Randomization and Social Affairs: The 1970 Draft Lottery

Randomization is not easily achieved by the mixing of capsules in a bowl.

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The recent Selective Service draft lottery provoked considerable comment and discussion, both within and without the academic community, on the appropriateness of the use of chance for determining the course of social affairs. For example, in a *Science* editorial (*1*) on the use of a lottery for selection among university applicants, Wolfle suggested that "to use a lottery to allocate risks or benefits is not only a denial of rationality, it is also a denial of man's humanity."

When viewed in a historical perspective, the use of lotteries begins to seem more understandable and more rational. The draft lottery is only one among a great many situations in which society has institutionalized a recognized chance mechanism as the appropriate means of arriving at a decision that is to affect many people.

Before discussing the 1970 draft lottery and reviewing its historical precedents, I present a brief review of some of the uses of chance mechanisms and randomization in the conduct of the affairs of man.

The Role of Chance and Randomness in Social Affairs

Although it was as late as the 16th century that Cardano attempted to organize the concept of chance events into an elementary theory of probability, throughout the history of man chance and games of chance have played an important role in organized society. For example, the Napaski Indians in Labrador made use of the "random" cracks in heated bones to give directions for hunting (*2*). Of course the Napaski were unaware of the randomness in their decisions and attributed the cracks to supernatural guidance.

The drawing of lots, one of the simplest forms of randomization, has been widely used in many contexts. Eisenhart (*3*) has pointed out that the Old Testament contains many examples of the practice, such as,

> And ye shall divide the land by lot, for an inheritance among your families: and to the more ye shall give the more inheritance, and to the fewer ye shall give the less inheritance: every man's lot shall be in the place where his lot falleth; according to the tribe of your fathers ye shall inherit.
>
> Numbers 33:54

The idea that the use of lots was a fair method of allocating duties or rewards is also expressed elsewhere in the Bible.

> The lot causeth disputes to cease, and it decideth between the mighty.
>
> Proverbs 18:18

Historically the word *lot* has a dual meaning. Not only has it meant an object that is used to determine a question by a chance mechanism, but it has also meant one's share of worldly reward determined by divine providence. The latter meaning is more consistent with the use of lots in the Bible. Thus, in biblical days, the outcome of the casting of lots was considered to be a result of divine guidance, whereas the same outcome currently would be considered a result of chance.

It was an Assyrian custom to select the official who was to give his name to the New Year by means of the casting of clay dice. There are records indicating that the eponym of the year 833 B.C. was chosen in this fashion. Actually, the king himself gave his name to the first year of his own reign, and then officials of the realm were chosen for subsequent years. Later, the sequence of officials was determined by rank and tradition rather than by lot (*4*).

Hasofer (*5*) describes other uses of random mechanisms encountered in biblical and talmudic literature, such as (i) the method of division of Israel between the tribes, (ii) the drawing of lots for the scapegoat on the Day of Atonement, (iii) the allocation of daily duties in the temple, (iv) lot-casting for sacrifices on festivals, and (v) the use of lots in civil law.

Another early use of lotteries and the drawing of lots can be found in the method for selection of rulers in Athens. A more recent example is the selection of political leaders in the small European state of San Marino. After an initial selection procedure which yields three pairs of candidates (one pair is ultimately selected), "an innocent child of San Marino draws from an urn one of three scraps of paper furnished with two names—and the republic has been provided with two new governors" (*6*). Even the Dalai Lama of Tibet has been "elected" by means of the drawing of lots from a golden jar (*6*).

Random selection has also played an important role in the legal processes of the United States. The present selection procedures for jurists in federal courts are regarded as providing a means of assembling a body of men and women who are representative of the public as a whole, and also as a means of preventing bias and discrimination. A recently established law has ordered the random selection of jurors in the federal courts, primarily from lists of voters, in order to guarantee a true cross section of the population eligible for jury service and to provide better ways of assessing bias and discrimination in jury selection (*7*). Of course, randomness guarantees representativeness only *on the average* and many jury panels are likely not to consist of an exactly true cross section of the eligible population.

