

Государственное образовательное учреждение
высшего профессионального образования

“ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ПУТЕЙ СООБЩЕНИЯ”

Кафедра «Информационные и вычислительные системы»

Лабораторная работа № 4

По курсу “Моделирование вычислительных систем”

Моделирование однопроцессорных вычислительных систем
с различными дисциплинами обслуживания

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Вариант №6

Задача	V	λ	Q	ZR
6	80	0,5	50	Exp
9		2	2	H
12		1	40	Э-2

Суммарная интенсивность потока заявок:

$$\lambda_0 = \sum_{j=1}^3 \lambda_j = 3,5$$

Средняя трудоёмкость обслуживания:

$$Q_0 = \sum_{j=1}^3 \frac{\lambda_j Q_j}{\lambda_0} = 19,71428571$$

Суммарное быстроедействие системы неизменно:

$$V = 80$$

Средняя длительность обслуживания заявки типа K:

$$b_1 = \frac{Q_1}{V} = 0,625; b_2 = \frac{Q_2}{V} = 0,025; b_3 = \frac{Q_3}{V} = 0,5$$

Загрузка системы со стороны заявки типа K:

$$\rho_j = \frac{\lambda_j Q_j}{V} = \lambda_j \cdot b_j; \rho_1 = 0,3125; \rho_2 = 0,05; \rho_3 = 0,5$$

Суммарная загрузка со стороны объединённого потока:

$$R = \sum_{j=1}^3 \rho_j = 0,8625$$

Коэффициент вариации случайной величины:

$$v_j = \sigma/M; v_1 = 1; v_2 = 0,2; v_3 = 0,7;$$

1. Беспriorитетная система.

Среднее время ожидания заявки класса K:

$$t_{ож}^{БП} = \frac{(\sum_{j=1}^H \lambda_j b_j^2 (1 + v_j^2))}{2(1 - R)} = 2,59$$

Среднее время пребывания заявки класса K:

$$t_{прj} = t_{ож}^{БП} + b_j; t_{пр1} = 3,4; t_{пр2} = 2,7; t_{пр3} = 3,28$$

Средняя длина очереди:

$$l_i = \lambda_i \cdot t_{ож}^{БП}; l_1 = 1,39; l_2 = 5,56; l_3 = 2,78$$

$$T_{ож} = \frac{(\sum_{j=1}^H \lambda_j t_{ож}^{БП})}{\lambda_0} = 2,78$$

$$T_{пр} = \frac{(\sum_{j=1}^H \lambda_j t_{прj})}{\lambda_0} = 3,02$$

$$L = \sum_{j=1}^H l_j = 9,73$$

GPSS-код

```
NNORM FUNCTION RN1,C25
0.,-5./0.00003,-4./0.00135,-3./0.0062,-2.5/0.02275,-2/0.06681,-1.5/
.11507,-1.2/0.15866,-1./0.21186,-.8/0.27425,-.6/0.34458,-.4/0.42074,-.2/0.5,0./
.57926,.2/0.65542,.4/0.72575,.6/0.78814,.8/0.84134,1./0.88493,1.2/0.93319,1.5/
.97725,2./0.99379,2.5/0.99865,3./0.99997,4/1.,5.

EXPO FUNCTION RN2,C24
0,0/0.1,.104/0.2,.222/0.3,.355/0.4,.509/0.5,.69/0.6,.915/0.7,1.2/0.75,1.38/0.8,1.6/
.84,1.83/0.88,2.12/0.9,2.3/0.92,2.52/0.94,2.81/0.95,2.99/0.96,3.2/0.97,3.5/
.98,3.9/0.99,4.6/0.995,5.3/0.998,6.2/0.999,7./0.9998,8.

T_OG      TABLE      QT1,0,12,59
T_PR      TABLE      V$T_PR1,0,12,59

T_PR1 FVARIABLE QT1+FT1

M_RESULT MATRIX ,1,3

      GENERATE 2, FN$EXPO,,,
      ASSIGN 2, (0.625#FN$EXPO)
      TRANSFER ,NACHALO

      GENERATE 0.5, FN$EXPO,,,
      ASSIGN 2, (FN$NNORM#0.005+0.025)
      TRANSFER ,NACHALO

      GENERATE 1, FN$EXPO,,,
      ASSIGN 2, ((0.25#FN$EXPO) + (0.25#FN$EXPO))

NACHALO  QUEUE 1
          GATE U 1,WORK
          LINK OCHERED,FIFO

WORK     SEIZE 1
          DEPART 1
          ADVANCE P2

NO_3     RELEASE 1
          UNLINK OCHERED,WORK,1
          TABULATE T_OG
          TABULATE T_PR
          MSAVEVALUE M_RESULT,1,1,QT1
          MSAVEVALUE M_RESULT,1,2,V$T_PR1
          MSAVEVALUE M_RESULT,1,3,QA1

          TERMINATE 1

START 100000
```

