SAMPLING

An important characteristic of inferential statistics is the process of going from the part to the whole. For example, you might study a randomly selected group of 500 students attending a university in order to make generalizations about the entire student body of that university.

The small group that is observed is called a *sample*, and the larger group about which the generalization is made is called a *population*. A **population** is defined as all members of any well-defined class of people, events, or objects. For example, in a study in which students in American high schools constitute the population of interest, you could define this population as all boys and girls attending high school in the United States. A **sample** is a portion of a population. For example, the students of Washington High School in Indianapolis constitute a sample of American high school students.

Statistical inference is a procedure by means of which you estimate **parameters** (characteristics of populations) from **statistics** (characteristics of samples). Such estimations are based on the laws of probability and are best estimates rather than absolute facts. In making any such inferences, a certain degree of error is involved. Inferential statistics can be used to test hypotheses about populations on the basis of observations of a sample drawn from the population.

RATIONALE OF SAMPLING

Inductive reasoning is an essential part of the scientific approach. The inductive method involves making observations and then drawing conclusions from these observations. If you can observe all instances of a population, you can, with confidence, base conclusions about the population on these observations (perfect induction). In Chapter 6, we treated the 18 students in Mr. Li's physics class as a population. Therefore, we could be confident that we had the true means, standard deviations, and so forth (the parameters). However, if you observe only some instances of a population, then you can do no more than infer that these observations will be true of the population as a whole (imperfect induction). This is the concept of sampling, which involves taking a portion of the population, making observations on this smaller group, and then generalizing the findings to the parent population—the larger population from which the sample was drawn.

Sampling is indispensable to the researcher. Usually, the time, money, and effort involved do not permit a researcher to study all possible members of a population. Furthermore, it is generally not necessary to study all possible cases to understand the phenomenon under consideration. Sampling comes to your aid by enabling you to study a portion of the population rather than the entire population.

Because the purpose of drawing a sample from a population is to obtain information concerning that population, it is extremely important that the individuals included in a sample constitute a representative cross section of individuals in the population. Samples must be representative if you are to be able to generalize with reasonable confidence from the sample to the population. For example, the researcher may assume that the students at Washington High School are representative of American adolescents. However, this sample may not be representative if the individuals who are included have some characteristics that differ from the target population. The location of their school, their socioeconomic backgrounds, their family situations, their prior experiences, and many other characteristics of this group may make them unrepresentative of American adolescents. An unrepresentative sample is termed a **biased sample.** The findings on a biased sample in a research study cannot legitimately be generalized to the population from which it is taken. For example, if the population of interest is all students in a particular urban school district but the researchers sampled only students from the district's two magnet schools, the sample would be biased.

STEPS IN SAMPLING

The first step in sampling is the identification of the **target population,** the large group to which the researcher wishes to generalize the results of the study. If the researcher is interested in learning about the teachers in the St. Louis public school system, all those who teach within that system constitute the target population. In a study of the attitudes and values of American adolescents, the target population would be all American boys and girls in the age range of 12 to 21 years, given that adolescence is operationally defined as the period between ages 12 and 21 years. We make a distinction between the target population and the **accessible population,** which is the population of subjects accessible to the researcher for drawing a sample. In most research, we deal with accessible populations. It would be expensive and time-consuming to sample from the total population of American adolescents, but we could draw a sample of adolescents from one state. Of course, we could only generalize results to adolescents in the chosen state, not to all American adolescents.

Once we have identified the population, the next step is to select the sample. Two major types of sampling procedures are available to researchers: probability and nonprobability sampling. **Probability sampling** involves sample selection in which the elements are drawn by chance procedures. The main characteristic of probability sampling is that every member or element of the population has a known probability of being chosen in the sample.

Nonprobability sampling includes methods of selection in which elements are not chosen by chance procedures. Its success depends on the knowledge, expertise, and judgment of the researcher. Nonprobability sampling is used when the application of probability sampling is not feasible. Its advantages are convenience and economy.

PROBABILITY SAMPLING

Probability sampling is defined as the kind of sampling in which every element in the population has an equal chance of being selected. The possible inclusion of each population element in this kind of sampling takes place by chance and is attained through random selection. When probability sampling is used, inferential statistics enable researchers to estimate the extent to which the findings based on the sample are likely to differ from what they would have found by studying the whole population. The four types of probability sampling most frequently used in educational research are simple random sampling, stratified sampling, cluster sampling, and systematic sampling.

Simple Random Sampling

The best known of the probability sampling procedures is **simple random sampling.** The basic characteristic of simple random sampling is that all members of the population have an equal and independent chance of being included in the **random sample.** The steps in simple random sampling comprise the following:

1. Define the population.
2. List all members of the population.
3. Select the sample by employing a procedure where sheer chance determines which members on the list are drawn for the sample.

The first step in drawing a random sample from a population is to assign each member of the population a distinct identification number. Let us illustrate this procedure by showing how to obtain a sample of 50 students from the population attending Washington High School. First, you need to enumerate all the individuals in the population. The principal's office could supply a list of all students enrolled in the school. For identification purposes, you would then assign a number to each individual in the population. If there are 800 students in the school, you use the numbers 000, 001, 002, 003, . . . , 799 for this purpose. Each individual must have an identification value with the same number of digits as every other individual. Many schools have already assigned identification numbers to all their students. One way to draw a random sample would be to write the student numbers on separate slips of paper, place the pieces of paper in a container, shake the container, and draw out a slip of paper. Shake the container again, draw out another paper, and continue the process until 50 slips of paper have been picked. This process would be very tedious. A more systematic way to obtain a random sample is to use a table of random numbers, which includes a series of numbers, typically four to six digits in length, arranged in columns and rows (see Table 7.1 for a small segment of a table). A table of random numbers is produced by a computer program that guarantees that all the digits (0–9) have an equal chance of occurring each time a digit is printed. Most statistics books include a table of random numbers in the appendix. In previous editions of this book, we included a five-page table of random numbers. We decided this is no longer needed because there are so many tables available on the Internet, in statistics texts, and from other sources.

Let us illustrate how to use a table of random numbers. With our list of the 800 students in the population, we will use a table to obtain numbers of three digits each, using only those numbers that are less than or equal to 799. For each number chosen, the corresponding member of the population falls into the sample. Continue the process until the desired number for the sample has been chosen—in this case, the first 50 numbers that meet the criterion.

