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SOME METHODS FOR ESTIMATING UNCLEARED JUVENILE OFFENSES

STANLEY H. TURNER*

The present paper has grown out of a research project on the measurement of delinquency,¹ which has been an effort to establish a valid index of delinquent acts committed by juveniles as recorded by the police. Because delinquency statistics derived from police sources are based not upon all juvenile offenses that actually occur but upon those offenses resulting in the apprehension of suspects of juvenile court age, a question may arise about the usefulness of rates based upon that sample for index purposes. Changes in juvenile offense rates from one time to another may be a function of the number of uncleared juvenile offenses. But this number is unknown. Various assumptions can be made and in certain cases tested.

THE PROBLEM

Consider the following situation:²

Time 1	Cleared	Not Cleared	Total
Juvenile	Juvenile Offenses Cleared T1	Juvenile Offenses Not Cleared T1	Juvenile Offenses T1
Adult	Adult Offenses Cleared T1	Adult Offenses Not Cleared T1	Adult Offenses T1
Total	Cleared Offenses T1	Offenses Not Cleared T1	Offenses T1

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¹ Supported by the Ford Foundation, the research project conducted by the Center of Criminological Research at the University of Pennsylvania is fully described in SELLIN & WOLFGANG, *THE MEASUREMENT OF DELINQUENCY* (1964).

² This scheme omits the possibility of an offense being committed by both adults and juveniles. Such

Time 2	Not Cleared	Cleared	Total
Juvenile	Juvenile Offenses Cleared T2	Juvenile Offenses Not Cleared T2	Juvenile Offenses T2
Adult	Adult Offenses Cleared T2	Adult Offenses Not Cleared T2	Adult Offenses T2
Total	Cleared Offenses T2	Offenses Not Cleared T2	Offenses T2

Let:

- a = The number of juvenile offenses Time 1
- b = The number of adult offenses Time 1
- c = The number of juvenile offenses Time 2
- d = The number of adult offenses Time 2
- w = The proportion of juvenile offenses cleared at Time 1
- x = The proportion of adult offenses cleared at Time 1
- y = The proportion of juvenile offenses cleared at Time 2
- z = The proportion of adult offenses cleared at Time 2

Then:

Time 1	Cleared	Not Cleared	Total
Juvenile..	aw	a(1 - w)	a
Adult.....	bx	b(1 - x)	b
Total.....	aw + bx	a(1 - w) + b(1 - x)	a + b

mixed cases could be added in either adult or juvenile categories, or a third category could be added without changing any subsequent procedures.

Time 2	Cleared	Not Cleared	Total
Juvenile...	cy	c(1 - y)	c
Adult...	dz	d(1 - z)	d
Total.....	cy + dz	c(1 - y) + d(1 - z)	c + d

Given:

aw = The number of cleared juvenile offenses at Time 1

bx = The number of cleared adult offenses at Time 1

a(1 - w) + b(1 - x) = The number of offenses not cleared at Time 1

cy = The number of juvenile offenses cleared at Time 2

dz = The number of adult offenses cleared at Time 2

c(1 - y) + d(1 - z) = The number of offenses not cleared at Time 2

Then the problem is to estimate four quantities:³

a(1 - w) = The number of juvenile offenses not cleared at Time 1

b(1 - x) = The number of adult offenses not cleared at Time 1

c(1 - y) = The number of juvenile offenses not cleared at Time 2

d(1 - z) = The number of adult offenses not cleared at Time 2

In order to estimate these quantities some assumptions must be made. A number of assumptions, leading to quite different results, could be made. For instance, it could be assumed that the proportion of juvenile offenses in the cleared offenses is the same as the proportion of juvenile offenses in the uncleared offenses.⁴

$$\frac{\text{Juv Cleared T1}}{\text{All Cleared T1}} = \frac{\text{Juv Uncleared T1}}{\text{All Uncleared T1}}$$

That is:

$$\frac{aw}{aw + bx} = \frac{a(1 - w)}{a(1 - w) + b(1 - x)}$$

³ An alternative to estimating these quantities would be to try to maximize the clearance rates. This process would reduce the number of unsolved offenses, and if these unsolved offenses were very small in number they could be safely ignored in the task of assessing changes in offense rates.

