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Drawing of Random Ten-Digit Numbers from Tables of Random Two-Digit and Three-Digit Numbers

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ABSTRACT: A method has been derived for drawing of random ten-digit numbers with the help of two tables of random numbers (one of random two-digit numbers and the other of random three-digit numbers). This paper describes the derivation of the method with numerical example in order to show the application of the method. The method derived here is the only method of drawing of random ten-digit numbers since no table of random ten-digit numbers is available till now for drawing of random none-digit numbers and also since no method of drawing of random ten-digit numbers is available till now.

KEYWORDS: Table of random two-digit numbers, table of random three-digit numbers, drawing of random ten-digit numbers, method of drawing.

I. INTRODUCTION

There exist a number of tables of random numbers. These are mainly due to *Tippett* (1927), *Mahalanobis* (1934), *Kendall* & *Smith* (1938 , 1939), *Fisher* & *Yates* (1938), *Hald* (1952), *Royo* & *Ferrer* (1954), *RAND Corporation* (1955), *Quenouille* (1959), *Moses* & *Oakford* (1963), *Rao*, *Mitra* & *Matthai* (1966), *Snedecor* and *Cochran* (1967), *Rohlf* & *Sokal* (1969), *Manfred* (1971), *Hill* & *Hill* (1977) and others. Among these tables, the following four tables are treated as suitable in drawing of simple random sample (with or without replacement) from a population (*Cochran*, 1940): The tables of random numbers that had been constructed are of two-digit numbers, three-digit numbers and four-digit numbers only. No table of random *m*-digit numbers is available till now for $m \geq 5$.

The proper randomness of the tables as mentioned above is yet to be tested. In a study made by *Chakrabarty* (2010) on the testing of randomness of the table due to *Fisher* and *Yates* (1938), it has been found that this table, consisting of the 7500 occurrences of the 100 two-digit numbers, is not properly random and deviates significantly from proper randomness. Due to this reason, one table consisting of 6000 random occurrences of the 100 two-digit numbers has been constructed as an alternative/competitor of this table (*Chakrabarty*, 2013*a*). Also, one table containing 5000 random occurrences of the 1000 two-digit numbers has been constructed by *Chakrabarty* (2013*b*) due to the unavailability of such table of two-digit numbers. Two more tables, one containing 20000 occurrences of random two-digit numbers and the other containing 20000 occurrences of random two-digit numbers, have also been constructed by the same author [*Chakrabarty*(2016*a* , 2016*b*)]. Recently, study has been made on testing the proper randomness of the random number tables due to Tippett (*Sarmah* & *Chakrabarty*, 2014), due to Kendall & Smith (*Sarmah* & *Chakrabarty*, 2014*b*), due to *Rand Corporation* (*Sarmah*, *Chakrabarty* & *Barman* (2015*b*). In the studies, each of the tables has been found to be suffered from proper randomness. This leads to think of constructing of table of random four-digit numbers. Moreover, there is or there may be necessity of drawing of random five-digit numbers, random six-digit numbers, random seven-digit numbers etc. However, due to the increasing difficulties in the construction of tables of these types of random numbers by the method composed by *Chakrabarty* (2013*a*), it had been compelled to think of an alternative approach of drawing of these types of random numbers. *Chakrabarty* has already developed methods of drawing of random four-digit numbers, random five-digit numbers, random six-digit numbers & random seven-digit numbers from a combination of independent tables of random two-digit numbers & random three-digit numbers [*Chakrabarty* (2016*c* , 2016*d* , 2016*e* , 2016*f* , 2016*g* , 2016*h* , 2016*i* , 2017*a*)]. In a study, *Chakrabarty* (2016*f*) derived one method of drawing of random six-digit numbers from a single table of random two-digit numbers. Later on, one method has been developed for drawing of random nine-digit numbers from a single table of random three-digit numbers by applying the similar logic that had been applied by *Chakrabarty* in finding out the method of drawing of random six-digit numbers from a single table of random two-digit numbers. (*Chakrabarty* , 2017*b*). However, the necessity of drawing of random

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ten-digit numbers arises in the situation of drawing of random samples from a very large population. Therefore, an attempt has here been made on finding out some method of drawing of random ten-digit numbers. A method has here been derived for drawing of random ten-digit numbers with the help of two tables of random numbers (one of random two-digit numbers and the other of random three-digit numbers). This paper describes the derivation of the method with numerical example in order to show the application of the method. The method derived here is the only method of drawing of random ten-digit numbers since no table of random ten-digit numbers is available till now for drawing of random none-digit numbers and also since no method of drawing of random ten-digit numbers is available till now.