Associated with the drawing of lots or the random selection of jurors are several concepts—fairness, lack of bias, lack of discrimination in a legal sense,

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and the fair distribution of burdens and responsibilities. When a number of people fulfill all the requirements of, or qualifications for, a particular position or duty, the notion of a lottery or random selection allows each individual the same chance of attaining that position or being selected for that duty. Moreover, the use of randomization tends to remove the responsibility for selection and allocation from the shoulder of any one individual, although individuals are still responsible for carrying out the randomization.

The use of randomization techniques and lotteries in a legal context dates back at least to the mid-19th century. In the 1842 case of United States v. Holmes a crew member from a ship was on trial for manslaughter. The ship had been struck by an iceberg, and Holmes, eight other seamen, and 32 passengers evacuated to the longboat carried by the ship. At some point the first mate, who was in charge of the longboat, concluded that the boat was in danger of sinking, and the crew (including Holmes) threw 14 passengers overboard. The boat, the remaining passengers, and the crew were ultimately rescued. In his charge to the jury the presiding judge pointed out that under the circumstances one *might* conclude that all the crew members needed to be spared in order to keep the lifeboat afloat and thus to save the lives of the remainder of the passengers. But, given that the crew must be saved, how should those to be cast overboard be selected? The judge argued as follows (*8*):

> But in addition, if the source of the danger have [sic] been obvious, and destruction ascertained to be certainly about to arrive, though at a future time, there should be consultation, and some mode of selection fixed, by which those in equal relations may have equal chance for their life. . . . When the ship is in no danger of sinking, but all sustenance is exhausted, and a sacrifice of one person is necessary to appease the hunger of others, the selection is by lot. This mode is resorted to as the fairest mode, and, in some sort, as an appeal to God, for selection of the victim. . . . For ourselves, we can conceive of no mode so consonant both to humanity and to justice; and the occasion, we think, must be peculiar which will dispense with its exercise.

A famous legal article by Fuller (*9*) carries the argument of United States v. Holmes somewhat further. Fuller hypothesizes a case where a group of explorers, trapped in a cave, feels compelled to eat one of its members in order for the others to survive, and the choice of victim is made by throwing a pair of dice, conveniently available. What is of considerable interest in the present context is the fact that the hypothetical Supreme Court review of this case presented by Fuller does not even consider the fairness of drawing lots. The court accepts such fairness implicitly but questions the murder and cannibalism that followed.

Yet there is a limit (legal and otherwise) beyond which the drawing of lots is considered unfair. In a recent case before the U.S. Court of Appeals it was noted that the selection by lot among public housing applicants is justifiable only in cases in which many applicants are equally qualified under some standard of neediness. In such cases a reasonable manner of selection may be based on the drawing of lots or on some other fair criterion, such as the chronological order of application (*10*).

The 1970 Draft Lottery Directive

On 26 November 1969, the President of the United States, Richard M. Nixon, signed Executive Order No. 11497 effecting changes to Part 1631.5 of the Selective Service Regulations and prescribing a random selection sequence for induction. The amendment reads as follows:

> The Director of Selective Service shall establish a random selection sequence for induction. Such random selection sequence shall be determined as the President may direct, and shall be applied nationwide. The first sequence shall determine the order of selection of registrants (other than delinquents or volunteers) who prior to January 1, 1970, shall have attained their nineteenth year of age but not their twenty-sixth. New random selection sequences shall be established, in a similar manner, for registrants who attain their nineteenth year of age on or after January 1, 1970. The random sequence number determined for any registrant shall apply to him so long as he remains subject to random selection. A random sequence number established for a registrant shall be equivalent, for purposes of selection, to the same random sequence number established for other registrants in other drawings.

This executive order was the culmination of a great number of lengthy studies regarding the military draft and its reform. A "draft lottery" system was the focus of a "sense of Congress" resolution introduced by Senators Edward M. Kennedy and Joseph P. Clark on 23 February 1967, and a recommendation for a draft lottery was contained in the 4 March 1967 report by President Lyndon B. Johnson's National Advisory Commission on Selective Service. Following this report, in a special message to Congress on 6 March 1967, President Johnson stated (*11*):

> The paramount problem remains to determine who shall be selected for induction out of the many who are available. . . . Assuming that all men available are equally qualified and eligible, how can that selection be made most fairly? . . . I have concluded that the only method which approaches complete fairness is to establish a Fair And Impartial Random (FAIR) system of selection which will determine the order of call for all equally eligible men. . . . The governing concept I propose for selection is one of equal and uniform treatment for all men in like circumstances.

