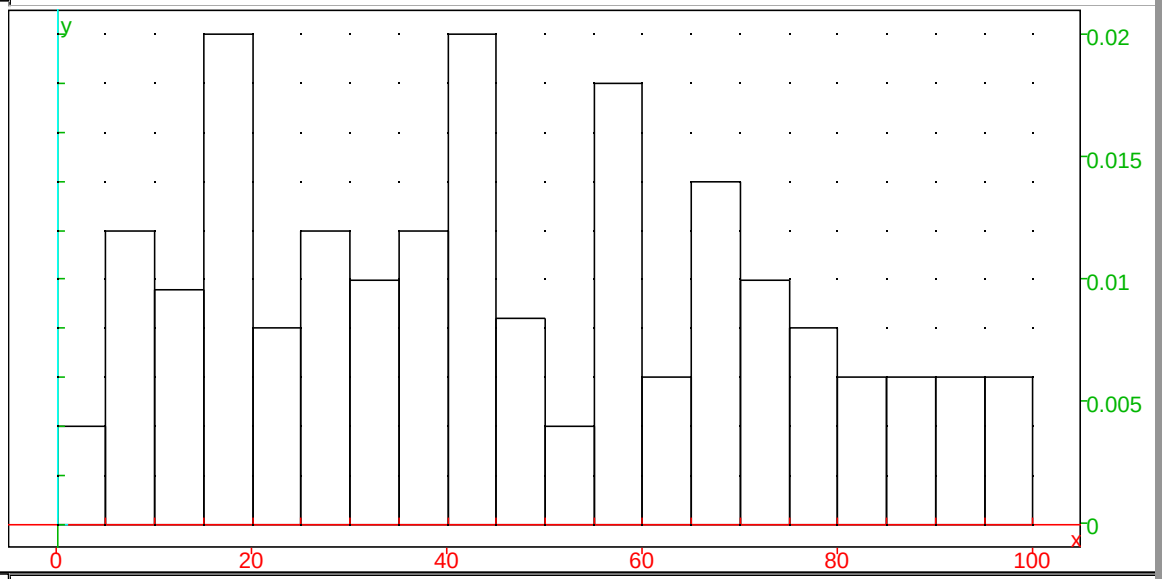
71 l2:=[seq(trunc(i/10^2),i=l)];

