Notes 8

A NOTE ON CLIQUE AVOIDANCE IN REPEATED JURY SELECTION FROM AMONG A FIXED POOL OF JURORS:

COMPARISONS OF MANPOWER SAVINGS IN SIX AND TWELVE-MEMBER JURIES

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Introduction

In *Williams v. Florida* (1970) 399 U.S. 78, the U.S. Supreme Court upheld the constitutionality of felony convictions by state juries with as few as six members. In *Colgrove v. Battin* (1973) 413 U.S. 149, the Court upheld six-member civil juries. As a result of these rulings the six-member jury is "widely assumed to be standard equipment for the streamlined court of the future." (Pabst, 1973, p. 6). The presumptions of many authors are that switching from twelve-member to six-member juries would involve savings in trial processing time and considerable savings because of reductions in the number of jurror man-days served which could come close to a 50% reduction in jury manpower requirements. (See e.g. Thompson, 1974, p. 14).

Even if the size of the jury panel and the number of available challenges were reduced proportionally when we reduced jury size from twelve to six, it does not follow that cutting jury size in half will lead to cutting jury manpower needs in half if we impose constraints on the jury selection process such as the need to prevent jurors from serving together on more than one jury. Such a requirement might be imposed to prevent the formation of cliques whose previous jury service together might lead to patterns of allegiance or antagonism which could impose biases on the jury decision process in succeeding trials. In most states, jurors are called for an extended period of jury service with the possibility of serving on more than one jury during their period of jury duty.

In Multnomah County, (Portland) Oregon, for example, jury pools are jointly drawn for duty in both Circuit Court and District Court trials and serve for a period of one month. During that month of service, members of the jury pool may sit on as many as ten different cases. Some 190-220 jurors serve each month, with a case load of 40-60 trials in Circuit Court (primarily twelve-member juries). No special effort is made in Multnomah County to prevent jurors from serving together more than once during their month of service and repeated dyads, triads, and even tetrads and occasional higher order groupings do occur. In drawing up jury panels in Multnomah County, court officials do, however, attempt to equalize actual jury duty by giving priority on panel placement to those members of the jury who were removed on challenges or who were participants in cases dismissed or resolved out of court after the jury has been selected but before it has had a chance to meet (Jones, 1975).

We wish to propose a scheme for selecting jury panels which will guarantee the avoidance of overlapping cliques among the juries chosen and which will also offer roughly equal opportunities of jury duty to all members of the jury pool.

II. The Basic Model

Let us denote by m (k, j, n) the maximal number of juries of size k which can be drawn from a jury pool of n members such that no j-tuple of jurrors is ever repeated. E.G., if j = 2, k = 12, then m (12, 2, n) is the maximum number of juries of size twelve that can be drawn from a pool of n jurors such that no pair of jurors serves together on more than one jury. It is easy to see that

$$m(k, j, n) \leq \frac{\binom{n}{j}}{\binom{k}{j}} \tag{1}$$

since if we do not repeat any j-tuples each jury of size k we draw exhausts exactly $\binom{k}{j}$ of the $\binom{n}{j}$ available j-tuples. If j = 2, we have from (1)

$$m(k, 2, n) \leq \frac{n(n-1)}{k(k-1)} \tag{2}$$

If k = 6, we have

$$m(6, 2, n) \leq \frac{n(n-1)}{30} \tag{3}$$

If k = 12, we have

$$m(12, 2, n) \leq \frac{n(n-1)}{132} \tag{4}$$

For a jury pool sufficiently large, the inequality in expression (1) can be well approximated as an equality. In particular, it can be shown (Erdos and Hanani, 1963, Theorem 1, p. 10) that for j = 2 [1]

$$\lim_{n \to \infty} m(k, 2, n) \cdot \frac{\binom{k}{2}}{\binom{n}{2}} = 1 \tag{5}$$

[1] That the limit analogous to that given in expression (5) holds for *every* k and j has been conjectured but never demonstrated; the asymptotic result has, however, been shown to hold for certain other special cases. (See Erdos and Hanani, 1963.)