After this message, however, Congress prohibited President Johnson from instituting a draft lottery system without the specific approval of Congress. The opponents of the draft lottery proposal had not objected to the "randomness" of the selection, but rather to the problems that would be created by the cutbacks in enlistment and officer procurement.

In 1969, President Nixon succeeded in persuading Congress to repeal the prohibition against a draft lottery and thus laid the groundwork for the 26 November executive order.

Earlier Draft Lotteries

During both World War I and World War II it became necessary to establish an order in which men should be drafted into the U.S. military service.

The preparations for the 1917 draft lottery were made at the last minute because of confusion about the manner in which numbers were to be drawn. By the public notification of the assignment of serial numbers several days in advance of the drawing, officials attempted to allay suspicions that the assignment of numbers to certain registration cards took place after the drawing and thus gave certain individuals favorable order numbers. The actual lottery, which took place on 2 July 1917, consisted of the drawing of 10,500 black capsules from a glass fishbowl. It was impossible for anyone to determine the number within the capsule by examining its exterior. Although it is not clear whether the capsules were well mixed at the start

of the drawings, once the drawings were under way the capsules were stirred at regular intervals.

Prior to drawing the first capsule, Secretary Baker of the War Department made the following statement (*12*):

> This is an occasion of great dignity and some solemnity. It represents the first application of a principle believed by many of us to be thoroughly democratic, equal and fair in selecting soldiers to defend the national honor abroad and at home.
>
> I take this occasion to say that every step has been most honestly studied with a view not only to preserving throughout the utmost fairness in the selection, but also to preserve all those appearances of fairness which are necessary to satisfy the country that this great selection has been made in accordance with every principle of justice.

As far as I have been able to ascertain no formal statistical analysis was carried out to determine whether the selection procedure was indeed fair.

Substantially the same method of drawing numbers was followed for two subsequent lotteries on 27 June 1918 and 30 September 1918 (*13*).

For the 1940 draft lottery, each Selective Service district in the country assigned a different number from 1 to 9000 to every eligible man. The number 9000 was chosen because it was 1164 integers higher than 7836, the highest number of men registered with any single local board (*14*). These "extra numbers" were included in the lottery to take care of later registration; thus, of the 9000 numbers in the ultimate fishbowl, the 1164 largest were in effect blanks. The average Selective Service district enrollment, however, was 2672, and as a result there were additional high numbers that represented relatively few registrants.

Before the drawing took place, each of the 6500 local Selective Service boards in the country sorted the cards of individuals registered with the board and removed the cards of those living in other localities. Then the cards were shuffled and numbered, and a list, giving the number assigned to each eligible man, was prepared. One copy of the list was posted in a public place before the lottery. This procedure actually led to a double attempt at randomization, because of the mixing of capsules in the next stage.

The 9000 numbers were placed in opaque capsules by women, in shifts, working under guard, and the capsules were then placed in small paper boxes, each box containing approximately 100 capsules (*15*) roughly in consecutive order. The boxes were emptied into a large glass bowl in the presence of witnesses at Selective Service headquarters. The bowl was the same one that had been used in 1917, although it had to be modified somewhat. Shortly before the drawings were to take place, it was discovered that the bowl was too small to hold the 9000 capsules; although there were fewer capsules than in 1917, they were sufficiently larger to overflow the bowl. As a result, a special plastic "collar" was devised to increase the height of the bowl.

After the capsules were in the bowl, they were stirred with a small wooden paddle made from a fragment of wooden rafter from Independence Hall in Philadelphia. The Chicago *Tribune* reported (*16*) the claim of witnesses who said that the paddle was too small to reach deep enough into the bowl. Some of the capsules broke open during the mixing and it was suggested that this further impeded the mixing process. (The Chicago *Tribune* carried a picture of an army sergeant reaching inside the bowl for a numbered slip that had fallen out of its capsule.)

Finally, the capsules were drawn one at a time, establishing the order for induction within each Selective Service district. Pictures show the first capsules being drawn from the top of the bowl. When the drawings were concluded only 8994 numbers had been drawn, and officials immediately organized a "little lottery" for the missing six numbers, which were then listed from 8995 to 9000. By this time, several questions had been raised regarding the adequacy of the mixing of the capsules.