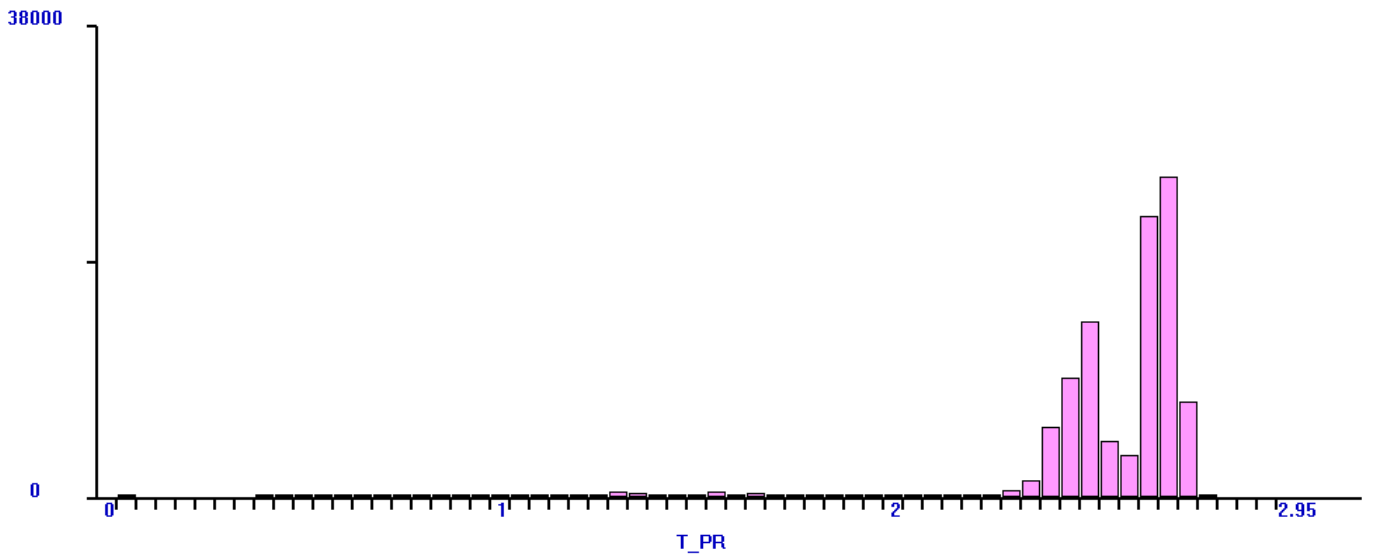
Результат моделирования

Dim 1	Dim 2		
	1	2	3
1	2.598	2.845	9.055

T_0G

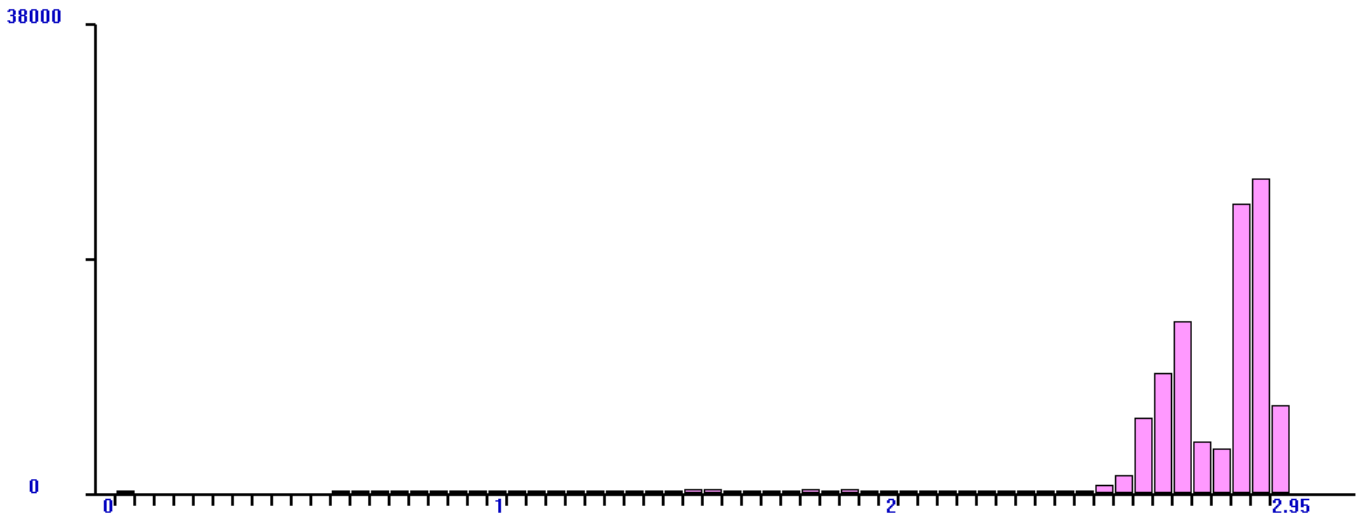
Mean: 2.535

S.D.: 0.245



Mean: 2.782

S.D.: 0.246



2. Система с относительными приоритетами.

$$R_k = \sum_{j=1}^k \rho_j; R_{k_1} = 0,3125; R_{k_2} = 0,3625; R_{k_3} = 0,8625$$

$$R_{k-1} = \sum_{j=1}^{k-1} \rho_j; R_{k-1_1} = 0; R_{k-1_2} = 0,3125; R_{k-1_3} = 0,3625$$

$$t_{ожk}^{оп} = \frac{(\sum_{j=1}^H \lambda_j b_j^2 (1 + v_i^2))}{2(1 - R_{k-1})(1 - R_k)}; t_{ож1}^{оп} = 0,556; t_{ож2}^{оп} = 0,872; t_{ож3}^{оп} = 4,36$$

$$t_{ипk}^{бп} = t_{ожk}^{бп} + b_k; t_{ип1} = 1,18; t_{ип2} = 0,9; t_{ип3} = 4,86$$

$$l_k = \lambda_k \cdot t_{ожk}^{бп}; l_1 = 0,27; l_2 = 1,74; l_3 = 4,36$$

$$T_{ож} = \frac{(\sum_{k=1}^H \lambda_k t_{ожk}^{оп})}{\lambda_0} = 1,82$$

$$T_{ип} = \frac{(\sum_{k=1}^H \lambda_k t_{ипk})}{\lambda_0} = 2,07$$

$$L = \sum_{k=1}^H l_k = 6,38$$

GPSS-код

```
NNORM FUNCTION RN1,C25
0.,-5./0.00003,-4./0.00135,-3./0.0062,-2.5/0.02275,-2/0.06681,-1.5/
.11507,-1.2/0.15866,-1./0.21186,-.8/0.27425,-.6/0.34458,-.4/0.42074,-.2/0.5,0./
