

IS RANDOM FAIR?

Conall Boyle

University of Central England, Birmingham

The statistician's view of randomness - our useful tool:

As statisticians we are well used to explaining how random sampling lies at the heart of the acquisition of new knowledge, and despite its counter-intuitive nature, it is usually a reliable technique. We can add that random sampling has a proven track record, and that there are countless examples [1] of failures where inadequate methods were used. To apply a bit of technical jargon we say that a 'fair' sample is one which is drawn randomly, that is when each member of the population has an equal (sometimes a measured) chance of being selected. There are mathematical derivations based on the notion of b.l.u.e. - best least-squared unbiased estimators which enable us to work out best estimates of statistics about the population, and also to predict likely errors. Some deviation from this scientific, provable procedure is allowed, for example the use of quota sampling to reduce maximum likely errors at the expense of overall accuracy. What we can say is that random sampling produces a fair result within predictable bounds; that straying from randomness is unreliable and runs the risk of 'bias'. As statisticians we understand that randomness is benign, a tool for understanding, a device for overcoming our own acknowledged weakness or inability to choose fairly, without bias. Could this idea be used more widely?

The commonplace view of randomness - sinister or silly:

'Random terror' is used to describe acts of unspeakable wickedness. 'Headteachers selected by a shot in the dark' (an actual newspaper headline) describes a system which is inadequate or even wicked. Sometimes the idea of selecting people by a lottery is treated in newspaper reports as a joke.

We are well aware of the pitfalls of what people imagine is random. Invite someone to pick a number, a card, a colour or a person at random and we know from experiment that the result will invariably be biased. People prefer numbers ending in 0 or 5, will generally choose the more attractive person. But this is *haphazard* selection conditioned by personal bias. The word 'random' which has a rigorous and positive meaning in statistics becomes vague and menacing when equated to 'haphazard' in everyday language. I would like to emphasise that I will be using the word 'random' in its statistical sense; similarly by a 'lottery' I intend a process of selection that is truly random.

Randomness brings fairness; a gift from statistics to the world at large:

It is always risky to carry across ('translate') technical words from one field (statistics) into

another (social policy). But the resonances from the concept of statistical randomness - that it is a fair method of selecting a sample from a population, that it avoids bias - seem to match closely similar concepts in social science. Statistical science has worked out satisfactory techniques with a proven track record; social science seems not to have come up with satisfactory answers to the elimination of bias, and ensuring that fairness prevails.

This was the starting point for my voyage of exploration on the uses of randomness through some form of lottery, in order to solve or at least ameliorate some of the knottiest problems of contemporary society. What I discovered to my surprise is that lotteries have been used extensively in the past, that some forms of random selection are still in use today, and that there are a number of philosophers who believe that random selection (lotteries) could even be the next important step forward in Democracy.

Randomness in history - the Florentine bag

There are plenty of examples of the use of a lottery throughout history. The Greeks were very keen on selecting administrators this way. Renaissance Italy made use of lotteries during their republican, democratic phases. My favourite example is the Florentine bag: Every three years several thousand Florentines were nominated for a term of office. A secret committee sifted through these names and allocated a tally for each person to one of two bags; the chosen and the rejected. Administrators were randomly drawn from the chosen bag, but there were always many more to choose from. In this way no-one could pervert the selection process, and more importantly no-one would feel rejected by it. (Elster, 1989 p84, based on Najemy, 1982)

Other uses for a lottery included decimation (reduction of a badly performing Roman legion by one-tenth through random execution); or, it could be argued, the lottery of birth which says that the eldest son of the King inherits the Crown. Against this it could be argued that because of lack of trust amongst the medieval Italians, perhaps a lottery was the only way. Selecting by lottery may be administratively quick and cheap, but surely it would be better to select decimation victims on their (de)merits, after a due process? And what about the blatant sexism implied in Royal male primogeniture?

We should be wary of throwing out the accumulated wisdom of experience: the Florentine bag system may have only lasted a few decades, but nearby San Marino has a similar lottery-based leader selection system: San Marino is the longest surviving Republic. Even the rule of male inheritance for monarchs so biased in favour of males has, by chance, given more women the top job than any other system.