Walter Bartky and Samuel Stouffer, then on the faculty of the University of Chicago, reported on their analysis of the draft lottery drawings in a statement published in the Chicago *Tribune*. They noted that the numbers drawn clustered "in nests in such a way that the serial numbers in the groups from 1 to 2,400 tended to escape drawing the first 2,000 or so draws, with the curious exception of too frequent drawing of serial numbers in the group 101 to 200" (*17*). As an example, they pointed out that no serial number between 300 and 600 was drawn in the first 2400 draws. By pure chance, this would occur less than once in 15×10^{40} times. The same improbability applied to the absence of numbers in the ranges 901 to 1200, 1501 to 1800, and 2101 to 2400. In addition, Bartky and Stouffer did a detailed analysis of the clustering of numbers in the drawing. Their criticisms were duly noted by the Director of Selective Service in his report to the President (*18*).

> In spite of all the preliminary stirrings of the capsules, the numbers that were picked seemed to be concentrated in certain hundreds. (This was due apparently to the fact that the numbers had been poured in lots of a hundred each and the lateral stirring had not effected a complete mixing or redistribution of the numbers).

In a second lottery held on 17 July 1941, 800 capsules were used, and these were "tossed about" and "rolled back and forth" on a canvas, in an effort to overcome the criticisms of the first lottery (*19*). Fewer men were involved in the second drawing and these latter registrants were integrated into the previous lottery list of the local boards by placing a new registrant, in the order chosen, after each group of ten previous registrants. There was also a third World War II lottery on 17 March 1942.

One lesson to be learned from the 1940 draft lottery and the surrounding publicity is that thorough physical mixing is extremely difficult to achieve. Thus, great care must be taken in order that capsules drawn from a bowl do not present a picture of marked and often dramatic departures from randomness. Unfortunately, the officials of the national Selective Service System headquarters who were in charge of the 1970 draft lottery did not learn from the errors of their predecessors.

Execution of the 1970 Draft Lottery

A presidential proclamation, issued simultaneously with the executive order of 26 November 1969, stipulated that the 1970 lottery would be based on birthdays, and Selective Service officials devised the actual method of drawing the dates. Although an official detailed description of the actual procedures used is not available, Captain William Pascoe, chief of public information for the Selective Service System and the man in charge of the lottery, has informed me that the following account which appeared in the *New York Times* is basically correct (*20*).

> Over the weekend before the December 1st drawing, Captain Pascoe and Col. Charles R. Fox, under the watch of John

H. Adams, an editor of *U.S. News and World Report*, set up the lottery.

They started out with 366 cylindrical capsules, one and a half inches long and one inch in diameter. The caps at the ends were round.

The men counted out 31 capsules and inserted in them slips of paper with the January dates. The January capsules were then placed in a large, square wooden box and pushed to one side with a cardboard divider, leaving part of the box empty.

The 29 February capsules were then poured into the empty portion of the box, counted again, and then scraped with the divider into the January capsules. Thus, according to Captain Pascoe, the January and February capsules were thoroughly mixed.

The same process was followed with each subsequent month, counting the capsules into the empty side of the box and then pushing them with the divider into the capsules of the previous months.

Thus, the January capsules were mixed with the other capsules 11 times, the February capsules 10 times and so on with the November capsules intermingled with others only twice and the December ones only once.

The box was then shut, and Colonel Fox shook it several times. He then carried it up three flights of stairs, a process that Captain Pascoe says further mixed the capsules.

The box was carried down the three flights shortly before the drawing began. In public view, the capsules were poured from the black box into the two-foot deep bowl.

Captain Pascoe said he did not know which end of the box he poured from. If he poured from the end where the capsules with the early months had been repeatedly shoved, these capsules might have fallen to the bottom of the bowl. Conversely, if he poured from the other end, the later months could have fallen to the bottom. This assumes that the shoving and shaking procedure did not adequately mix the capsules.

Once in the bowl, the capsules were not stirred. . . . The persons who drew the capsules last month generally picked ones from the top, although once in a while they would reach their hand to the middle or the bottom of the bowl.

Once again the question of inadequate mixing of capsules must be raised. From the above description one might expect that dates late in the year would tend to be drawn early, and dates early in the year would tend to come up late in the drawing (or vice versa, if in fact the box had been turned over).