II. DRAWING OF RANDOM TEN-DIGIT NUMBERS

Let d_1d_2 be a random two-digit number drawn from a table of random two-digit numbers.
The possible values that d_1d_2 assumes are the 100 two-digit numbers

00 , 01 , 02 , ……. , 98 , 99

and the probability that d_1d_2 assumes any of them is equal which is 0.01.
Similarly, if d_3d_4 **is another two-digit number drawn independently from the same table then** the possible values that d_3d_4 assumes are also the 100 two-digit numbers

00 , 01 , 02 , ……. , 98 , 99

and the probability that that d_3d_4 assumes any of them is equal which is 0.01.
Now if the two two-digit numbers namely

$$d_1d_2 \quad \& \quad d_3d_4$$

are combined together to form the four-digit number $d_1d_2d_3d_4$
then the possible values that $d_1d_2d_3d_4$ assumes are the 10000 four-digit numbers

0000 , 0001 , 0002 , …… , 9998 , 9999

and the probability that $d_1d_2d_3d_4$ assumes any one of them is equal which is 0.0001
(since the two numbers d_1d_2 & d_3d_4 have been drawn independently).
Thus the four-digit number $d_1d_2d_3d_4$ is a random one.
Similarly, the other four-digit number

$$d_3d_4d_1d_2$$

is also a random one.
Again, let $d_5d_6d_7$ be a random three-digit number drawn from a table of random three-digit numbers.
The possible values that $d_5d_6d_7$ assumes are the 1000 three-digit numbers

000 , 001 , 002 , ……. , 998 , 999

and the probability that $d_5d_6d_7$ assumes any of them is equal which is 0.001.
Similarly, if $d_8d_9d_{10}$ **is another three-digit number drawn independently from the same table then** the possible values that $d_8d_9d_{10}$ assumes are also the 1000 three-digit numbers

000 , 001 , 002 , ……. , 908 , 999

and the probability that $d_8d_9d_{10}$ assumes any of them is equal which is 0.001.
Now if the two three-digit numbers namely

$$d_5d_6d_7 \quad \& \quad d_8d_9d_{10}$$

are combined together to form the six-digit number $d_5d_6d_7d_8d_9d_{10}$
then the possible values that $d_5d_6d_7d_8d_9d_{10}$ will assume are the 100000 six-digit numbers

000000 , 000001 , 000002 , …… , 999999

and the probability that $d_5d_6d_7d_8d_9d_{10}$ assumes any one of them is equal which is 0.000001
(since the two numbers $d_5d_6d_7$ & $d_8d_9d_{10}$ have been drawn independently).
Thus the six-digit number $d_5d_6d_7d_8d_9d_{10}$ is a random one.

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Similarly, the other six-digit number

$$d_8 d_9 d_{10} d_5 d_6 d_8$$

is also a random one.
Now, if we combine one four-digit number with one six-digit number then we will get one ten-digit number.
Thus, the 2 random four-digit numbers

$$d_1 d_2 d_3 d_4 \ \& \ d_3 d_4 d_1 d_2$$

and the 2 random six-digit numbers

$$d_5 d_6 d_7 d_8 d_9 d_{10} \ \& \ d_8 d_9 d_{10} d_5 d_6 d_8$$

results in the 8 possible random ten-digit numbers

$$d_1 d_2 d_3 d_4 d_5 d_6 d_7 d_8 d_9 d_{10} \ , \ d_1 d_2 d_3 d_4 d_8 d_9 d_{10} d_5 d_6 d_8 \ ,$$
$$d_3 d_4 d_1 d_2 d_5 d_6 d_7 d_8 d_9 d_{10} \ , \ d_3 d_4 d_1 d_2 d_8 d_9 d_{10} d_5 d_6 d_8 \ ,$$
$$d_5 d_6 d_7 d_8 d_9 d_{10} d_1 d_2 d_3 d_4 \ , \ d_5 d_6 d_7 d_8 d_9 d_{10} d_3 d_4 d_1 d_2 \ ,$$
$$d_8 d_9 d_{10} d_5 d_6 d_8 d_1 d_2 d_3 d_4 \ , \ d_8 d_9 d_{10} d_5 d_6 d_8 d_3 d_4 d_1 d_2$$

If one of these 8 ten-digit numbers is selected at random, the selected number will be a random ten-digit number.
If the process is repeated once, one more random ten-digit number is obtained.
By further repetitions, one can obtain more random ten-digit numbers.