We begin by randomly selecting a starting point in the table. You can do this by closing your eyes and putting your finger on the page, or you can use a procedure that is an absolutely random way to enter the table. First, roll a die to determine which page to use. We roll a 3, so we pull the third page from a table of random numbers (Table 7.1). Then we note the last two digits from the serial number on a dollar bill. They are 03, so we go to row 3. Then we take the last two digits from a second dollar bill, which are 22, taking us to the intersection of row 3 and column 22. The intersection of the row and column is the location of the first random number. Because our population is 800, we will only look at the first three digits of the numbers in the table. If the population were 1500, we would look at the first four digits. In our example, we could use either the first three digits or the last three; we have chosen to use the first three. The first three digits from that intersection are 403, so the individual with number 403 is in the sample. Because the digits in a table are random, the numbers can be used vertically in both directions or horizontally in both directions. You should specify the direction you will use prior to entering the table and use it consistently. The remaining numbers would be located by moving in the specified direction. If we have decided to move vertically, the next three digits are 497, 243, 262, 782, and on down the column through 351. The next number is 995, which is larger than 799 (the size of the sample) so we would skip it and move on down, selecting the numbers smaller than 799. We have highlighted the numbers in that column that would be selected. You would then move to the next column and continue the process until you have 50 random numbers less than 799.

You probably will not actually have to do all this. However, we wanted to show you a way in which the numbers drawn from a table of random numbers can be absolutely without bias. You most likely will have access to web-based random number generators such as Research Randomizer (www.randomizer.org). If you access this website, you will find information about the Research Randomizer and a tutorial on how to use it to generate random numbers quickly. It is part of the Social Psychology Network and is free. Or, you may be lucky and conduct your research in a school whose record-keeping system allows for drawing a random sample using the school's computer.

The generally understood meaning of the word *random* is "without purpose or by accident." However, random sampling is purposeful and methodical. It is apparent that a sample selected randomly is not subject to the biases of the researcher. Rather, researchers commit themselves to selecting a sample in such a way that their biases are not permitted to operate; chance alone determines which elements in the population will be in the sample. They are pledging to avoid a deliberate selection of subjects who will confirm the hypothesis.

Table 7.1 Page from a Table of Random Numbers

	Column Number							
	00000	00000	11111	11111	22222	22222	33333	33333
Row	01234	56789	01234	56789	01234	56789	01234	56789
				3rd Thousand				
00	89221	02362	65787	74733	51272	30213	92441	39651
01	04005	99818	63918	29032	94012	42363	01261	10650
02	98546	38066	50856	75045	40645	22841	53254	44125
03	41719	84401	59226	01314	54581	40398	49988	65579
04	28733	72489	00785	25843	24613	49797	85567	84471
05	65213	83927	77762	03086	80742	24395	68476	83792
06	65553	12678	90906	90466	43670	26217	69900	31205
07	05668	69080	73029	85746	58332	78231	45986	92998
08	39202	99718	49757	79519	27387	76373	47262	91612
09	64592	32254	45879	29431	38320	05981	18067	87137
10	07513	48792	47314	83660	68907	05336	82579	91582
11	86593	68501	56638	99800	82839	35148	56541	07232
12	83735	22599	97977	81248	36838	99560	32410	67614
13	08595	21826	54655	08204	87990	17033	56258	05384
14	41273	27149	44293	69458	16828	63962	15864	35431
15	00473	75908	56238	12242	72631	76314	47252	06347
16	86131	53789	81383	07868	89132	96182	07009	86432
17	33849	78359	08402	03586	03176	88663	08018	22546
18	61870	41657	07468	08612	98083	97349	20775	45091
19	43898	65923	25078	86129	78491	97653	91500	80786
20	29939	39123	04548	45985	60952	06641	28726	46473
21	38505	85555	14388	55077	18657	94887	67831	70819
22	31824	38431	67125	25511	72044	11562	53279	82268
23	91430	03767	13561	15597	06750	92552	02391	38753
24	38635	68976	25498	97526	96458	03805	04116	63514

You would expect a random sample to be representative of the target population sampled. However, a random selection, especially with small samples, does not absolutely guarantee a sample that will represent the population well. Random selection does guarantee that any differences between the sample and the parent population are only a function of chance and not a result of the researcher's bias. The differences between random samples and their parent population are not systematic. For example, the mean reading achievement of a random sample of sixth-graders may be higher than the mean reading achievement of the target population, but it is equally likely that the mean for the sample will be lower than the mean for the target population. In other words, with random sampling the sampling errors are just as likely to be negative as they are to be positive.

Furthermore, statistical theorists have shown, through deductive reasoning, how much a researcher can expect the observations derived from random samples to differ from what would be observed in the population when the null hypothesis is true. All inferential statistical procedures have this aim in mind. When random sampling is used, the researcher can employ inferential statistics to estimate how much the population is likely to differ from the sample. The inferential statistics in this chapter are all based on random sampling and apply directly only to those cases in which the sampling has been random.

Unfortunately, simple random sampling requires enumeration of all individuals in a finite population before the sample can be drawn—a requirement that often presents a serious obstacle to the practical use of this method. Now let us look at other probability sampling methods that approximate simple random sampling and may be used as alternatives in certain situations.

Stratified Sampling

When the population consists of a number of subgroups, or strata, that may differ in the characteristics being studied, it is often desirable to use a form of probability sampling called **stratified sampling.** For example, if you were conducting a poll designed to assess opinions on a certain political issue, it might be advisable to subdivide the population into subgroups on the basis of age, neighborhood, and occupation because you would expect opinions to differ systematically among various ages, neighborhoods, and occupational groups. In stratified sampling, you first identify the strata of interest and then randomly draw a specified number of subjects from each stratum. The basis for stratification may be geographic or may involve characteristics of the population such as income, occupation, gender, age, year in college, or teaching level. In studying adolescents, for example, you might be interested not merely in surveying the attitudes of adolescents toward certain phenomena but also in comparing the attitudes of adolescents who reside in small towns with those who live in medium-size and large cities. In such a case, you would divide the adolescent population into three groups based on the size of the towns or cities in which they reside and then randomly select independent samples from each stratum.

An advantage of stratified sampling is that it enables the researcher to also study the differences that might exist between various subgroups of a population. In this kind of sampling, you may either take equal numbers from each stratum or select in proportion to the size of the stratum in the population. The latter procedure is known as **proportional stratified sampling,** which is applied when the characteristics of the entire population are the main concern in the study. Each stratum is represented in the sample in exact proportion to its frequency in the total population. For example, if 10 percent of the voting population are college students, then 10 percent of a sample of voters to be polled would be taken from this stratum. If a superintendent wants to survey the teachers in a school district regarding some policy and believes that teachers at different levels may feel differently, he or she could stratify on teaching level and then select a number from each level in proportion to its size in the total population of teachers. If 43 percent of the teachers are high school teachers, then 43 percent of the sample would be high school teachers.

In some research studies, however, the main concern is with differences among various strata. In these cases, the researcher chooses samples of equal size from each stratum. For example, if you are investigating the difference between the attitudes of graduate and undergraduate students toward an issue, you include equal numbers in both groups and then study the differences that might exist between them. You choose the procedure according to the nature of the research question. If your emphasis is on the types of differences among the strata, you select equal numbers of cases from each. If the characteristics of the entire population are your main concern, proportional sampling is more appropriate. When the population to be sampled is not homogeneous but consists of several subgroups, stratified sampling may give a more representative sample than simple random sampling. In simple random sampling, certain strata may by chance be over- or underrepresented in the sample. For example, in the simple random sample of high school students it would be theoretically possible (although highly unlikely) to obtain female subjects only. This could not happen, however, if males and females were listed separately and a random sample were then chosen from each group. The major advantage of stratified sampling is that it guarantees representation of defined groups in the population.

