Правительство Российской Федерации

Федеральное государственное автономное образовательное учреждение высшего профессионального образования «Национальный исследовательский университет «Высшая школа экономики»»

Московский институт электроники и математики Национального исследовательского университета «Высшая школа экономики»

ОТЧЁТ

По лабораторной работе №4

По дисциплине «Методы программирования»

Выполнил:

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Проверил:

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Москва 2023

Исходный код лабораторной работы находится по ссылке:

https://github.com/vladimir-vaganov/ProgTech_LAB4/blob/main/Lab_MP4.cpp

Документация в виде html-страницы находится по ссылке:

https://github.com/vladimir-vaganov/ProgTech_LAB4/tree/main/html

Скриншоты запуска программы:

```
"C:\Users\korya\Desktop\Ђў¬cp\βεΕюф√ лЁюуЁрьышЁютрэш \ųpcp 4\Lab_MP4.exe"
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Volume of data is 10000

Mean is 5030.54

Standard deviation is 2890.09

Coefficient of variation is 0.574509

Array n looks like:

[0...1000)      :       975
[1000...2000)   :       977
[2000...3000)   :       1023
[3000...4000)   :       991
[4000...5000)   :       1014
[5000...6000)   :       969
[6000...7000)   :       990
[7000...8000)   :       1008
[8000...9000)   :       1053
[9000...10000)  :       1000

Total of array n is 10000

Value of criterion is 5.894


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Volume of data is 50000

Mean is 4991.39

Standard deviation is 2886.78

Coefficient of variation is 0.578352

Array n looks like:

[0...1000)      :       5010
[1000...2000)   :       5002
[2000...3000)   :       5063
[3000...4000)   :       4898
[4000...5000)   :       5148
[5000...6000)   :       4929
[6000...7000)   :       5067
[7000...8000)   :       4928
[8000...9000)   :       4949
[9000...10000)  :       5006

Total of array n is 50000

Value of criterion is 10.7464


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"C:\Users\korya\Desktop\Ђў¬cp\βεΕюф√ лЁюуЁрьышЁютрэш \ųpcp 4\Lab_MP4.exe"
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Volume of data is 100000

Mean is 5019.04

Standard deviation is 2888.79

Coefficient of variation is 0.575567

Array n looks like:

[0...1000)      :       10065
[1000...2000)   :       9760
[2000...3000)   :       9846
[3000...4000)   :       10001
[4000...5000)   :       10074
[5000...6000)   :       10110
[6000...7000)   :       9851
[7000...8000)   :       10010
[8000...9000)   :       10143
[9000...10000)  :       10140

Total of array n is 100000

Value of criterion is 16.5468


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Volume of data is 500000

Mean is 5000.99

Standard deviation is 2888.65

Coefficient of variation is 0.577615

Array n looks like:

[0...1000)      :       50232
[1000...2000)   :       50192
[2000...3000)   :       49398
[3000...4000)   :       50033
[4000...5000)   :       49611
[5000...6000)   :       50067
[6000...7000)   :       50369
[7000...8000)   :       49982
[8000...9000)   :       50135
[9000...10000)  :       49981

Total of array n is 500000

Value of criterion is 15.3012


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"C:\Users\korya\Desktop\Ђў¬cp\βεΕюф√ лЁюуЁрьышЁютрэш \ųpcp 4\Lab_MP4.exe"


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Volume of data is 1000000

Mean is 5000.43