⁴ This assumption is based upon suggestions by O. W. Wilson in *How To Measure the Extent of Juvenile Delinquency*, 41 J. CRIM. L., C. & P.S. 436 (1950).

Therefore:

$$a^2w - a^2w^2 + abw - abwx$$

$$= a^2w + abx - a^2w^2 - abwx$$

$$abw = abx$$

$$w = x.$$

And if the same assumption is made about adults

$$y = z.$$

The accompanying table lists all the assumptions considered.

These assumptions quite frequently lead to different results, which could imply different or contradictory conclusions about changes in offense rates. Three criteria were used to choose among these assumptions: usability, testability, and plausibility.

Usability: An assumption is usable if, when it is true, it leads to an estimate of the four quantities mentioned above. If it doesn't lead to an estimate it is unusable.

Testability: An assumption is testable if, when it is true, the estimates can be refuted by empirical data or if at least some of the estimates can be refuted at least some of the time. If no estimates can ever be refuted, an assumption is untestable.

Plausibility: This term is defined only comparatively. Thus, one assumption is less plausible than another if it assumes everything that the other does and, in addition, something else.

Assumptions A, B, C, D, and E can be compared as follows:

Assumption	Usability	Testability	Plausibility
A. Same proportion of juveniles in cleared as in uncleared.....	Yes	No	Medium
B. Proportions cleared do not change.....	Yes	Yes	Medium
C. Both A and B are true..	Yes	Yes	Least
D. Constant ratio of proportions cleared.....	No	No	Most
E. Proportions cleared do not change significantly.....	Yes	Yes	Medium

Assumption D is not usable. This can be shown as follows. If assumption A [$w = x$ and $y = z$] is true then D [$w/x = y/z$] becomes true since $w/w =$

TABLE

Assumption*	Formula
A. The proportion of juvenile offenses in the cleared offenses is the same as the proportion of juvenile offenses in the uncleared offenses. Same for adults.	$w = x \quad y = z$
B. The proportion of juvenile offenses cleared among all juvenile offenses is a constant. Same for adults.	$w = y \quad x = z$
C. Both assumptions A and B are true.	$w = x = y = z$
D. The proportion of juvenile offenses among all juvenile offenses bears a constant ratio to the proportion of adult offenses among all adult offenses.	$w/x = y/z$
E. (Modification of B) The clearance rate for juveniles does not vary significantly from one year to the next. Same for adults.	$w + \alpha\sigma w > y > w - \alpha\sigma w$ $x + \beta\sigma x > z > x - \beta\sigma x$

* Other, and perhaps better, assumptions can be made. For instance, some notion of capacity could be introduced by making the proportion cleared depend in part on the number of offenses and the number of available police, and so on.

y/y . Similarly if assumption B [$w = y$ and $x = z$] is true then D [$w/x = y/z$] becomes true since $w/x = w/x$. Let some data exist that cannot refute either assumption A or assumption B but can refute the assumption that they are both true. Then there is no single solution to D.

Assumption A is not testable. No data can ever refute it. It states that $w = x$ and $y = z$. To apply this assumption merely multiply the proportion of juveniles in the cleared offenses (whatever that proportion is) times the number of uncleared offenses (whatever that number is). No situation exists where this estimate cannot be made; hence it is impossible to test the reasonableness of this assumption.⁵ These considerations led to studying assumptions B and E in greater detail.