The Meaning of Randomness

Although many people view the use of randomization with suspicion, its role in social affairs, as can be seen, is pronounced. Part of this suspicion arises from a confusion over the meaning of randomization. *The Random House Dictionary, College Edition*, defines *random* as "proceeding, made, or occurring without definite aim, reason, or pattern," and *randomness* as "haphazard, chance, casual, stray, aimless." On the other hand, *random* as used in statistics is a technical term with a meaning that is potentially at variance with its popular usage.

In statistics the word random is used to describe an idealized process by which numbers (or data) are generated. This more formal notion of randomness underlies the meaning of probability, and in turn probability is often used to provide a formal definition of randomness. For example, statisticians often speak of a process as generating random integers, say from 1 to 366, when the process produces random variables (i) that are independent in the sense of probability, and (ii) that take the values 1, 2, . . . , 366 with equal probabilities, 1/366 (*21*). One can talk of a process as generating random permutations (orderings) of the numbers from 1 through 366 when the process produces independent random variables which take each of the possible orderings of these numbers with equal probabilities 1/366! Although these latter definitions may seem less satisfactory to many people than those of *The Random House Dictionary*, they introduce notions of variability that are absent in the popular usage of random, and these notions lead to idealized patterns of variability by which one can assess the presence of systematic biases. (Note that a process that is haphazard can have a systematic component, but a process that is random cannot.)

It is a difficult (and, strictly speaking, impossible) task to generate random integers that satisfy the formal definition given above, because independence and equiprobability are concepts that can only be approximated at best. As a result, mechanical aids are typically used to help achieve a good approximation to the idealized notion of randomness, and prepared tables of mechanically generated "random integers" are now widely available. A good source of such random numbers is the extensive table prepared by the Rand Corporation (*22*) and tables of "random permutations" are also available (*23*).

Because idealized randomization on occasion yields orderings of numbers that appear systematic, it is widely argued that post hoc examination can nearly always turn up evidence of nonrandomness. Yet an examination of the imperfect techniques used to achieve

Table 1. The 1970 random selection sequence by month and day.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	305	086	108	032	330	249	093	111	225	359	019	129
2	159	144	029	271	298	228	350	045	161	125	034	328
3	251	297	267	083	040	301	115	261	049	244	348	157
4	215	210	275	081	276	020	279	145	232	202	266	165
5	101	214	293	269	364	028	188	054	082	024	310	056
6	224	347	139	253	155	110	327	114	006	087	076	010
7	306	091	122	147	035	085	050	168	008	234	051	012
8	199	181	213	312	321	366	013	048	184	283	097	105
9	194	338	317	219	197	335	277	106	263	342	080	043
10	325	216	323	218	065	206	284	021	071	220	282	041
11	329	150	136	014	037	134	248	324	158	237	046	039
12	221	068	300	346	133	272	015	142	242	072	066	314
13	318	152	259	124	295	069	042	307	175	138	126	163
14	238	004	354	231	178	356	331	198	001	294	127	026
15	017	089	169	273	130	180	322	102	113	171	131	320
16	121	212	166	148	055	274	120	044	207	254	107	096
17	235	189	033	260	112	073	098	154	255	288	143	304
18	140	292	332	090	278	341	190	141	246	005	146	128
19	058	025	200	336	075	104	227	311	177	241	203	240
20	280	302	239	345	183	360	187	344	063	192	185	135
21	186	363	334	062	250	060	027	291	204	243	156	070
22	337	290	265	316	326	247	153	339	160	117	009	053
23	118	057	256	252	319	109	172	116	119	201	182	162
24	059	236	258	002	031	358	023	036	195	196	230	095
25	052	179	343	351	361	137	067	286	149	176	132	084
26	092	365	170	340	357	022	303	245	018	007	309	173
27	355	205	268	074	296	064	289	352	233	264	047	078
28	077	299	223	262	308	222	088	167	257	094	281	123
29	349	285	362	191	226	353	270	061	151	229	099	016
30	164		217	208	103	209	287	333	315	038	174	003
31	211		030		313		193	011		079		100

Table 2. Lottery drawing numbers by thirds and by months.