Selection in contemporary society:

Selection involves choosing: in any society some people get the 'goods' - wealth, position, education, housing; and some people get the 'bads' - jury or military service, pollution, poverty. Many of these goods and bads are distributed through the impersonal operations of the market; there is a branch of economic theory (Pareto optimality) which claims that the free market is the only way of distributing goods fairly. This is a seductive idea which lies behind the rhetoric of the free-marketeers, and explains why they are so keen to introduce the money-based market

transactions into areas like health and education in the name of freedom and personal choice.

But free-market theory is based on an abstract idea of how firms and individuals operate. Even if it was a complete explanation (which is vigorously challenged by some), there still remains large areas of society outside the market. Government distributes many goods and services, some of a personal nature like health and education, others are collective like roads or police. Many of the firms that claim to operate in the free market are actually oligopolies, more like government bureaucracies than market traders. Perhaps from the point of view of individuals in society the most significant selection a big firm makes is who to employ. In our society possession of a job is highly valued.

Measuring merit: eliminating discrimination

Selection by government agencies or other bureaucracies for the award of 'goods' or the imposition of 'bads' has an important bearing on the life-chances of everyone. It is for this reason that we wish to see the selection done fairly, in a non-discriminatory fashion. 'Selection on merit' is the slogan; measuring merit is the problem.

The curious case of the 11+: The 11+ test was (and in some cases still is) a method of selecting 11 year olds based on measured I.Q. The instigator of this system was Cyril Burt, who believed strongly in the heritability of intelligence, and that it could be measured at 11 years old in a way which would reliably predict performance at 18 and later. Later it was discovered that Burt was a statistical fraudster, and I.Q. testing acquired some disrepute, to be replaced by other methods, (based on Taylor, 1980) Ironically, these other methods, such as interviewing parents for their suitability, having little or no scientific basis. The 11+ gave some disadvantaged children a much better chance than these latter-day methods.

A strong argument against the 11+ was the error rate, that because of measurement error about one in five children were allocated to the wrong school. Additionally, even Burt would be forced to concede, intelligence was not totally heritable; his correlation figure of .77 implied about quarter came from elsewhere. Instead of a sharp cut-off between pass and fail at some arbitrary value of I.Q. perhaps Burt should have advocated a lottery, with say 90% of those 120 point plus passing, down to 10% of those scoring 100-110. Explaining measurement error is not easy, but it is surely dishonest to replace a good selection test with a poor one.

The organ transplant debate: Perhaps the most poignant selection process involves selecting patients for organ transplantation. Human organs are necessarily in short supply, so how do you decide on the competing merits of a 60-year-old statistics professor and a 20-year-old school drop-out. At first the job was given to a committee of lay persons (in Seattle known as the 'God Committee')(Elster, 1992) who became so anguished that they gave up. This extreme situation has encouraged a profound philosophical debate on Social Justice and how scarce goods should be allocated. Lotteries crop up as a possible solution.

The Jews at Yale: Admission to a prestigious University is an example of an important 'good' which is limited to a chosen few. Yale, through devious, but objective-seeming selection criteria had kept the number of Jews admitted down to a consistent 10% for many decades. Of course any statistical quality controller could tell you that figures which are too consistent must surely be faked. A truly fair system of selection will inevitably produce some random variation.(from Oren, 1985)

Present day uses of randomness In selection

Juries, the law, the draft are current example of the deliberate use of randomness The US draft - the call-up for military service, (Tashman & Lamborn) was conducted by randomly selecting a set of birth-dates. Athens restricted car use in an arbitrary way by banning vehicles depending on whether their registration number ended in an odd or even digit. In parliament, private members' bills are chosen "by ballot", their quaint term for a lottery. The Law makes statistical-sounding references to 'the balance of probabilities', but lawyers seem to have no better understanding of the significance of these technical terms than any other member of the public. Discussions arise in the selection of juries as to whether they should be representative or random. If a jury appears to lack. say. any member of an ethnic minority it might be felt that this is unfair, and some minimum quotas should be set. Against this is the notion that random should mean random, with all the potential for occasional atypical juries.

The use of a random procedure in selecting employees for redundancy, has I believe been rejected by a Tribunal on grounds of unfairness. It is wrong, it was felt, to deprive a person of a job without some attempt at explanation.

Allocating social housing is one area where the use of rational points-systems is widespread, and for good reason. But not everywhere. I have discovered (Boyle, 1994) two examples where lotteries are used. One example is in Australia under the 'Star Bowcott' Scheme. A more significant scheme is that used in the Netherlands. Social housing is advertised just like any other. Applicants for specific properties go into a draw to choose the recipient. Neither of these procedures has appeared in the literature as far as I can tell. Is this a case of street wisdom being far ahead of the rational administrators?