Standard deviation is 2886.7

Coefficient of variation is 0.57729

Array n looks like:

[0...1000)      :       100298
[1000...2000)   :       99865
[2000...3000)   :       99469
[3000...4000)   :       99869
[4000...5000)   :       100162
[5000...6000)   :       99969
[6000...7000)   :       100361
[7000...8000)   :       100277
[8000...9000)   :       99775
[9000...10000)  :       99955

Total of array n is 1000000

Value of criterion is 6.93056


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Volume of data is 5000000

Mean is 5002.09

Standard deviation is 2886.94

Coefficient of variation is 0.577148

Array n looks like:

[0...1000)      :       501258
[1000...2000)   :       499069
[2000...3000)   :       497141
[3000...4000)   :       498241
[4000...5000)   :       501031
[5000...6000)   :       500334
[6000...7000)   :       501893
[7000...8000)   :       501594
[8000...9000)   :       498917
[9000...10000)  :       500522

Total of array n is 5000000

Value of criterion is 44.9229


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```
"C:\Users\korya\Desktop\...\Lab_MP4.exe"
Choose a generator:

1. XOR-shift
2. Ne pridumal

2

Generation time for volume of   100     126700 ns
Generation time for volume of   500     56700 ns
Generation time for volume of   1000    123100 ns
Generation time for volume of   5000    204800 ns
Generation time for volume of   10000   301700 ns
Generation time for volume of   50000   1008900 ns
Generation time for volume of   100000  1911600 ns
Generation time for volume of   500000  8849200 ns
Generation time for volume of   1000000 17650700 ns
Generation time for volume of   5000000 89607500 ns
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Volume of data is 100

Mean is 4627.86

Standard deviation is 2816.1

Coefficient of variation is 0.608511

Array n looks like:

[0...1000)      :       16
[1000...2000)   :       7
[2000...3000)   :       7
[3000...4000)   :       12
[4000...5000)   :       12
[5000...6000)   :       14
[6000...7000)   :       7
[7000...8000)   :       11
[8000...9000)   :       8
[9000...10000)  :       6

Total of array n is 100

Value of criterion is 10.8


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Volume of data is 500

Mean is 4896.76

Standard deviation is 2917.04

Coefficient of variation is 0.595709

Array n looks like:

[0...1000)      :       56
[1000...2000)   :       53
[2000...3000)   :       44
[3000...4000)   :       59
[4000...5000)   :       41
```

```
"C:\Users\korya\Desktop\...\Lab_MP4.exe"
Generation time for volume of   1000000 17650700 ns
Generation time for volume of   5000000 89607500 ns
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Volume of data is 100

Mean is 4627.86

Standard deviation is 2816.1

Coefficient of variation is 0.608511

Array n looks like:

[0...1000)      :       16
[1000...2000)   :       7
[2000...3000)   :       7
[3000...4000)   :       12
[4000...5000)   :       12
[5000...6000)   :       14
[6000...7000)   :       7
[7000...8000)   :       11
[8000...9000)   :       8
[9000...10000)  :       6

Total of array n is 100

Value of criterion is 10.8


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Volume of data is 500

Mean is 4896.76

Standard deviation is 2917.04

Coefficient of variation is 0.595709

Array n looks like:

[0...1000)      :       56
[1000...2000)   :       53