45 58 44 38 2 90 60 28 41 84 73 7 42 68 76 89 25 15 90 17 17 31 9 90 38 Menu

72 histogram(classes(l1,0,5));



```
73 histogram(classes(l2,0,5));
```

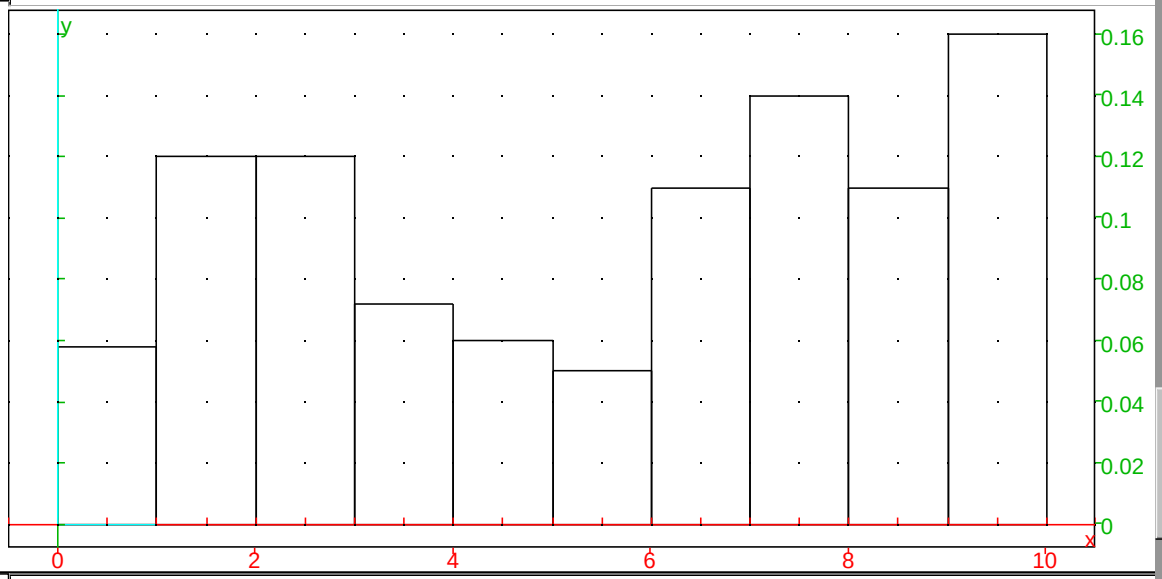



```
74 l1:=[seq(i mod 10,i=l)];
```

[3 5 0 2 1 8 7 8 0 3 8 7 2 1 6 9 2 1 0 1 5 2 6 9 4 6 1 9 9 5 4 1 8

Menu

```
75 histogram(classes(l1,0,1));
```




```
76 x:=1; a:=237;c:=54321;m:=prevprime(10^4); l:=[];
```

(1, 237, 54321, 9973, [])

Menu

```
77 for i from 1 to 500  do x:=(a*x+c) mod m; l:=[op(l),x] ; od:
```

Done

Menu

```
78 l1:=[seq(i mod 10^2,i=l)];
```

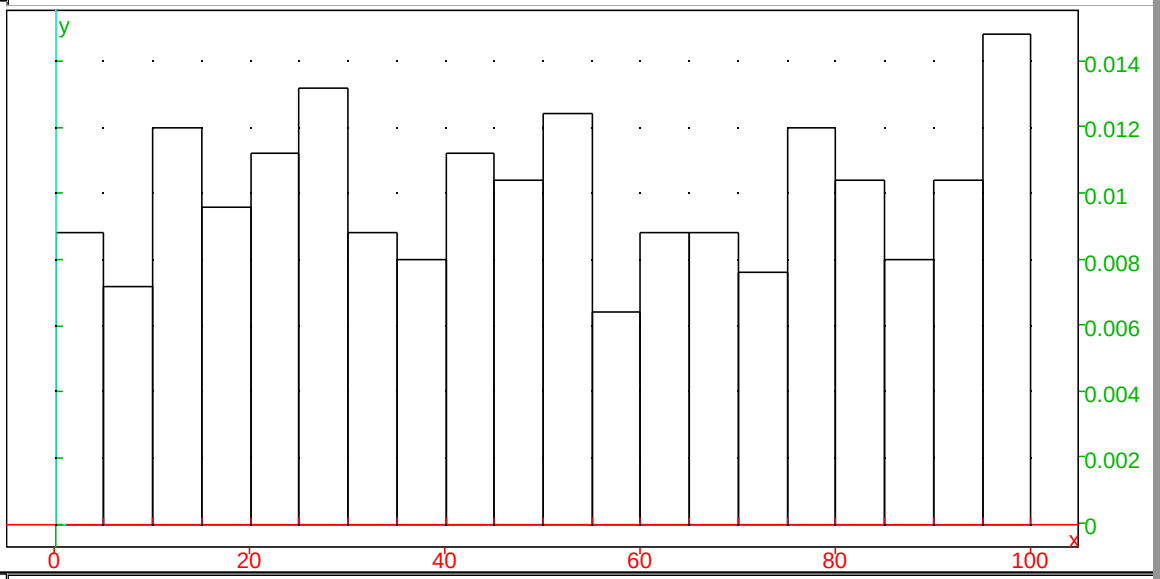
[93 94 44 95 62 27 20 98 29 1 58 77 43 76 26 47 76 89 96 18 57 31 49 96