.57926,.2/0.65542,.4/0.72575,.6/0.78814,.8/0.84134,1./0.88493,1.2/0.93319,1.5/
.97725,2./0.99379,2.5/0.99865,3./0.99997,4/1.,5.

EXPO FUNCTION RN2,C24
0,0/.1,.104/.2,.222/.3,.355/.4,.509/.5,.69/.6,.915/.7,1.2/.75,1.38/.8,1.6/
.84,1.83/.88,2.12/.9,2.3/.92,2.52/.94,2.81/.95,2.99/.96,3.2/.97,3.5/
.98,3.9/.99,4.6/.995,5.3/.998,6.2/.999,7./0.9998,8.

T_OG      TABLE      QT1,0,0.1,64
T_PR      TABLE      V$T_PR1,0,0.1,64

T_PR1 FVARIABLE QT1+FT1

M_RESULT MATRIX ,1,3

      GENERATE 2, FN$EXPO,,,3
      ASSIGN 1,3
      ASSIGN 2, (0.625#FN$EXPO)
      TRANSFER ,NACHALO

      GENERATE 0.5, FN$EXPO,,,2
      ASSIGN 1,2
      ASSIGN 2, (FN$NNORM#0.005+0.025)
      TRANSFER ,NACHALO

      GENERATE 1, FN$EXPO,,,1
      ASSIGN 1,1
      ASSIGN 2, ((0.25#FN$EXPO)+(0.25#FN$EXPO))

NACHALO  QUEUE 1
          GATE U 1,WORK
          LINK OCHERED,PR
WORK     SEIZE 1
          DEPART 1
          ADVANCE P2

          TEST E P1,3,NO_3
          TABULATE T_OG
          TABULATE T_PR

NO_3     RELEASE 1
          UNLINK OCHERED,WORK,1

          MSAVEVALUE M_RESULT,1,1,QT1
          MSAVEVALUE M_RESULT,1,2,V$T_PR1
          MSAVEVALUE M_RESULT,1,3,QA1

          TERMINATE 1

START 10000
```