Cluster Sampling

As mentioned previously, it is very difficult, if not impossible, to list all the members of a target population and select the sample from among them. The population of American high school students, for example, is so large that you cannot list all its members for the purpose of drawing a sample. In addition, it would be very expensive to study a sample that is scattered throughout the United States. In this case, it would be more convenient to study subjects in naturally occurring groups, or clusters. For example, a researcher might choose a number of schools randomly from a list of schools and then include all the students in those schools in the sample. This kind of probability sampling is referred to as **cluster sampling** because the unit chosen is not an individual but, rather, a group of individuals who are naturally together. These individuals constitute a cluster insofar as they are alike with respect to characteristics relevant to the variables of the study. To illustrate, let us assume a public opinion poll is being conducted in Atlanta. The investigator would probably not have access to a list of the entire adult population; thus, it would be impossible to draw a simple random sample. A more feasible approach would involve the selection of a random sample of, for example, 50 blocks from a city map and then the polling of all the adults living on those blocks. Each block represents a cluster of subjects, similar in certain characteristics associated with living in proximity. A common application of cluster sampling in education is the use of intact classrooms as clusters.

It is essential that the clusters actually included in your study be chosen at random from a population of clusters. Another procedural requirement is that once a cluster is selected, *all* the members of the cluster must be included in the sample. The sampling error (discussed later) in a cluster sample is much greater than in true random sampling. It is also important to remember that if the number of clusters is small, the likelihood of sampling error is great—even if the total number of subjects is large.

Systematic Sampling

Still another form of probability sampling is called **systematic sampling.** This procedure involves drawing a sample by taking every *K*th case from a list of the population.

First, you decide how many subjects you want in the sample (n). Because you know the total number of members in the population (N), you simply divide N by n and determine the sampling interval (K) to apply to the list. Select the first member randomly from the first K members of the list and then select every Kth member of the population for the sample. For example, let us assume a total population of 500 subjects and a desired sample size of 50: $K = N/n = 500/50 = 10$.

Start near the top of the list so that the first case can be randomly selected from the first 10 cases, and then select every tenth case thereafter. Suppose the third name or number on the list was the first selected. You would then add the sampling interval, or 10, to 3—and thus the 13th person falls in the sample, as does the 23rd, and so on—and would continue adding the constant sampling interval until you reached the end of the list.

Systematic sampling differs from simple random sampling in that the various choices are not independent. Once the first case is chosen, all subsequent cases to be included in the sample are automatically determined. If the original population list is in random order, systematic sampling would yield a sample that could be statistically considered a reasonable substitute for a random sample. However, if the list is not random, it is possible that every Kth member of the population might have some unique characteristic that would affect the dependent variable of the study and thus yield a biased sample. Systematic sampling from an alphabetical list, for example, would probably not give a representative sample of various national groups because certain national groups tend to cluster under certain letters, and the sampling interval could omit them entirely or at least not include them to an adequate extent.

Note that the various types of probability sampling that have been discussed are not mutually exclusive. Various combinations may be used. For example, you could use cluster sampling if you were studying a very large and widely dispersed population. At the same time, you might be interested in stratifying the sample to answer questions regarding its different strata. In this case, you would stratify the population according to the predetermined criteria and then randomly select the cluster of subjects from among each stratum.

NONPROBABILITY SAMPLING

In many research situations, the enumeration of the population elements—a basic requirement in probability sampling—is difficult, if not impossible. Or a school principal might not permit a researcher to draw a random sample of students for a study but would permit use of certain classes. In these instances, the researcher would use nonprobability sampling, which involves nonrandom procedures for selecting the members of the sample. In nonprobability sampling, there is no assurance that every element in the population has a chance of being included. Its main advantages are convenience and economy. The major forms of nonprobability sampling are convenience sampling, purposive sampling, and quota sampling.

Convenience Sampling

Convenience sampling, which is regarded as the weakest of all sampling procedures, involves using available cases for a study. Interviewing the first individuals you encounter on campus, using a large undergraduate class, using the students in your own classroom as a sample, or taking volunteers to be interviewed in survey research are various examples of convenience sampling. There is no way (except by repeating the study using probability sampling) of estimating the error introduced by the convenience sampling procedures. Probability sampling is the ideal, but in practice, convenience sampling may be all that is available to a researcher. In this case, a convenience sample is perhaps better than nothing at all. If you do use convenience sampling, be extremely cautious in interpreting the findings and know that you cannot generalize the findings.

Purposive Sampling

In **purposive sampling—**also referred to as **judgment sampling—**sample elements judged to be typical, or representative, are chosen from the population. The assumption is that errors of judgment in the selection will counterbalance one another. Researchers often use purposive sampling for forecasting national elections. In each state, they choose a number of small districts whose returns in previous elections have been typical of the entire state. They interview all the eligible voters in these districts and use the results to predict the voting patterns of the state. Using similar procedures in all states, the pollsters forecast the national results.

The critical question in purposive sampling is the extent to which judgment can be relied on to arrive at a typical sample. There is no reason to assume that the units judged to be typical of the population will continue to be typical over a period of time. Consequently, the results of a study using purposive sampling may be misleading. Because of its low cost and convenience, purposive sampling has been useful in attitude and opinion surveys. Be aware of the limitations, however, and use the method with extreme caution.

Quota Sampling

Quota sampling involves selecting typical cases from diverse strata of a population. The quotas are based on known characteristics of the population to which you wish to generalize. Elements are drawn so that the resulting sample is a miniature approximation of the population with respect to the selected characteristics. For example, if census results show that 25 percent of the population of an urban area lives in the suburbs, then 25 percent of the sample should come from the suburbs.

Here are the steps in quota sampling:

1. Determine a number of variables, strongly related to the question under investigation, to be used as bases for stratification. Variables such as gender, age, education, and social class are frequently used.
2. Using census or other available data, determine the size of each segment of the population.
3. Compute quotas for each segment of the population that are proportional to the size of each segment.
4. Select typical cases from each segment, or stratum, of the population to fill the quotas.

The major weakness of quota sampling lies in step 4, the selection of individuals from each stratum. You simply do not know whether the individuals chosen are representative of the given stratum. The selection of elements is likely to be based on accessibility and convenience. If you are selecting 25 percent of the households in the inner city for a survey, you are more likely to go to houses that are attractive rather than dilapidated, to those that are more accessible, to those where people are at home during the day, and so on. Such procedures automatically result in a systematic bias in the sample because certain elements are going to be misrepresented. Furthermore, there is no basis for calculating the error involved in quota sampling.