Menu

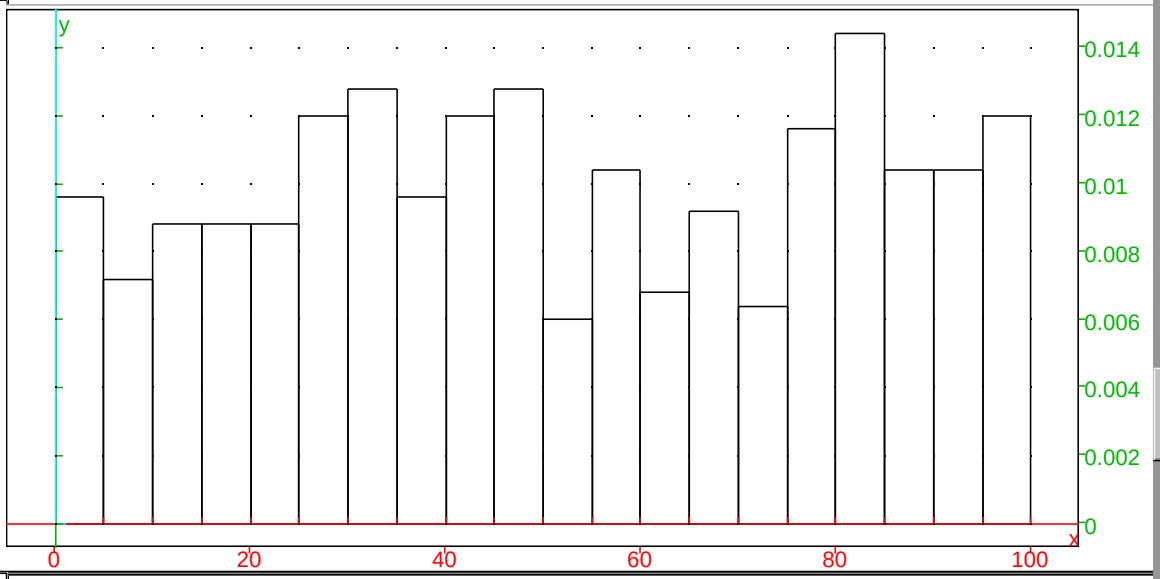
```
79 l2:=[seq(trunc(i/10^2),i=l)];
```

[46 96 81 97 21 82 95 67 99 40 52 39 95 22 53 1 93 25 96 86 24 83 42 41

```
80 histogram(classes(l1,0,5));
```

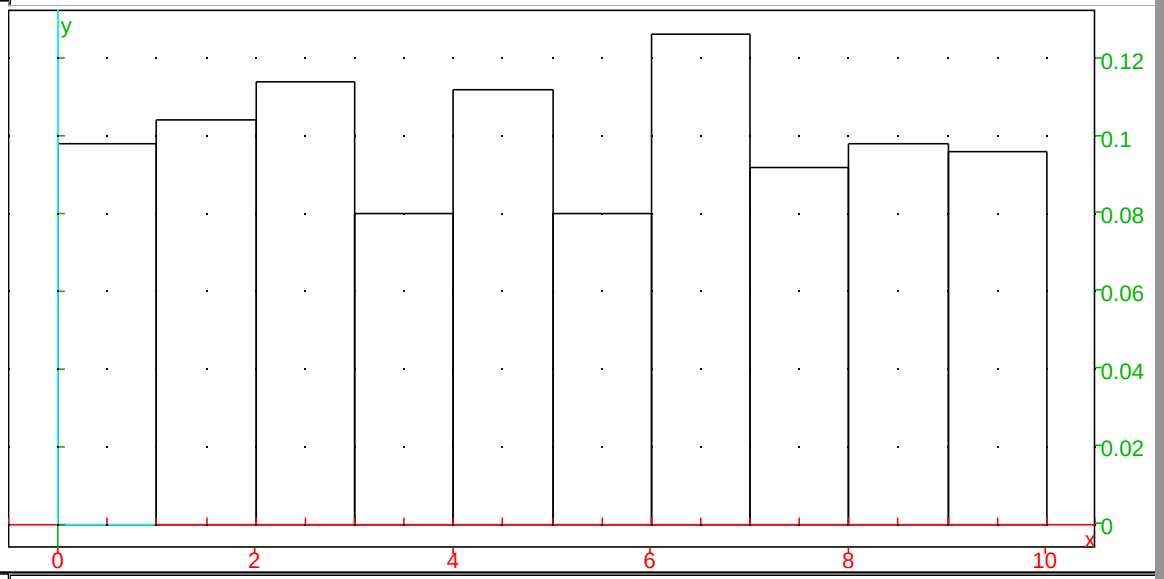



```
81 histogram(classes(l2,0,5));
```




```
82 l1:=[seq(i mod 10,i=l)];
[3 4 4 5 2 7 0 8 9 1 8 7 3 6 6 7 6 9 6 8 7 1 9 6 8 8 4 8 2 5 6 5 5
```