If we wish to know how large a jury pool (n) we need to guarantee at least m juries of size k such that no pair of jurors is repeated, expression (1) and some simple algebra leads to the result that

$$n \approx \frac{\sqrt{1 + \quad 1 + 4k(k-1)m}}{2} \tag{6}$$

III. Comparing Six-Member and Twelve-Member Juries

For a jury pool of sufficient size, the number of six-member juries with no repeated pairs which can be drawn from that pool is roughly 4.4 i.e., $\frac{132}{30}$ times the number of twelve-member juries with no repeated pairs which can be drawn from it (see expressions (3) and (4)). In other words, if we are concerned to avoid clique formation arising from previously shared jury duty, six-member juries which satisfy this constraint are over four times as plentiful as twelve-member juries which do so, for n sufficiently large.[2] Of course, avoiding repeated pairs gets considerably easier as the size of the jury pool increases, since the number of juries with no repeated dyads rises roughly as the square of n. For example, with 40 jurors we may compose 52 different juries of size six with no overlapping pairs, but with only 60 jurors we may compose 118 different juries of size six with no overlapping pairs. It is easy to see that the "efficiency ratio" of the jury pool, i.e., the ratio:

$$\frac{\text{number of juries which can be formed subject to the nonrepetion of dyads constraint}}{\text{size of the jury pool}}$$

increases with n. For low n the efficiency ratio is less than one, beginning, for $n \leqslant k\text{-}1$, at 0.

[2]It might at first appear that, when no restrictions on juror overlap are imposed, many more distinct six-member juries can be drawn from a jury pool of given size than can twelve-member juries. This is mistaken. The ratio of six-member juries to twelve-member juries which can be drawn from a pool of size n is simply $\frac{\binom{n}{6}}{\binom{n}{12}}$. After some manipulation, it is easy to see that if $n > 18$, then $\frac{\binom{n}{6}}{\binom{n}{12}} < 1$. Thus, somewhat counterintuitively, the larger the jury pool the more do the possible distinct juries of size twelve outnumber the possible distinct juries of size six. Of course, when we impose no restriction on juror overlap, when n is reasonably large, we may generate a *very* large number of k-member juries from a pool of size n. For example, if n is over 100, then billions of different six-member juries and an even larger number of distinct twelve-member juries may be generated.

For j = 2 and certain values of k, it can be shown that the efficiency ratio equals one if and only if

$$n = k^2 - k + 1 \tag{7}$$

In particular, it is a well known result in combinatiorial mathematics (see e.g., Ryser, 1963, Theorem 3.2, p. 91 and Theorem 4.2, p. 93) that the ratio is one when (7) holds for all k of the form $k = p^r + 1$, where p is a prime number and r is a positive integer. Thus, for k = 6 and k = 12 expression (7) determines the jury pool size n such that n jurors will yield exactly n juries of size k with no repeated pairs. (Both 6 and 12 are exactly one greater than a prime number and we may let r = 1.) Thus, 31 (133) jurors suffice to determine 31 (133) six-member (twelve-member) juries with no overlapping pairs.

One further note: when the efficiency ratio is exactly one it may also be shown that each of the $(k^2 - k + 1)$ jurors serves on exactly k k-member juries (Ryser, Theorem 3.2, p. 91).

In Multnomah County, on average, jury panels of roughly 12 members are used for trials before six-member juries and jury panels of roughly 24 members are used for trials before twelve-member juries (Jones, 1975). If we look at the size of the jury panel rather than at the size of the jury itself, we may readily establish results similar to those stated above. Thus, for a jury panel of size 24, since 24 is one more than a prime number, it follows that from 553 jurors $(24^2 - 24 + 1)$ we could form 553 distinct twenty-four-member panels with no overlapping pairs.

To guarantee, say 200 distinct panels of size 24 (and hence to guarantee 200 distinct juries of any size less than 24 - c, where c is the number of available challenges),[3] we may use expression (6) to solve for the needed n. This gives us $n \geqslant 333$. For Multnomah County, this would exceed somewhat the available number of jurors. On the other hand, if jury panels need have only twelve members, to guarantee 200 distinct jury panels of size twelve with no repeated pairs would only require roughly 163 jurors – well within available limits. Thus, for six-member juries (twelve-member panels) it should be possible to avoid any overlapping pairs. If our concern is to avoid dyadic overlap, juries of size six (panels of size twelve) are 4.2 $\left(\frac{24 \cdot 23}{12 \cdot 11}\right)$ times more efficient in manpower utilization than are juries of size twelve (panels of size twenty-four).

One last point: if we weaken our condition to require only the avoidance of repeated triples (groups of three who have served together previously on same jury), then the superiority of six-member juries is further enhanced, since for n sufficiently large, we may form roughly 9.2

[3]In Multnomah County, $c \leqslant k$ for all but murder trials (Jones, 1975).

$\left(\frac{24 \cdot 23 \cdot 22}{12 \cdot 11 \cdot 10}\right)$ times as many six-member juries (twelve-member panels) as twelve-member juries (twenty-four-member panels) from a jury pool of size n, when we impose the constraint of no repeated triples.

IV. Conclusion

We hope to have shown how it is possible, without a major change in present jury selection processes, to reduce one source of potential bias in jury decision-making by eliminating the possibility that jurors who serve on several juries during the course of their service will ever serve together more than once; also, we have shown that if that is our aim, six-member juries are more than four times as efficient as twelve-member juries.