Despite these shortcomings, researchers have used quota sampling in many projects that might otherwise not have been possible. Many believe that speed of data collection outweighs the disadvantages. Moreover, years of experience with quota samples have made it possible to identify some of the pitfalls and to take steps to avoid them.

RANDOM ASSIGNMENT

We distinguish random sampling from random assignment. **Random assignment** is a procedure used after we have a sample of participants and before we expose them to a treatment. For example, if we wish to compare the effects of two treatments on the same dependent variable, we use random assignment to put our available participants into groups. Random assignment requires a chance procedure such as a table of random numbers to divide the available subjects into groups. Then a chance procedure such as tossing a coin is used to decide which group gets which treatment.

As with random sampling, any bias the researcher has will not influence who gets what treatment, and the groups will be statistically equivalent before treatment. Group 1 may have more highly motivated subjects than group 2, but it is just as likely that group 2 will have more highly motivated subjects than group 1. The same is true of all possible known or unknown variables that might influence the dependent variable. Therefore, the same lawful nature of sampling errors that are true of random sampling are true of random assignment.

THE SIZE OF THE SAMPLE (FUNDAMENTALS)

Laypeople are often inclined to criticize research (especially research whose results they do not like) by saying the sample was too small to justify the researchers' conclusions. How large should a sample be? Other things being equal, a larger sample is more likely to be a good representative of the population than a smaller sample. However, the most important characteristic of a sample is its representativeness, not its size. A random sample of 200 is better than a random sample of 100, but a random sample of 100 is better than a biased sample of 2.5 million.

Size alone will not guarantee accuracy. A sample may be large and still contain a bias. The latter situation is well illustrated by the *Literary Digest* magazine poll of 1936, which predicted the defeat of President Roosevelt. Although the sample included approximately 2.5 million respondents, it was not representative of the voters; thus, the pollsters reached an erroneous conclusion. The bias resulted from selecting respondents for the poll from automobile registrations, telephone directories, and the magazine's subscription lists. These subjects would certainly not represent the total voting population in 1936, when many people could not afford automobiles, telephones, or magazines. Also, because the poll was conducted by mail, the results were biased by differences between those who responded and those who did not. We have since learned that with mailed questionnaires, those who are against the party in power are more likely to return their questionnaires than those who favor the party in power. The researcher must recognize that sample size will not compensate for any bias that faulty sampling techniques may introduce. Representativeness must remain the prime goal in sample selection.

Later in this chapter, we introduce a procedure for determining appropriate sample size, on the basis of how large an effect size is considered meaningful and on statistical considerations. Such procedures, known as **power calculations,** are the best way to determine needed sample sizes.

THE CONCEPT OF SAMPLING ERROR

When an inference is made from a sample to a population, a certain amount of error is involved because even random samples can be expected to vary from one to another. The mean intelligence score of one random sample of fourth-graders will probably differ from the mean intelligence score of another random sample of fourth-graders from the same population. Such differences, called **sampling errors,** result from the fact that the researcher has observed only a sample and not the entire population.

Sampling error is "the difference between a population parameter and a sample statistic." For example, if you know the mean of the entire population (symbolized μ) and also the mean of a random sample (symbolized $\overline{X}$) from that population, the difference between these two ($\overline{X} - \mu$) represents sampling error (symbolized e). Thus, $e = \overline{X} - \mu$. For example, if you know that the mean intelligence score for a population of 10,000 fourth-graders is $\mu = 100$ and a particular random sample of 200 has a mean of $\overline{X} = 99$, then the sampling error is $\overline{X} - \mu = 99 - 100 = -1$. Because we usually depend on sample statistics to estimate population parameters, the notion of how samples are expected to vary from populations is a basic element in inferential statistics. However, instead of trying to determine the discrepancy between a sample statistic and the population parameter (which is not often known), the approach in inferential statistics is to estimate the variability that could be expected in the statistics from a number of different random samples drawn from the same population. Because each of the sample statistics is considered to be an estimate of the same population parameter, any variation among sample statistics must be attributed to sampling error.

The Lawful Nature of Sampling Errors

Given that random samples drawn from the same population will vary from one another, is using a sample to make inferences about a population really any better than just guessing? Yes, it is because sampling errors behave in a lawful and predictable manner. The laws concerning sampling error have been derived through deductive logic and have been confirmed through experience.

Although researchers cannot predict the nature and extent of the error in a single sample, they can predict the nature and extent of sampling errors in general. Let us illustrate with reference to sampling errors connected with the mean.

Sampling Errors of the Mean

Some sampling error can always be expected when a sample mean is used to estimate a population mean μ. Although, in practice, such an estimate is based on a single sample mean, assume that you drew several random samples from the same population and computed a mean for each sample. You would find that these sample means would differ from one another and would also differ from the population mean (if it were known). Statisticians have carefully studied sampling errors of the mean and found that they follow known laws.

1. *The expected mean of sampling errors is zero*. Given an infinite number of random samples drawn from a single population, the positive errors can be expected to balance the negative errors so that the mean of the sampling errors will be zero. For example, if the mean height of a population of college freshmen is 5 feet 9 inches and several random samples are drawn from that population, you would expect some samples to have mean heights greater than 5 feet 9 inches and some to have mean heights less than 5 feet 9 inches. In the long run, however, the positive and negative sampling errors will balance. If you had an infinite number of random samples of the same size, calculated the mean of each of these samples, and then computed the mean of all these means, this mean would be equal to the population mean.

   Because positive errors equal negative errors, a single sample mean is as likely to underestimate a population mean as to overestimate it. Therefore, we can justify stating that a sample mean is an unbiased estimate of the population mean and is a reasonable estimate of the population mean.
2. *Sampling error is an inverse function of sample size*. As the size of a random sample increases, there is less fluctuation from one sample to another in the value of the mean. In other words, as the size of a sample increases, the expected sampling error decreases. Small samples produce more sampling error than large ones. You would expect the means based on samples of 10 to fluctuate a great deal more than the means based on samples of 100. In the height example, it is much more likely that a random sample of 4 will include 3 above-average freshmen and 1 below-average freshman than that a random sample of 40 would include 30 above-average and 10 below-average freshman. As sample size increases, the likelihood that the mean of the sample is near the population mean also increases. There is a mathematical relationship between sample size and sampling error. This relationship has been incorporated into inferential formulas, which we discuss later.
3. *Sampling error is a direct function of the standard deviation of the population*. The more spread, or variation, there is among members of a population, the more spread there will be in sample means. For example, the mean weights of random samples of 25, each selected from a population of professional jockeys, would show relatively less sampling error than the mean weights of samples of 25 selected from a population of schoolteachers. The weights of professional jockeys fall within a narrow range; the weights

of schoolteachers do not. Therefore, for a given sample size, the expected sampling error for teachers' weights would be greater than the expected sampling error for jockeys' weights.