Drawing numbers	Months												Total
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1–122	9	7	5	8	9	11	12	13	10	9	12	17	122
123–244	12	12	10	8	7	7	7	7	15	15	12	10	122
245–366	10	10	16	14	15	12	12	11	5	7	6	4	122
Total	31	29	31	30	31	30	31	31	30	31	30	31	366

randomness in certain instances can often suggest systematic patterns that are likely to occur when these techniques are used in practice. Thus, the methods that are used to achieve a random draft lottery sequence can indicate the nonrandomness that can then be found by post hoc examination. This point is elaborated on in the next section.

Analysis of the 1970 Drawings

Table 1 gives the random selection sequence, established at the drawings on 1 December 1969, by month and day. These results are shown graphically in Fig. 1, in which the selection numbers are plotted against birth date numbers from 1 January through 31 December. A close examination of Fig. 1 reveals a scarcity of points in the upper right-hand and lower left-hand corners. Moreover, points tend to be somewhat clustered and there are relatively large blank areas in some parts of the figure.

The Spearman rank correlation coefficient (*24*), which can be used as a measure of the linear relation between birth date and lottery number assigned to that date, for these data has a value of −.226. Even though the linear trend is somewhat difficult for the untrained eye to detect from Fig. 1, the correlation value is significantly different from zero at the .001 level of significance.

Some aspects of Fig. 1 become more pointed when the data is collapsed and presented in Table 2 as a 3 by 12 cross-classification. The columns of Table 2 represent birth date months since, as described above, the capsules for the lottery were added month by month. For convenience the lottery drawing numbers were divided into thirds. (At the time of the drawing, United Press International carried statements, made by officials from the Department of Defense and the White House, to the effect that draft-eligible men with birthdays among the first third drawn would almost certainly be called for induction, those in the second third would be in an uncertain group, and those in the final third would probably avoid the draft. More recent reports, however, indicate that some local Selective Service boards do not have many eligible inductees with low numbers, and many of these boards will induct men with lottery numbers well beyond the first or even second third.)

The first 4 months of the year appeared less frequently than the other 8 months in the first third of the numbers drawn, while the last 4 months of the year appeared less frequently in the last third (see Table 2). The middle 4 months are also underrepresented in the second third of the drawings. If the capsules had been completely (and randomly) mixed, the probability of an arrangement of data as extreme as (or more extreme than) that observed in Table 2 would be .02 (*25*).

Next, one can ask whether the average lottery numbers for each of the 12 months are significantly different from one another, given the variation expected under a random selection situation. The Kruskal-Wallis test for one-way analysis of variance on ranks was designed to answer just this question (*26*). For the data of Table 1 the Kruskal-Wallis test statistic takes the value $H = 25.95$, which, when referred to a chi-square table on 11 degrees of freedom, corresponds to a significance level