Therefore in order to draw *n* random ten-digit numbers from two tables of random numbers (one of random two-digit numbers and the other of random three-digit numbers) it is required to draw two sets, one of *n* random four-digit numbers and the other of *n* random six-digit numbers, from the table of random two-digit numbers and the table of random three-digit numbers respectively. Methods of drawing of random six-digit numbers and of random fouu-digit numbers are available in *Chakrabarty* (2016*g*) and *Chakrabarty* (2017*a*).

It is to be noted that any successive four digits and/or any successive six digits of different ten-digit numbers can be same. Conversely, with the same successive four digits and/or with the same successive six digits there can be different ten-digit numbers. Therefore, the random four-digit numbers as well as the random six-digit numbers to be drawn in order to form random ten-digit numbers need not necessarily be distinct.

It is further to be noted that the random selection of the choice of whether four-digit numbers will be placed at the left position or six-digit numbers will be placed at the left position while combining them in the formation of random ten-digit numbers can be made afresh for each random ten-digit number to be drawn or can be made once, before drawing the random four-digit numbers and the random six-digit numbers, to be applied in the construction of all random ten-digit numbers to be drawn.

Thus, in order to draw *n* random ten-digit numbers one can apply the following two methods:

First method of drawing

In order to draw *n* random ten-digit numbers, in this method, one can proceed with the following steps:

(1) Make a choice at random which random number (whether four-digit number or six-digit number) will be placed at the left position and which random number will be placed at the right position while combining them in the formation of random ten-digit numbers. This can be done by a binomial trial, for example tossing of a fair coin.
(2) Draw the set of *n* random four-digit numbers by the method discussed in *Chakrabarty* (2017*a*).
(3) Draw the set of *n* random six-digit numbers by the method discussed in *Chakrabarty* (2016*g*).
(4) Combine the respective random four-digit numbers and random six-digit by the choice of the positions obtained in step (1) to obtain the *n* random ten-digit numbers.

Second method of drawing

In order to draw *n* random ten-digit numbers, in this method, one can proceed with the following steps:

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(1) Draw a random four-digit number and a random six-digit number from the respective tables of random number.
(2) Make a choice at random which random number (whether four-digit number or six-digit number) will be placed at the left position and which random number will be placed at the right position while combining them in the formation of random ten-digit numbers. This can be done by a binomial trial, for example tossing of a fair coin.
(3) Combine the four-digit number with the six-digit number, obtained in step (1), as per the selected choice of the positions to obtain one random ten-digit number.
(4) Perform the above three steps more $(n-1)$ times to obtain more $(n-1)$ random ten-digit numbers.
(5) The random ten-digit numbers obtained in step (3) & Step (4) are the required n random ten-digit numbers.

III. NUMERICAL EXAMPLE

Let it be wanted to draw 20 random ten-digit numbers from two tables, one of random two-digit numbers and the other of random three-digit numbers.

One set of the 20 random four-digit numbers, selected by the method discussed in *Chakrabarty* (2017*a*) are

0964 , 9647 , 3955 , 9483 , 5237 , 0790 , 8050 , 6628 , 4254 , 2736 , 9951 , 0209 , 8990 , 2827 , 5042 , 5213 , 3646 , 8159 , 5327 , 3477 .

Similarly, one set of the 20 random six-digit numbers, selected by the method discussed in *Chakrabarty* (2016*g*) are

647090 , 487296 , 559139 , 083984 , 937522 , 090072 , 590808 , 287466 , 542422 , 360279 , 551998 , 094402 , 970892 , 274286 , 426500 , 137182 , 646336 , 559811 , 278503 , 774354 .

First method of drawing

Let a trial namely the throwing of an unbiased coin be performed to make a choice which set's two-digit number will be placed at the left position and which set's two-digit number will be placed at the right position while combining them in the formation of random four-digit number.
Suppose, the selected choice is as follows:

Four-digit number will be placed at the **Right** position,
& Six-digit number will be placed at the **Left** position.

Now, combining the 20 random four-digit numbers with the corresponding random six-digit numbers as per the selected choice of combination, one can obtain the following 20 random ten-digit numbers:

0964647090 , 9647487296 , 3955559139 , 9483083984 , 5237937522 , 0790090072 , 8050590808 , 6628287466 , 4254542422 , 2736360279 , 9951551998 , 0209094402 , 8990970892 , 2827274286 , 5042426500 , 5213137182 , 3646646336 , 8159559811 , 5327278503 , 3477774354 .