4. *Sampling errors are distributed in a normal or near-normal manner around the expected mean of zero*. Sample means near the population mean will occur more frequently than sample means far from the population mean. As you move farther and farther from the population mean, you find fewer and fewer sample means occurring. Both theory and experience have shown that the means of random samples are distributed in a normal or near-normal manner around the population mean. Because a sampling error in this case is the difference between a sample mean and the population mean, the distribution of sampling errors is also normal or near normal in shape.

The distribution of sample means will resemble a normal curve even when the population from which the samples are drawn is not normally distributed. For example, in a typical elementary school you will find approximately equal numbers of children of various ages included, so a polygon of the children's ages would be basically rectangular. If you took random samples of 40 each from a school with equal numbers of children aged 6 through 11 years, you would find many samples with a mean age near the population mean of 8.5 years, sample means of approximately 8 or 9 would be less common, and sample means as low as 7 or as high as 10 would be rare. Note that the word error in this context does not mean "mistake"—it refers to what is unaccounted for.

TABLE 1 - RANDOM DIGITS

11164	36318	75061	37674	26320	75100	10431	20418	19228	91792
21215	91791	76831	58678	87054	31687	93205	43685	19732	08468
10438	44482	66558	37649	08882	90870	12462	41810	01806	02977
36792	26236	33266	66583	60881	97395	20461	36742	02852	50564
73944	04773	12032	51414	82384	38370	00249	80709	72605	67497
49563	12872	14063	93104	78483	72717	68714	18048	25005	04151
64208	48237	41701	73117	33242	42314	83049	21933	92813	04763
51486	72875	38605	29341	80749	80151	33835	52602	79147	08868
99756	26360	64516	17971	48478	09610	04638	17141	09227	10606
71325	55217	13015	72907	00431	45117	33827	92873	02953	85474
65285	97198	12138	53010	94601	15838	16805	61004	43516	17020
17264	57327	38224	29301	31381	38109	34976	65692	98566	29550
95639	99754	31199	92558	68368	04985	51092	37780	40261	14479
61555	76404	86210	11808	12841	45147	97438	60022	12645	62000
78137	98768	04689	87130	79225	08153	84967	64539	79493	74917
62490	99215	84987	28759	19177	14733	24550	28067	68894	38490
24216	63444	21283	07044	92729	37284	13211	37485	10415	36457
16975	95428	33226	55903	31605	43817	22250	03918	46999	98501
59138	39542	71168	57609	91510	77904	74244	50940	31553	62562
29478	59652	50414	31966	87912	87154	12944	49862	96566	48825
96155	95009	27429	72918	08457	78134	48407	26061	58754	05326
29621	66583	62966	12468	20245	14015	04014	35713	03980	03024
12639	75291	71020	17265	41598	64074	64629	63293	53307	48766
14544	37134	54714	02401	63228	26831	19386	15457	17999	18306
83403	88827	09834	11333	68431	31706	26652	04711	34593	22561
67642	05204	30697	44806	96989	68403	85621	45556	35434	09532
64041	99011	14610	40273	09482	62864	01573	82274	81446	32477
17048	94523	97444	59904	16936	39384	97551	09620	63932	03091
93039	89416	52795	10631	09728	68202	20963	02477	55494	39563
82244	34392	96607	17220	51984	10753	76272	50985	97593	34320
96990	55244	70693	25255	40029	23289	48819	07159	60172	81697
09119	74803	97303	88701	51380	73143	98251	78635	27556	20712
57666	41204	47589	78364	38266	94393	70713	53388	79865	92069
46492	61594	26729	58272	81754	14648	77210	12923	53712	87771
08433	19172	08320	20839	13715	10597	17234	39355	74816	03363
10011	75004	86054	41190	10061	19660	03500	68412	57812	57929
92420	65431	16530	05547	10683	88102	30176	84750	10115	69220
35542	55865	07304	47010	43233	57022	52161	82976	47981	46588
86595	26247	18552	29491	33712	32285	64844	69395	41387	87195
72115	34985	58036	99137	47482	06204	24138	24272	16196	04393
07428	58863	96023	88936	51343	70958	96768	74317	27176	29600
35379	27922	28906	55013	26937	48174	04197	36074	65315	12537
10982	22807	10920	26299	23593	64629	57801	10437	43965	15344
90127	33341	77806	12446	15444	49244	47277	11346	15884	28131
63002	12990	23510	68774	48983	20481	59815	67248	17076	78910
40779	86382	48454	65269	91239	45989	45389	54847	77919	41105
43216	12608	18167	84631	94058	82458	15139	76856	86019	47928
96167	64375	74108	93643	09204	98855	59051	56492	11933	64958
70975	62693	35684	72607	23026	37004	32989	24843	01128	74658
85812	61875	23570	75754	29090	40264	80399	47254	40135	69916

TABLE 2 – RANDOM DIGITS

40603	16152	83235	37361	98783	24838	39793	80954	76865	32713
40941	53585	69958	60916	71018	90561	84505	53980	64735	85140
73505	83472	55953	17957	11446	22618	34771	25777	27064	13526
39412	16013	11442	89320	11307	49396	39805	12249	57656	88686
57994	76748	54627	48511	78646	33287	35524	54522	08795	56273
61834	59199	15469	82285	84164	91333	90954	87186	31598	25942
91402	77227	79516	21007	58602	81418	87838	18443	76162	51146
58299	83880	20125	10794	37780	61705	18276	99041	78135	99661
40684	99948	33880	76413	63839	71371	32392	51812	48248	96419
75978	64298	08074	62055	73864	01926	78374	15741	74452	49954
34556	39861	88267	76068	62445	64361	78685	24246	27027	48239
65990	57048	25067	77571	77974	37634	81564	98608	37224	49848
16381	15069	25416	87875	90374	86203	29677	82543	37554	89179
52458	88880	78352	67913	09245	47773	51272	06976	99571	33365
33007	85607	92008	44897	24964	50559	79549	85658	96865	24186
38712	31512	08588	61490	72294	42862	87334	05866	66269	43158
58722	03678	19186	69602	34625	75958	56869	17907	81867	11535
26188	69497	51351	47799	20477	71786	52560	66827	79419	70886
12893	54048	07255	86149	99090	70958	50775	31768	52903	27645
33186	81346	85095	37282	85536	72661	32180	40229	19209	74939
79893	29448	88392	54211	61708	83452	61227	81690	42265	20310
48449	15102	44126	19438	23382	14985	37538	30120	82443	11152
94205	04259	68983	50561	06902	10269	22216	70210	60736	58772
38648	09278	81313	77400	41126	52614	93613	27263	99381	49500
04292	46028	75666	26954	34979	68381	45154	09314	81009	05114
17026	49737	85875	12139	59391	81830	30185	83095	78752	40899
48070	76848	02531	97737	10151	18169	31709	74842	85522	74092
30159	95450	83778	46115	99178	97718	98440	15076	21199	20492
12148	92231	31361	60650	54695	30035	22765	91386	70399	79270
73838	77067	24863	97576	01139	54219	02959	45696	98103	78867
73547	43759	95632	39555	74391	07579	69491	02647	17050	49869
07277	93217	79421	21769	83572	48019	17327	99638	87035	89300
65128	48334	07493	28098	52087	55519	83718	60904	48721	17522
38716	61380	60212	05099	21210	22052	01780	36813	19528	07727
31921	76458	73720	08657	74922	61335	41690	41967	50691	30508
57238	27464	61487	52329	26150	79991	64398	91273	26824	94827
24219	41090	08531	61578	08236	41140	76335	91189	66312	44000
31309	49387	02330	02476	96074	33256	48554	95401	02642	29119
20750	97024	72619	66628	66509	31206	55293	24249	02266	39010
28537	84395	26654	37851	80590	53446	34385	86893	87713	26842
97929	41220	86431	94485	28778	44997	38802	56594	61363	04206
40568	33222	40486	91122	43294	94541	40988	02929	83190	74247
41483	92935	17061	78252	40498	43164	68646	33023	64333	64083
93040	66476	24990	41099	65135	37641	97613	87282	63693	55299
76869	39300	84978	07504	36835	72748	47644	48542	25076	68626
02982	57991	50765	91930	21375	35604	29963	13738	03155	59914
94479	76500	39170	06629	10031	48724	49822	44021	44335	26474
52291	75822	95966	90947	65031	75913	52654	63377	70664	60082
03684	03600	52831	55381	97013	19993	41295	29118	18710	64851
58939	28366	86765	67465	45421	74228	01095	50987	83833	37216