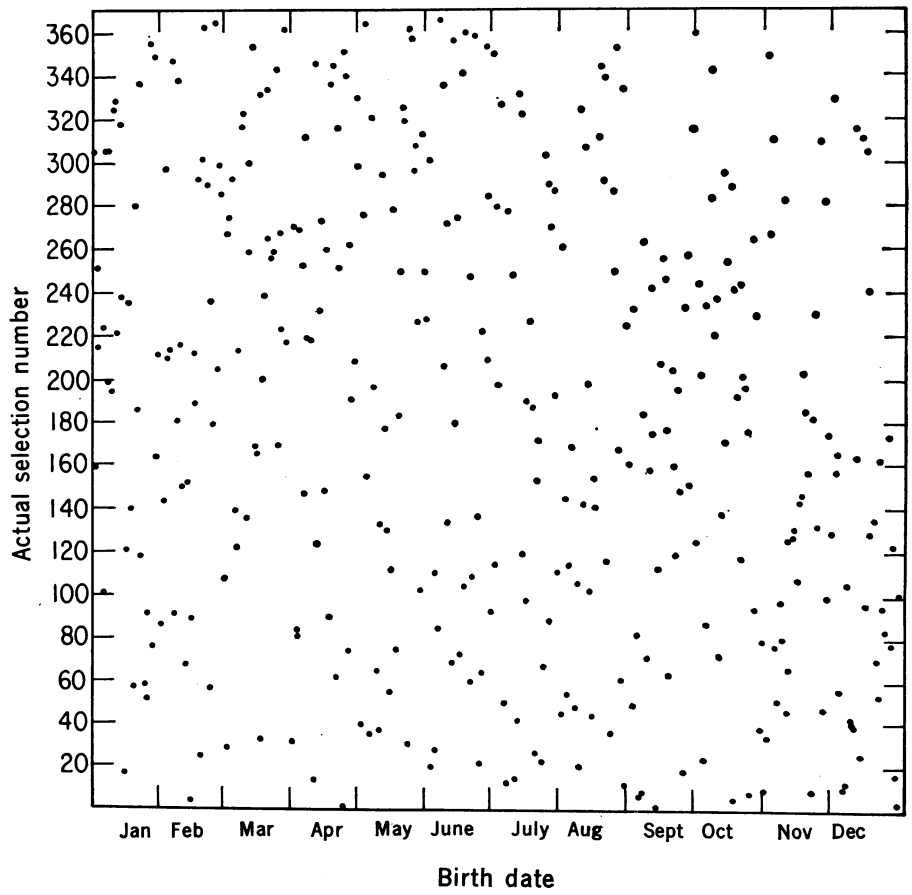

Fig. 1. The 1970 random selection sequence versus birth date.

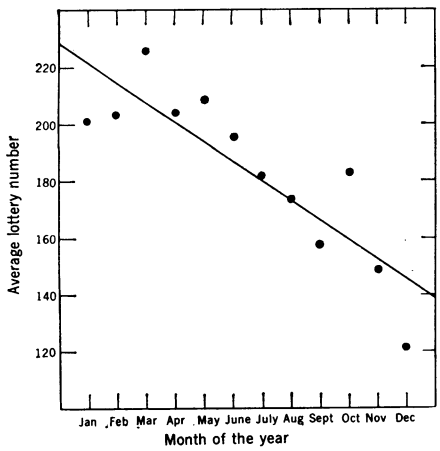

Fig. 2. Average lottery numbers by month. The line is the least squares regression line, treating the months as being equally spaced.

of less than .005. This value implies that the monthly averages observed could not reasonably have been generated as a result of a random selection procedure. Furthermore, Table 3, which gives the average lottery number by month, shows a clear linear trend, especially from May through December, with the average lottery number being high at the beginning of the calendar year and low at the end. Table 3 and the related linear trend are shown graphically in Fig. 2. Because the capsules were added to the box 1 month at a time, with some mixing after each month was added, it is not surprising that the first 5 months have roughly the same average number. Moreover, it is not surprising that December has the lowest average number since the capsules for that month were added at the end of the original mixing.

The Spearman correlation coefficient as applied to the data in Table 3, with the use of the ranks of monthly averages, yields a value of −.839, which is significantly different from zero at the .001 level of significance. This is the significance value which should be associated with the trend line in Fig. 2. The two tests are independent, since the Kruskal-Wallis test remains unchanged if the months are permuted in any way, whereas the rank correlation coefficient test statistic depends solely on which of the possible permutations actually exists (*27*).

Taken all together the above observations and tests offer strong evidence to the effect that the capsules were not mixed sufficiently well to guarantee that the lottery drawing sequence was a random permutation of the 366 possible birthdays. The observed sequence strongly reflects the order in which the capsules were placed in the wooden box during the initial mixing procedure.

There are at least two additional questions that can be raised regarding the lottery procedure. First, should 29 February, which occurs only during leap years, be treated in the same way as all other days of the year? Second, does the nonuniformity of births over days of the year introduce further inequities? The questions are related to what one might think of as possible second-order effects, and they will not be considered here. One can note, however, that the actual effect of these nonuniformities depends on the number of men being inducted into the army on the basis of these lottery numbers.

The 1971 Draft Lottery

On 1 July 1970, the Selective Service System conducted a draft lottery to establish the order in which men born in 1951 are to be called for induction during 1971. In response to the public criticism of the 1970 lottery, Selective Service officials called upon the National Bureau of Standards (NBS) Statistical Engineering Laboratory to provide 25 random calendars and 25 random permutations of the numbers 1 through 365, which were to be used in the randomization procedure.

Unlike earlier draft lotteries, the one held on 1 July 1970 was based on drawings from two different drums, each containing 365 capsules. As a capsule containing a date was drawn from one drum, a capsule with a number between 1 and 365 was simultaneously drawn from another drum which set the sequence number for the birth date picked.