[2000...3000)   :       44
[3000...4000)   :       59
[4000...5000)   :       41
[5000...6000)   :       55
[6000...7000)   :       47
[7000...8000)   :       51
[8000...9000)   :       49
[9000...10000)  :       45

Total of array n is 500

Value of criterion is 6.08


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"C:\Users\korya\Desktop\...\Lab_MP4.exe"
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Volume of data is 1000

Mean is 5108.39

Standard deviation is 2867.15

Coefficient of variation is 0.561264

Array n looks like:

[0...1000)      :       94
[1000...2000)   :       98
[2000...3000)   :       84
[3000...4000)   :       101
[4000...5000)   :       98
[5000...6000)   :       105
[6000...7000)   :       106
[7000...8000)   :       109
[8000...9000)   :       106
[9000...10000)  :       99

Total of array n is 1000

Value of criterion is 4.8


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Volume of data is 5000

Mean is 4941.32

Standard deviation is 2850.9

Coefficient of variation is 0.576952

Array n looks like:

[0...1000)      :       477
[1000...2000)   :       533
[2000...3000)   :       500
[3000...4000)   :       514
[4000...5000)   :       543
[5000...6000)   :       504
[6000...7000)   :       493
[7000...8000)   :       498
[8000...9000)   :       468
[9000...10000)  :       470

Total of array n is 5000

Value of criterion is 11.312


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"C:\Users\korya\Desktop\Ч'ÿ-cp\|кЄюф√ яЁюуЁрьышЁютрэш \ўpcp 4\Lab_MP4.exe"

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Volume of data is 10000

Mean is 4975.54

Standard deviation is 2885.41

Coefficient of variation is 0.579919

Array n looks like:

[0...1000)      :       1009
[1000...2000)   :       1042
[2000...3000)   :       964
[3000...4000)   :       999
[4000...5000)   :       1029
[5000...6000)   :       968
[6000...7000)   :       1017
[7000...8000)   :       1017
[8000...9000)   :       996
[9000...10000)  :       959

Total of array n is 10000

Value of criterion is 7.282


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Volume of data is 50000

Mean is 4980.96

Standard deviation is 2894.85

Coefficient of variation is 0.581183

Array n looks like:

[0...1000)      :       5153
[1000...2000)   :       4930
[2000...3000)   :       5039
[3000...4000)   :       5065
[4000...5000)   :       5021
[5000...6000)   :       5039
[6000...7000)   :       4879
[7000...8000)   :       4795
[8000...9000)   :       5057
[9000...10000)  :       5022

Total of array n is 50000

Value of criterion is 19.2832


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"C:\Users\korya\Desktop\Ч'ÿ-cp\|кЄюф√ яЁюуЁрьышЁютрэш \ўpcp 4\Lab_MP4.exe"
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Volume of data is 100000

Mean is 4994.05

Standard deviation is 2885.41

Coefficient of variation is 0.57777

Array n looks like:

[0...1000)      :       10060
[1000...2000)   :       10005
[2000...3000)   :       9955
[3000...4000)   :       9967
[4000...5000)   :       10152
[5000...6000)   :       9981
[6000...7000)   :       10028
[7000...8000)   :       9871
[8000...9000)   :       9977
[9000...10000)  :       10004

Total of array n is 100000

Value of criterion is 4.8174


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Volume of data is 500000

Mean is 5000.03

Standard deviation is 2885.38

Coefficient of variation is 0.577072