TABLE 3 – RANDOM DIGITS

37100	62492	63642	47638	13925	80113	88067	42575	44078	62703
53406	13855	38519	29500	62479	01036	87964	44498	07793	21599
55172	81556	18856	59043	64315	38270	25677	01965	21310	28115
40353	84807	47767	46890	16053	32415	60259	99788	55924	22077
18899	09612	77541	57675	70153	41179	97535	82889	27214	03482
68141	25340	92551	11326	60939	79355	41544	88926	09111	86431
51559	91159	81310	63251	91799	41215	87412	35317	74271	11603
92214	33386	73459	79359	65867	39269	57527	69551	17495	91456
15089	50557	33166	87094	52425	21211	41876	42525	36625	63964
96461	00604	11120	22254	16763	19206	67790	88362	01880	37911
28177	44111	15705	73835	69399	33602	13660	84342	97667	80847
66953	44737	81127	07493	07861	12666	85077	95972	96556	80108
19712	27263	84575	49820	19837	69985	34931	67935	71903	82560
68756	64757	19987	92222	11691	42502	00952	47981	97579	93408
75022	65332	98606	29451	57349	39219	08585	31502	96936	96356
11323	70069	90269	89266	46413	61615	66447	49751	15836	97343
55208	63470	18158	25283	19335	53893	87746	72531	16826	52605
11474	08786	05594	67045	13231	51186	71500	50498	59487	48677
81422	86842	60997	79669	43804	78690	58358	87639	24427	66799
21771	75963	23151	90274	08275	50677	99384	94022	84888	80139
42278	12160	32576	14278	34231	20724	27908	02657	19023	07190
17697	60114	63247	32096	32503	04923	17570	73243	76181	99343
05686	30243	34124	02936	71749	03031	72259	26351	77511	00850
52992	46650	89910	57395	39502	49738	87854	71066	84596	33115
94518	93984	81478	67750	89354	01080	25988	84359	31088	13655
00184	72186	78906	75480	71140	15199	69002	08374	22126	23555
87462	63165	79816	61630	50140	95319	79205	79202	67414	60805
88692	58716	12273	48176	86038	78474	76730	82931	51595	20747
20094	42962	41382	16768	13261	13510	04822	96354	72001	68642
60935	81504	50520	82153	27892	18029	79663	44146	72876	67843
51392	85936	43898	50596	81121	98122	69196	54271	12059	62539
54239	41918	79526	46274	24853	67165	12011	04923	20273	89405
57892	73394	07160	90262	48731	46648	70977	58262	78359	50436
02330	74736	53274	44468	53616	35794	54838	39114	68302	26855
76115	29247	55342	51299	79908	36613	68361	18864	13419	34950
63312	81886	29085	20101	38037	34742	78364	39356	40006	49800
27632	21570	34274	56426	00330	07117	86673	46455	66866	76374
06335	62111	44014	52567	79480	45886	92585	87828	17376	35254
64142	87676	21358	88773	10604	62834	63971	03989	21421	76086
28436	25468	75235	75370	63543	76266	27745	31714	04219	00699
09522	83855	85973	15888	29554	17995	37443	11461	42909	32634
93714	15414	93712	02742	34395	21929	38928	31205	01838	60000
15681	53599	58185	73840	88758	10618	98725	23146	13521	47905
77712	23914	08907	43768	10304	61405	53986	61116	76164	54958
78453	54844	61509	01245	91199	07482	02534	08189	62978	55516
24860	68284	19367	29073	93464	06714	45268	60678	58506	23700
37284	06844	78887	57276	42695	03682	83240	09744	63025	60997
35488	52473	37634	32569	39590	27379	23520	29714	03743	08444
51595	59909	35223	44991	29830	56614	59661	83397	38421	17503
90660	35171	30021	91120	78793	16827	89320	08260	09181	53616