These 20 ten-digit numbers are the required random ten-digit numbers as wanted to draw.

Second method of drawing

First, let us draw one random four-digit numbers and one random four-digit numbers.
Let the two numbers drawn be

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0964 , 647090.

Let a trial namely the throwing of an unbiased coin be performed to make a choice which set's two-digit number will be placed at the left position and which set's two-digit number will be placed at the right position while combining them in the formation of random four-digit number.

Suppose, the selected choice is as follows:

Four-digit number will be placed at the **Left** position,
& Six-digit number will be placed at the **Right** position.

Thus, the 1st selected ten-digit random number is 0964647090.

In order to obtain the remaining 19 random ten-digit numbers, the two steps are to be repeated 19 times.
Let the outcomes of all the 20 trials be as follows:

Table-I

Serial No of Trial	Four-digit Number obtained	Six-digit Number obtained	Outcome of the Random Trial: Position of		Selected Random Six-Digit Number
			four-digit Number	six-digit Number	
1	0964	647090	Left	Right	0964647090
2	9647	487296	Left	Right	9647487296
3	3955	559139	Right	Left	5591393955
4	9483	083984	Right	Left	0839849483
5	5237	937522	Left	Right	5237937522
6	0790	090072	Right	Left	0900720790
7	8050	590808	Left	Right	8050590808
8	6628	287466	Right	Left	2874666628
9	4254	542422	Left	Right	4254542422
10	2736	360279	Left	Right	2736360279
11	9951	551998	Right	Left	5519989951
12	0209	094402	Left	Right	0209094402
13	8990	970892	Right	Left	9708928990
14	2827	274286	Right	Left	2742862827
15	5042	426500	Left	Right	5042426500
16	5213	137182	Left	Right	5213137182
17	3646	646336	Right	Left	6463363646
18	8159	559811	Left	Right	8159559811
19	5327	278503	Left	Right	5327278503
20	3477	774354	Right	Left	7743543477

Thus, the 20 random ten-digit numbers as wanted to draw are

0964647090 , 9647487296 , 5591393955 , 0839849483 , 5237937522 , 0900720790 , 8050590808 , 2874666628 , 4254542422 , 2736360279 , 5519989951 , 0209094402 , 9708928990 , 2742862827 , 5042426500 , 5213137182 , 6463363646 , 8159559811 , 5327278503 , 7743543477.

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IV. CONCLUSION

There is unavailability of table of random ten-digit numbers. Therefore, it has not yet been possible to draw random ten-digit numbers using random numbers table. The method of drawing of random ten-digit numbers, developed here, is the only way of drawing of random ten-digit numbers in the absence of table of random ten-digit numbers.

The method of drawing of random ten-digit numbers, discussed in this article, is based on the drawing of random four-digit numbers from a single table of random two-digit numbers and drawing of random six-digit numbers from a single table of random three-digit numbers. There may be possibility of some method of drawing of random ten-digit numbers from four tables, namely two independent tables of random two-digit numbers and two independent tables of random three-digit numbers, that can be derived by similar way as the derivation of the method derived here. However, this method is yet to be searched for. At this stage therefore, it is one problem for the researchers to search for this method..

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Dr. Dhritikesh Chakrabarty is also an awardee of the Post Doctoral Research Award by the University Grants Commission for the period 2002─05.

He attended five of orientation/refresher course held in Gauhati University, Indian Statistical Institute, University of Calicut and Cochin University of Science & Technology sponsored/organized by University Grants Commission/Indian Academy of Science. He also attended/participated eleven workshops/training programmes of different fields at various institutes.

Dr. Dhritikesh Chakrabarty joined the Department of Statistics of Handique Girls' College, Gauhati University, as a Lecturer on December 09, 1987 and has been serving the institution continuously since then. Currently he is in the position of Associate Professor (& Ex Head) of the same Department of the same College. He has also been serving the National Institute of Pharmaceutical Education & Research (NIPER), Guwahati, as a Guest Faculty continuously from May 02, 2010. Moreover, he is a Research Guide (Ph.D. Guide) in the Department of Statistics of Gauhati University and also a Research Guide (Ph.D. Guide) in the Department of Statistics of Assam Down Town University. He has been guiding a number of Ph.D. students in the two universities. He acted as Guest Faculty in the Department of

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