Admission to medical or law school is a highly sought-after prize for many bright pupils. In the Netherlands for medicine and in Harvard (US) for law, admission is on the basis of a weighted lottery. The higher your test scores the better chance you have of getting in.

Limits to rationality, from quantum mechanics to chaos theory.

The examples of the present-day use of lotteries given in the previous paragraph could be expanded, but this is still an unusual method of selection. Lotteries are seen as historical curiosity, inappropriate to modern rational and logical administration. This view is derived from the initial success of Isaac Newton with celestial mechanics in explaining the movements of the planets. Further successes for the scientific method followed, and the social sciences wished to join in. Economics was the first but sociology soon followed. What exists now is an abiding belief in rationality, that if there is not a rational and logical way of choosing between claimants at the moment, that is only because there is insufficient data, or that an explanation could be found. Deterministic models

predominate in the minds of administrators, with little regard to the statistical variability as we understand it.

Two writers have suggested that randomness should be deliberately introduced into the political and administrative process in order to promote democracy. John Burnheim (1986) suggests 'Demarchy' - that society, including productive enterprises, ought to be run by local committees specific to each function. The committee members should be chosen *at random* like juries. John Broome (1994) has written widely about all aspects of the use of randomness and lotteries in the processes of democratic administration. He is generally in favour of the use of lotteries in a wide variety of circumstances as a means of promoting fairness.

Philosophers are generally very clever folk, but even they have difficulty fully understanding what is meant by a random process; in particular I don't think they fully appreciate the inherent possibility of a rogue, non-typical result. Lawyers and administrators are practical people dealing with day-by-day issues, and find randomness a very strange and difficult idea, especially when they have to explain it to a jury or the public. We statisticians have an inbred understanding of all the nuances of the idea of random selection through our training and experience. Let us try to communicate this wonderful idea which has the potential to make life fairer for so many people.

NOTE: [1] There is the famous Lanarkshire milk experiment reported in Yule and Kendall, the 1948 US Presidential election, when a newspaper went so far as to print a headline DEWEY WINS. My own favourite is a bye-election poll held in Wolverhampton South in the 1970's. One newspaper employed a proper pollster and correctly predicted the surprise Tory win. The local newspaper sent reporters onto the streets to conduct a 'straw poll' and got the result badly wrong.

REFERENCES:

- Boyle, Conall (1994) *Fairness in the Allocation of Social Rented Housing* in Proc European Network for Housing Research Conference, Glasgow University, Aug29-Sept 4.
- Broome, John (1984) *Selecting People Randomly* Ethics. Oct 1984, 35-55.
- Broome, John (1994) *Fairness versus doing the most good* Hastings Conference Report, July-August 1994, 36-39.
- Burnheim, John (1986) *Is democracy possible? The alternative to electoral politics* Polity Press, Cambridge, England.
- Capra, Fritjof (1975) *The Tao of Physics* London, Wildwood House.
- Elster, Jon (1989) *Solomonic judgments: Studies in the limits of Rationality* Cambridge University Press
- Elster, Jon (1992) *Local Justice: How Institutions Allocate Scarce Goods and Necessary Burdens* Cambridge University Press
- Etzioni, Amitai (1989) *The spirit of Community* Crown Press.
- Hirst, Paul (1994) *Associative Democracy* 241-247 Democratic Left Review, Spring 1994.

- Najemy, J (1982) *Corporatism and consensus in Florentine electoral politics 1280-1400* Chapel Hill University of North Carolina Press.
- Oren, D A (1985) *Joining the club: a history of Jews and Yale* Yale University Press.
- Stewart, Ian (1989) *Does God Play Dice - The new Mathematics of Chaos* Penguin Books, London.
- Tashman, Leonard & Lamborn, Kathleen (1979) *The ways and means of statistics* Harcourt Brace Jovanovith New York
- Taylor, Howard F (1980) *The I.Q. Game - A methodological inquiry into the heredity-environment question* Rutgers University Press. New Brunswick, New Jersey.

Conall Boyle. School of Building and Building Surveying, University of Central England.
Birmingham B422SU. 0121-331 5178 Fax 0121-331 5172.