TABLE 4 – RANDOM DIGITS

54723	56527	53076	38235	42780	22716	36400	48028	78196	92985
84828	81248	25548	34075	43459	44628	21866	90350	82264	20478
65799	01914	81363	05173	23674	41774	25154	73003	87031	94368
87917	38549	48213	71708	92035	92527	55484	32274	87918	22455
26907	88173	71189	28377	13785	87469	35647	19695	33401	51998
68052	65422	88460	06352	42379	55499	60469	76931	83430	24560
42587	68149	88147	99700	56124	53239	38726	63652	36644	50876
97176	55416	67642	05051	89931	19482	80720	48977	70004	03664
53295	87133	38264	94708	00703	35991	76404	82249	22942	49659
23011	94108	29196	65187	69974	01970	31667	54307	40032	30031
75768	49549	24543	63285	32803	18301	80851	89301	02398	99891
86668	70341	66460	75648	78678	27770	30245	44775	56120	44235
56727	72036	50347	33521	05068	47248	67832	30960	95465	32217
27936	78010	09617	04408	18954	61862	64547	52453	83213	47833
31994	69072	37354	93025	38934	90219	91148	62757	51703	84040
02985	95303	15182	50166	11755	56256	89546	31170	87221	63267
89965	10206	95830	95406	33845	87588	70237	84360	19629	72568
45587	29611	98579	42481	05359	36578	56047	68114	58583	16313
01071	08530	74305	77509	16270	20889	99753	88035	55643	18291
90209	68521	14293	39194	68803	32052	39413	26883	83119	69623
04982	68470	27875	15480	13206	44784	83601	03172	07817	01520
19740	24637	97377	32112	74283	69384	49768	64141	02024	85380
50197	79869	86497	68709	42073	28498	82750	43571	77075	07123
46954	67536	28968	81936	95999	04319	09932	66223	45491	69503
82549	62676	31123	49899	70512	95288	15517	85352	21987	08669
61798	81600	80018	84742	06103	60786	01408	75967	29948	21454
57666	29055	46518	01487	30136	14349	56159	47408	78311	25896
29805	64994	66872	62230	41385	58066	96600	99301	85976	84194
06711	34939	19599	76247	87879	97114	74314	39599	43544	36255
13934	46885	58315	88366	06138	37923	11192	90757	10831	01580
28549	98327	99943	25377	17628	65468	07875	16728	22602	33892
40871	61803	25767	55484	90997	86941	64027	01020	39518	34693
47704	38355	71708	80117	11361	88875	22315	38048	42891	87885
62611	19698	09304	29265	07636	08508	23773	56545	08015	28891
03047	83981	11916	09267	67316	87952	27045	62536	32180	60936
26460	50501	31731	18938	11025	18515	31747	96828	58258	97107
01764	25959	69293	89875	72710	49659	66632	25314	95260	22146
11762	54806	02651	52912	32770	64507	59090	01275	47624	16124
31736	31695	11523	64213	91190	10145	34231	36405	65860	48771
97155	48706	52239	21831	49043	18650	72246	43729	63368	53822
31181	49672	17237	04024	65324	32460	01566	67342	94986	36106
32115	82683	67182	89030	41370	50266	19505	57724	93358	49445
07068	75947	71743	69285	30395	81818	36125	52055	20289	16911
26622	74184	75166	96748	34729	61289	36908	73686	84641	45130
02805	52676	22519	47848	68210	23954	63085	87729	14176	45410
32301	58701	04193	30142	99779	21697	05059	26684	63516	75925
26339	56909	39331	42101	01031	01947	02257	47236	19913	90371
95274	09508	81012	42413	11278	19354	68661	04192	36878	84366
24275	39632	09777	98800	48027	96908	08177	15364	02317	89548
36116	42128	65401	94199	51058	10759	47244	99830	64255	40516

TABLE 5 – RANDOM DIGITS

47505	02008	20300	87188	42505	40294	04404	59286	95914	07191
13350	08414	64049	94377	91059	74531	56228	12307	87871	97064
33006	92690	69248	97443	38841	05051	33756	24736	43508	53566
55216	63886	06804	11861	30968	74515	40112	40432	18682	02845
21991	26228	14801	19192	45110	39937	81966	23258	99348	61219
71025	28212	10474	27522	16356	78456	46814	28975	01014	91458
65522	15242	84554	74560	26206	49520	65702	54193	25583	54745
27975	54923	90650	06170	99006	75651	77622	20491	53329	12452
07300	09704	36099	61577	34632	55176	87366	19968	33986	46445
54357	13689	19569	03814	47873	34086	28474	05131	46619	41499
00977	04481	42044	08649	83107	02423	46919	59586	58337	32280
13920	78761	12311	92808	71581	85251	11417	85252	61312	10266
08395	37043	37880	34172	80411	05181	58091	41269	22626	64799
46166	67206	01619	43769	91727	06149	17924	42628	57647	76936
87767	77607	03742	01613	83528	66251	75822	83058	97584	45401
29880	95288	21644	46587	11576	30568	56687	83239	76388	17857
36248	36666	14894	59273	04518	11307	67655	08566	51759	41795
12386	29656	30474	25964	10006	86382	46680	93060	52337	56034
52068	73801	52188	19491	76221	45685	95189	78577	36250	36082
41727	52171	56719	06054	34898	93990	89263	79180	39917	16122
49319	74580	57470	14600	22224	49028	93024	21414	90150	15686
88786	76963	12127	25014	91593	98208	27991	12539	14357	69512
84866	95202	43983	72655	89684	79005	85932	41627	87381	38832
11849	26482	20461	99450	21636	13337	55407	01897	75422	05205
54966	17594	57393	73267	87106	26849	68667	45791	87226	74412
10959	33349	80719	96751	25752	17133	32786	34368	77600	41809
22784	07783	35903	00091	73954	48706	83423	96286	90373	23372
86037	61791	33815	63968	70437	33124	50025	44367	98637	40870
80037	65089	85919	74391	36170	82988	52311	59180	37846	98028
72751	84359	15769	13615	70866	37007	74565	92781	37770	76451
18532	03874	66220	79050	66814	76341	42452	65365	07167	90134
22936	22058	49171	11027	07066	14606	11759	19942	21909	15031
66397	76510	81150	00704	94990	68204	07242	82922	65745	51503
89730	23272	65420	35091	16227	87024	56662	59110	11158	67508
81821	75323	96068	91724	94679	88062	13729	94152	59343	07352
94377	82554	53586	11432	08788	74053	98312	61732	91248	23673
68485	49991	53165	19865	30288	00467	98105	91483	89389	61991
07330	07184	86788	64577	47692	45031	36325	47029	27914	24905
10993	14930	35072	36429	26176	66205	07758	07982	33721	81319
20801	15178	64453	83357	21589	23153	60375	63305	37995	66275
79241	35347	66851	79247	57462	23893	16542	55775	06813	63512
43593	39555	97345	58494	52892	55080	19056	96192	61508	23165
29522	62713	33701	17186	15721	95018	76571	58615	35836	66260
88836	47290	67274	78362	84457	39181	17295	39626	82373	10883
65905	66253	91482	30689	81313	01343	37188	37756	04182	19376
44798	69371	07865	91756	42318	63601	53872	93610	44142	89830
35510	99139	32031	27925	03560	33806	85092	70436	94777	57963
50125	93223	64209	49714	73379	89975	38567	44316	60262	10777
25173	90038	63871	40418	23818	63250	05118	52700	92327	55449
68459	90094	44995	93718	83654	79311	18107	12557	09179	28416