Результат моделирования

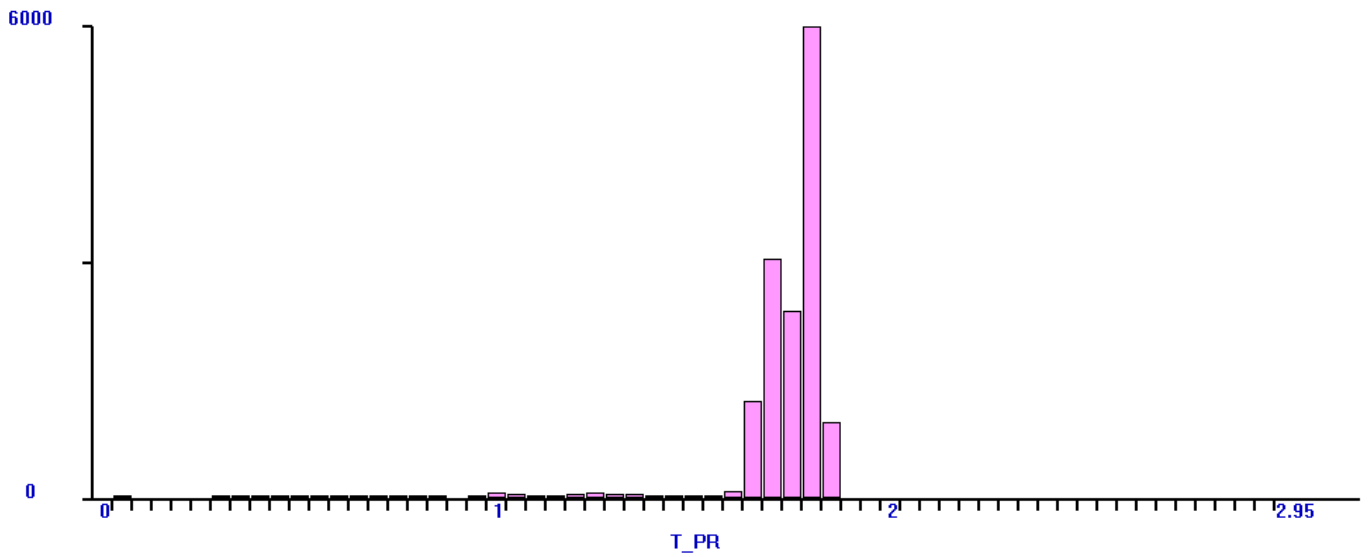
M_RESULT

	Dim 2		
Dim 1	1	2	3
1	1.731	1.978	6.033

T_OG

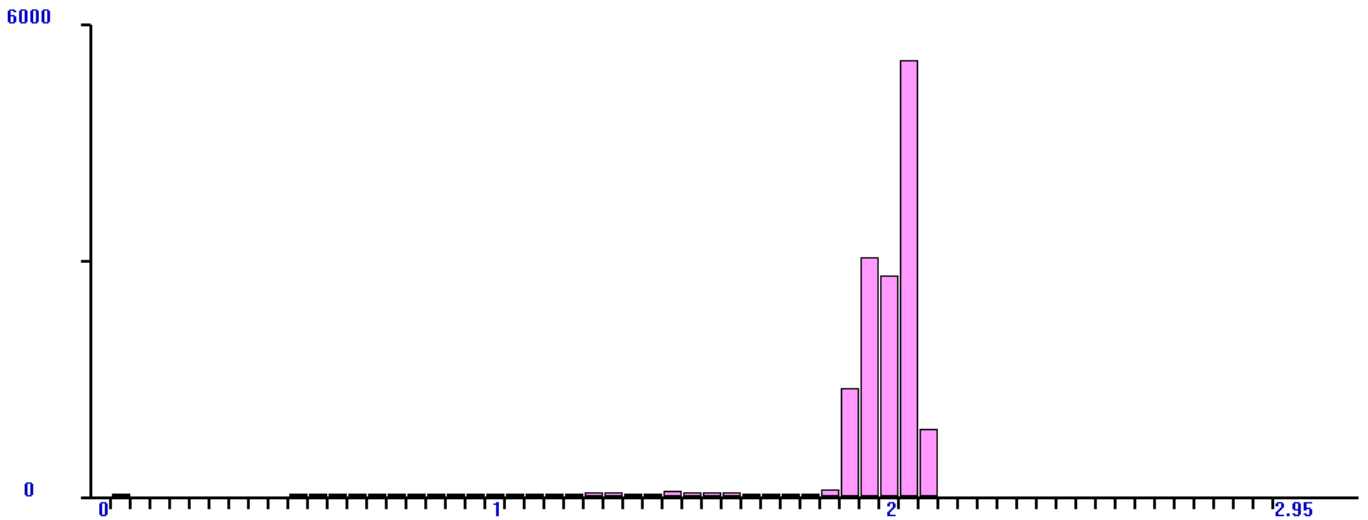
Mean: 1.709

S.D.: 0.135



Mean: 1.956

S.D.: 0.137



3. Система с абсолютными приоритетами.

$$R_k = \sum_{j=1}^k \rho_j; R_{k_1} = 0,3125; R_{k_2} = 0,3625; R_{k_3} = 0,8625$$

$$R_{k-1} = \sum_{j=1}^{k-1} \rho_j; R_{k-1_1} = 0; R_{k-1_2} = 0,3125; R_{k-1_3} = 0,3625$$

$$t_{ож\ k}^{АП} = \frac{(\sum_{j=1}^H \lambda_j b_j^2 (1 + v_i^2))}{2(1 - R_{k-1})(1 - R_k)} + \frac{R_{k-1} b_k}{1 - R_{k-1}}; t_{ож\ 1}^{ОП} = 0,556; t_{ож\ 2}^{ОП} = 0,883; t_{ож\ 3}^{ОП} = 4,64$$

$$t_{ип\ k} = t_{ож\ k}^{БП} + b_k; t_{ип\ 1} = 1,18; t_{ип\ 2} = 0,9; t_{ип\ 3} = 5,14$$