83 histogram(classes(l1,0,1));



84 x:=1; a:=237;c:=54321;m:=10; l:=[];

(1, 237, 54321, 10, [])

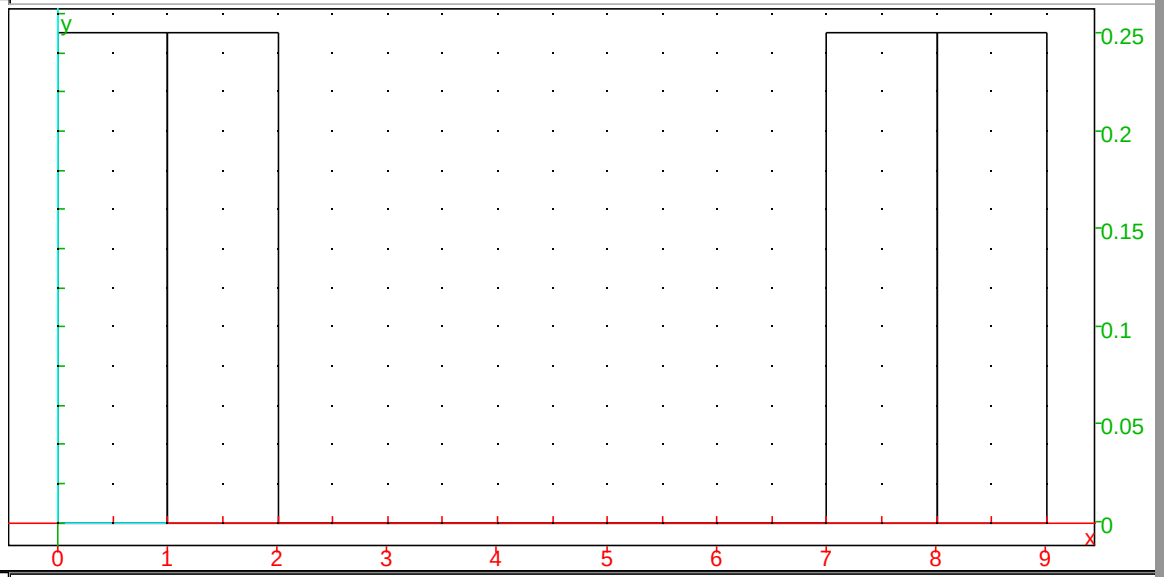
Menu

85 for i from 1 to 100 do x:=(a*x+c) mod m; l:=[op(l),x] ; od:

Done

Menu

86 histogram(classes(l,0,1)); #certaines valeurs ne sont pas atteintes.



87

88 Prog Edit Add nxt OK Save

```
periode:= proc(a)
x:=1;p:=1;
if (a mod 5 <> 0)  then while x>0 do p:=p+1;x:=(a*x+1) mod 125;   od; fi;
p; end  proc;
```

// End defining periode

```
proc(a)
  x:=1;
  p:=1;
  if (irem(a,5))<>0 then
    while x>0 do
      p:=p+1;
      x:=irem(a*x+1,125);
    od;
  fi ;
  p;
```

```
89 periode(1),periode(5); #verification
                    ( 125,  1  )                                    Menu
90 l:=seq(periode(i),i=2..124);max(l);
 100,  100,  50,  1,  125,  20,  100,  50,  1,  125,  100,  100,  50,  1,  125,  100,  20,  50,  1,  125,  100,  100
                                                                    Menu
91 On a: x_n=(a^n-1)/(a-1) mod m, donc la periode est l'ordre de a.
```