The randomization procedures used for the 1971 draft lottery had two basic components. The first consisted of a multiple-stage randomization, which made use of a table of random permutations. The second consisted of a physical mixing, in public view, to give the lottery face validity and to appeal to the public's sense of what is random. These two components are reminiscent of a commonly held lay interpretation of both American and English jurisprudence—that a court trial must not only be fair and just but must also give every appearance of being fair and just.

Table 3. Average lottery numbers by month.

Month	Average number
January	201.2
February	203.0
March	225 8
April	203.7
May	208.0
June	195.7
July	181.5
August	173.5
September	157.3
October	182.5
November	148.7
December	121.5

An independent panel, consisting of three former presidents of the American Statistical Association, examined and endorsed the procedures used by NBS. A detailed description of these procedures (including the identification of the permutations actually used for the loading of capsules and drums, and the listings of the drawing sequences from the two drums) has been prepared by NBS (*28*). The reader interested in detailed analysis of the drawings is referred to these reports.

Summary

Randomization has played an important role in social affairs, going back at least to biblical days. The drawing of lots, one of the simplest forms of randomization, has been used publicly in many different contexts.

Although the legal use of randomization techniques and lotteries in the United States dates back at least to the mid-19th century, only recently have the federal courts recognized the need for proper randomization to assure fairness, lack of bias, and lack of discrimination.

A recent presidential commission has supported the call for all-volunteer armed forces (*29*), but it appears that the recommendations of this commission are at least several years away from becoming law. In fact, it has been suggested that the present lottery system is retarding any moves toward all-volunteer armed forces by reducing the number of draft-induced volunteers, and thereby necessitating an increase in the number of draftees. So, in the short run, it appears that the draft lottery will be the means by which the United States will man much of its armed forces. Since this is the case, it is important that future lotteries achieve

equity in selection and that the lack of randomization present in previous lotteries be eliminated. [Indeed, it is interesting to note that several young men have filed suit in federal court, seeking to void the 1970 drawing and to force a new lottery. The basis of these suits is the lack of proper randomization (*30*).]

The 1917 and 1940 Selective Service draft lotteries have served in the past as indications that the commonly held notion of "randomness" is often at variance with the strict statistical meaning. The 1970 draft lottery has not helped to mitigate the doubts of many regarding the equity and fairness of random drawings, although the recent 1971 draft lottery sets a very positive example, which, it is hoped, will counteract the effects of the earlier lotteries.

Since randomization does have a role in the everyday workings of society, it is important that the public be educated to accept the proper use of randomization, while rejecting attempts to use chance as a disguise for inequity, bias, and unlawful discrimination. As one step toward this end, future draft lotteries should adhere to a reasonable definition of randomness, and the public should be well informed of the precautions taken to preclude arbitrary features that have marred previous draft lotteries. In addition, it is clearly desirable that the Selective Service provide the public with an official statement giving all relevant details on the design and execution of the lotteries. The most recent draft lottery serves as an admirable model in this regard.

Note added in proof: Professor Hans Zeisel has brought to my attention the details of the draft procedure used in Austria-Hungary between 1889 and the start of World War I. This draft procedure was also based on a lottery, with every person liable for the draft (or a representative) drawing a slip of paper on which was recorded a number indicating a place in the draft list. It is conceivable that Selective Service officials, in charge of the World War I lottery in the United States, were familiar with the details of this draft lottery procedure.

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13. See *Report of the Provost Marshal General to the Secretary of War, On the First Draft under the Selective Service Act, 1917* (U.S. Government Printing Office, Washington, D.C., 1918), p. 19; also see *Second Report of the Provost Marshal General to the Secretary of War, On the Operations of the Selective Service System to December 20, 1918* (U.S. Government Printing Office, Washington, D.C., 1918), pp. 39–44.
14. There is some disagreement as to the actual number. The Chicago *Tribune*, 2 November 1940, reports a registration of 7836, while the number 8090 is reported in *Selective Service in Peacetime: First Report of the Director of Selective Service, 1940–41* (U.S. Government Printing Office, Washington, D.C., 1942), p. 91.
15. Once again, there is some disagreement as to the number of capsules per box. The Chicago *Tribune* reported that there were approximately 900 but *Selective Service in Peacetime* (*14*), p. 94, implies that there were approximately 100.
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