Array n looks like:

[0...1000)      :       49853
[1000...2000)   :       49676
[2000...3000)   :       50387
[3000...4000)   :       50251
[4000...5000)   :       49806
[5000...6000)   :       50321
[6000...7000)   :       49894
[7000...8000)   :       49499
[8000...9000)   :       50313
[9000...10000)  :       50000

Total of array n is 500000

Value of criterion is 16.8048


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```
"C:\Users\korya\Desktop\Ч'ÿ-cp\|кЄюф√ яЁюуЁрьышЁютрэш \ўpcp 4\Lab_MP4.exe"

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Volume of data is 1000000

Mean is 5003.06

Standard deviation is 2885.9

Coefficient of variation is 0.576828

Array n looks like:

[0...1000)      :       99519
[1000...2000)   :       100414
[2000...3000)   :       99616
[3000...4000)   :       99829
[4000...5000)   :       99950
[5000...6000)   :       100399
[6000...7000)   :       99949
[7000...8000)   :       99859
[8000...9000)   :       100537
[9000...10000)  :       99928

Total of array n is 1000000

Value of criterion is 10.5719


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Volume of data is 5000000

Mean is 4999.07

Standard deviation is 2887.23

Coefficient of variation is 0.577553

Array n looks like:

[0...1000)      :       500795
[1000...2000)   :       499144
[2000...3000)   :       500304
[3000...4000)   :       500742
[4000...5000)   :       500082
[5000...6000)   :       498862
[6000...7000)   :       500376
[7000...8000)   :       499748
[8000...9000)   :       499890
[9000...10000)  :       500057

Total of array n is 5000000

Value of criterion is 7.05948


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Process returned 0 (0x0)   execution time : 0.974 s
Press any key to continue.
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Результаты запуска программы в виде таблицы:

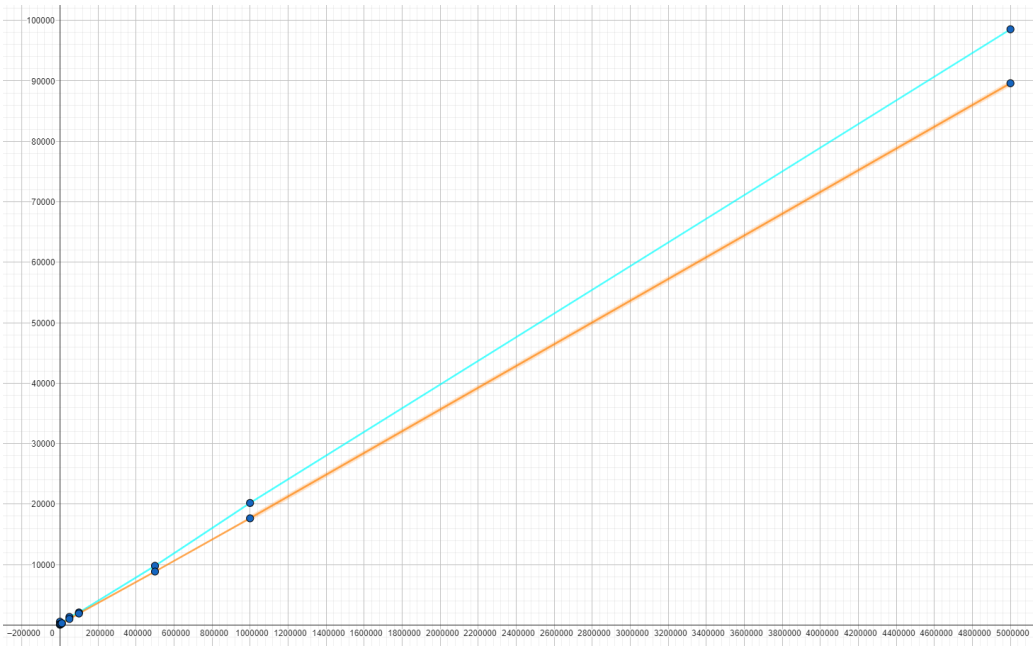
Первый генератор										
	100	500	1000	5000	10000	50000	100000	500000	1E+06	5E+06
Среднее	4968,4	5128,4	5092,6	4990,6	5030,5	4991,4	5019	5001	5000,4	5002,1
Отклонение	3072,3	2895,9	2865,6	2860	2890,1	2886,8	2888,8	2888,7	2886,7	2886,9
Коэффициент вариации	0,618	0,564	0,562	0,573	0,574	0,578	0,575	0,577	0,577	0,577
Значение критерия Хи-квадрат	12	7,24	10,64	10,8	5,894	10,74	16,54	15,3	6,93	44,92
Время генерации (мкс)	548	153	123	149	265	1339	2077	9796	20188	98535

Второй генератор										
	100	500	1000	5000	10000	50000	100000	500000	1E+06	5E+06
Среднее	4627,9	4896,8	5108,4	4941,3	4975,5	4981	4994,1	5000	5003,1	4999,1
Отклонение	2816,1	2917	2867,2	2850,9	2885,4	2894,9	2885,4	2885,4	2885,9	2887,2
Коэффициент вариации	0,608	0,595	0,561	0,576	0,579	0,581	0,577	0,577	0,576	0,577
Значение критерия Хи-квадрат	10,8	6,08	4,8	11,31	7,28	19,28	4,81	16,8	10,57	7,05
Время генерации	126	56	123	204	301	1008	1911	8849	17650	89607

Эталонные значения	
Математическое ожидание	5000
Стандартное отклонение	2886,8
Коэффициент вариации	0,577
Граница критерия Хи-квадрат	11,34

Зеленым обозначены положительные результаты в проверке на однородность выборки, а также равномерность распределения и случайность.

Графики зависимостей времени генерации от объема выборки (голубой – первый генератор, оранжевый – второй генератор):



Оба графика являются линейными, но можно заметить, что первый генератор работает дольше второго из-за количества внутри генерации следующего псевдослучайного числа.