$$l_k = \lambda_k \cdot t_{ож\ k}^{БП}; l_1 = 0,27; l_2 = 1,76; l_3 = 4,64$$

$$T_{ож} = \frac{(\sum_{k=1}^H \lambda_k t_{ож\ k}^{ОП})}{\lambda_0} = 1,91$$

$$T_{ип} = \frac{(\sum_{k=1}^H \lambda_k t_{ип\ k})}{\lambda_0} = 2,15$$

$$L = \sum_{k=1}^H l_k = 6,69$$

GPSS-код

```
NNORM FUNCTION RN1,C25
0.,-5./0.00003,-4./0.00135,-3./0.0062,-2.5/0.02275,-2/0.06681,-1.5/
.11507,-1.2/0.15866,-1./0.21186,-.8/0.27425,-.6/0.34458,-.4/0.42074,-.2/0.5,0./
.57926,.2/0.65542,.4/0.72575,.6/0.78814,.8/0.84134,1./0.88493,1.2/0.93319,1.5/
.97725,2./0.99379,2.5/0.99865,3./0.99997,4/1.,5.

EXPO FUNCTION RN2,C24
0,0/0.1,.104/0.2,.222/0.3,.355/0.4,.509/0.5,.69/0.6,.915/0.7,1.2/0.75,1.38/0.8,1.6/
.84,1.83/0.88,2.12/0.9,2.3/0.92,2.52/0.94,2.81/0.95,2.99/0.96,3.2/0.97,3.5/
.98,3.9/0.99,4.6/0.995,5.3/0.998,6.2/0.999,7./0.9998,8.

T_OG      TABLE      QT1,0,0.1,64
T_PR      TABLE      V$T_PR1,0,0.1,64

T_PR1 FVARIABLE QT1+FT1

M_RESULT MATRIX ,1,3

      GENERATE 2, FN$EXPO,,,3
      ASSIGN 1,3
      ASSIGN 2, (0.625#FN$EXPO)
      TRANSFER ,NACHALO

      GENERATE 0.5, FN$EXPO,,,2
      ASSIGN 1,2
      ASSIGN 2, (FN$NNORM#0.005+0.025)
      TRANSFER ,NACHALO

      GENERATE 1, FN$EXPO,,,1
      ASSIGN 1,1
      ASSIGN 2, ((0.25#FN$EXPO)+(0.25#FN$EXPO))

NACHALO  QUEUE 1
          PREEMPT 1,PR
          DEPART 1
          ADVANCE P2

          TEST E P1,3,NO_3
          TABULATE T_OG
          TABULATE T_PR

NO_3     RELEASE 1

          MSAVEVALUE M_RESULT,1,1,QT1
          MSAVEVALUE M_RESULT,1,2,V$T_PR1
          MSAVEVALUE M_RESULT,1,3,QA1

          TERMINATE 1

START 10000
```

Результат моделирования

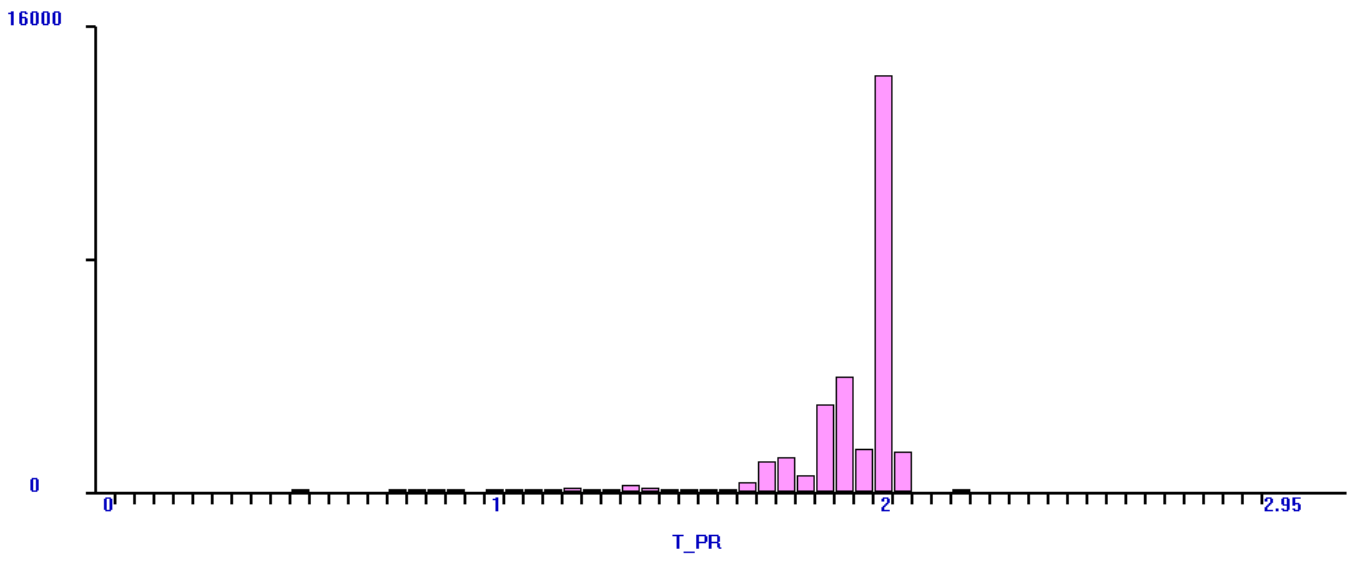
M_RESULT

Dim 1	Dim 2		
	1	2	3
1	1.949	2.196	6.792

T_OG

Mean: 1.887

S.D.: 0.152



Mean: 2.134

S.D.: 0.153