TABLE 6 – RANDOM DIGITS

96195	07059	13266	31389	87612	88004	31843	83469	22793	14312
22408	94958	19095	58035	43831	32354	83946	57964	70404	32017
53896	23508	16227	56929	74329	12264	26047	66844	47383	42202
22565	02475	00258	79018	70090	37914	27755	00872	71553	56684
49438	20772	60846	69732	07612	70474	46483	21053	95475	53448
65620	34684	00210	04863	01373	19978	61682	69315	46766	83768
20246	26941	41298	04763	19769	25865	95937	03545	93561	73871
09433	09167	35166	32731	73299	41137	37328	28301	61629	05040
95552	73456	16578	88140	80059	50296	07656	01396	83099	09718
76053	05150	69125	69442	16509	03495	26427	58780	27576	31342
34822	35843	78468	82380	52313	71070	71273	10768	86101	51474
07753	04073	58520	80022	28185	16432	86909	82347	10548	83929
04204	94434	62798	81902	29977	57258	87826	35003	46449	76636
96770	19440	29700	42093	64369	69176	29732	37389	34054	28680
65989	62843	10917	34458	81936	84775	39415	10622	36102	16753
06644	94784	66995	61812	54215	01336	75887	57685	66114	76984
88950	46077	34651	12038	87914	20785	39705	73898	12318	78334
21482	95422	02002	33671	46764	50527	46276	77570	68457	62199
55137	61039	02006	69913	11291	87215	89991	26003	55271	08153
98441	81529	59607	65225	49051	28328	85535	37003	87211	10204
57168	30458	23892	07825	53447	53511	09315	42552	43135	57892
71886	65334	38013	09379	83976	42441	14086	33197	82671	05037
40418	59504	52383	07232	14179	59693	37668	26689	93865	78925
28833	76661	47277	92935	63193	94862	60560	72484	29755	40894
37883	62124	62199	49542	55083	20575	44636	92282	52105	77664
44882	33592	66234	13821	86342	00135	87938	57995	34157	99858
19082	13873	07184	21566	95320	28968	31911	06288	77271	76171
45316	29283	89318	55806	89338	79231	91545	55477	19552	03471
22788	55433	31188	74882	44858	69655	08096	70982	61300	23792
08293	86193	05026	21255	63082	92946	28748	25423	45282	57821
29223	70541	67115	84584	10100	33854	26466	77796	70698	99393
22681	80110	31595	09246	39147	11158	43298	36220	88841	11271
74580	90354	43744	22178	38084	60027	24201	71686	59767	33274
69093	71364	08107	96952	50005	30297	97417	89575	04676	35616
40456	91234	58090	65342	95002	28447	21'700	43137	13746	85959
72927	67349	83962	58912	59734	76323	02913	46306	53956	38936
61869	33093	81129	06481	89281	83629	81960	63704	56329	10357
40048	16520	07638	10797	22270	57350	72214	36410	95526	87614
68773	97669	28656	89938	12917	25630	08068	19445	76250	24727
09774	30751	49740	11385	91468	28900	76804	52460	52320	70493
46139	36689	82587	13586	35061	76128	38568	62300	43439	53434
26566	95323	32993	89988	12152	01862	93113	33875	31730	62941
06765	57141	48617	18282	13086	76064	83334	70192	15972	80429
35384	90380	12317	89702	33091	68835	62960	38010	52710	87604
49333	78482	36199	11355	86044	88760	03724	22927	91716	92332
45595	14044	56806	99126	85584	87750	78149	22723	48245	78126
79819	15054	76174	12206	06886	06814	43285	20008	75345	19779
11971	62234	74857	46401	20817	57591	41189	49604	29604	30660
11452	89318	53084	21993	62471	74101	61217	76536	58393	63718
38746	81271	96260	98137	60275	22647	33103	50090	29395	10016

TABLE 7 – RANDOM DIGITS

93369	13044	69686	78162	29132	51544	17925	56738	32683	83153
19360	55049	94951	76341	38159	31008	41476	05278	03909	02299
47798	89890	06893	65483	97658	74884	38611	27264	26956	83504
69223	32007	03513	61149	66270	73087	16795	76845	44645	44552
34511	50721	84850	34159	38985	75384	22965	55366	81632	78872
54031	59329	58963	52220	76806	98715	67452	78741	58128	00077
66722	85515	04723	92411	03834	12109	85185	37350	93614	15351
71059	07496	38404	18126	37894	44991	45777	02070	38159	23930
45478	86066	31135	33243	01190	47277	55146	56130	70117	83203
97246	91121	89437	20393	76598	99458	76665	83793	37448	32664
22982	25936	96417	34845	28942	65569	38253	77182	12996	19505
48243	62993	47132	85248	79160	90981	71696	79609	33809	60839
93514	14915	67960	82203	22598	94802	75332	95585	69542	79924
69707	98303	93069	16216	01542	51771	16833	20922	94415	27617
87467	91794	70814	12743	17543	04057	71231	11309	32780	83270
81006	81498	59375	30502	44868	81279	23585	49678	70014	10523
15458	83481	50187	43375	56644	72076	59403	65469	74760	69509
33469	12510	23095	48016	22064	39774	07373	10555	33345	21787
67198	07176	65996	18317	83083	11921	06254	68437	59481	54778
58037	92261	85504	55690	63488	26451	43223	38009	50567	09191
84983	68312	25519	56158	22390	12823	92390	28947	36708	25393
35554	02935	72889	68772	79774	14336	50716	63003	86391	94074
04368	17632	50962	71908	13105	76285	31819	16884	11665	16594
81311	60479	69985	30952	93067	70056	55229	83226	22555	66447
03823	89887	55828	74452	21692	55847	15960	47521	27784	25728
80422	65437	38797	56261	88300	35980	56656	45662	29219	49257
61307	49468	43344	43700	14074	19739	03275	99444	62545	23720
83873	82557	10002	80093	74645	33109	15281	38759	09342	69408
38110	16855	28922	93758	22885	36706	92542	60270	99599	17983
43892	91189	87226	56935	99836	85489	89693	49475	31941	78065
93683	09664	53927	49885	94979	88848	42642	93218	80305	49428
32748	02121	11972	96914	83264	89016	45140	20362	63242	86255
49211	92963	38625	65312	52156	36400	67050	64058	45489	24165
63365	64224	69475	57512	85097	05054	88673	96593	00902	53320
63576	26373	44610	43748	90399	06770	71609	90916	69002	57180
41078	47036	65524	68466	77613	20076	71969	47706	22506	81053
70846	89558	64173	15381	67322	70097	82363	90767	17879	32697
68800	64492	20162	32707	69510	82465	26821	79917	34615	35820
44977	89525	51269	63747	30997	97213	53016	65909	05723	50168
79354	63847	24395	53679	07667	67993	24634	78867	78516	00448
14954	22299	40156	52685	19093	06090	23800	06739	76836	19050
01711	98439	09446	33937	98956	85676	89493	05132	45886	49379
62328	55328	45738	93940	15772	81975	91017	21387	57949	13992
73004	62109	81907	71077	50322	66093	79921	61412	18347	21115
34218	89445	03609	52336	19005	15179	94958	99448	11612	76981
99159	01968	45886	86875	05196	64297	59339	39878	61548	56442
92858	29949	15817	93372	34732	61584	72007	58597	43802	51066
27396	97477	65554	71601	01540	26509	19487	39684	18676	41219
37103	45309	30129	43380	66638	10841	77292	40288	25826	61431
57347	97012	48428	20606	54138	75716	23741	50462	13221	47216