Assumption B states

$$w = y \text{ and } x = z$$

Therefore

T1	Cleared	Uncleared
Juvenile.....	aw	$a(1 - w)$
Adult.....	bx	$b(1 - x)$
	K	L

⁵ This assumption states that it is just as easy to solve an adult as a juvenile offense. This might be

T2	Cleared	Uncleared
Juvenile.....	cw	$c(1 - w)$
Adult.....	dx	$d(1 - x)$
	M	N

and

$$a(1 - w) + b(1 - x) = L$$

$$c(1 - w) + d(1 - x) = N$$

then we can solve for, say w

$$w = \frac{(aw)(dx) - (cw)(bx)}{(aw)(dx) - (cw)(bx) + (dx)L - (bx)N}$$

This assumption can be partially tested since if the assumption is true then for juveniles:

$$\frac{aw}{aw + a(1 - w)} = \frac{cy}{cy + c(1 - y)}$$

$$c(1 - y) = \left(\frac{cy}{aw}\right) a(1 - w)$$

tested in a more complicated situation than presently considered. This would involve ranking homogeneous groups of crimes by their clearance rates. Then if it were easier to solve juvenile offenses, the proportion of juveniles should increase as the clearance rate decreases, all other things being equal.

and for adults

$$d(1 - z) = \left(\frac{dz}{bx} \right) d(1 - z).$$

Then either

$$\frac{cy}{aw} L > N > \frac{dz}{bx} (L)$$

or

$$\frac{cy}{aw} (L) < N < \frac{dz}{bx} (L).$$

That is, the total number of uncleared offenses at T2 is bracketed by

$$\frac{\text{cleared juvenile offenses T2}}{\text{cleared juvenile offenses T1}} \quad (\text{all uncleared offenses T1})$$

and

$$\frac{\text{cleared adult offenses T2}}{\text{cleared juvenile offenses T1}} \quad (\text{all uncleared offenses T1}).$$

If the observed value of N falls outside the above bracketing, then assumption B is false.

However, it may be that the proportions cleared do not stay *exactly* the same but vary by chance from year to year. Assumption E is one way of allowing for such chance variation.

Assumption E:

$$w + \alpha\sigma w > y > w - \alpha\sigma w$$

$$x + \beta\sigma x > z > x - \beta\sigma x$$

This assumption can be partially tested in a way similar to assumption B: For instance,

$$\frac{a(w + \alpha\sigma w)}{a(w + \alpha\sigma w) + a(1 - [w + \alpha\sigma w])} > \frac{cy}{cy + c(1 - y)}.$$

To determine $\alpha\sigma w$: Choose a level of significance.⁶ For example, set $\alpha = 2.58$; then

$$\alpha\sigma w < (L + aw) 2.58\sigma w$$

$$< (L + aw) 2.58 \sqrt{\frac{(w)(1 - w)}{a}}$$

$$(L + aw) 2.58 \sqrt{\frac{(w)(1 - w)}{a}}$$

$$< (L + aw) 2.58 \sqrt{\frac{K}{aw}}$$

$$(w^2)(1 - w) < K$$

$$4/27 = K$$

and

$$\alpha\sigma w < (L + aw) 2.58 \sqrt{\frac{4/27}{aw}}$$

$$\alpha\sigma w < \frac{L + aw}{\sqrt{aw}}$$

then

$$c(1 - y) > \frac{cy}{aw + \frac{L + aw}{\sqrt{aw}}} \cdot a \left(1 - \left[w + \frac{L + aw}{\sqrt{aw}} \right] \right)$$

and setting $\beta = \alpha = 2.58$

$$d(1 - z) > \frac{dz}{bx + \frac{L + bx}{\sqrt{bx}}} b \left(1 - \left[x + \frac{L + bx}{\sqrt{bx}} \right] \right)$$

then compare

$$\frac{cy}{aw + \frac{L + aw}{\sqrt{aw}}} \text{ to } \frac{dz}{bx + \frac{L + bx}{\sqrt{bx}}}$$

and call the smaller "s", then

$$N = c(1 - y) + d(1 - z) > sL$$

and compare

$$\frac{cy}{aw - \frac{L + aw}{\sqrt{aw}}}$$

to

$$\frac{dz}{bx - \frac{L + bx}{\sqrt{bx}}}$$

and call the greater "g", then

$$N = c(1 - y) + d(1 - z) < gL$$

and finally,

$$gL > N > sL.$$

If the N falls outside the brackets assumption E is false.

⁶ Other ways exist for testing whether w and y are significantly different, but they are not discussed here. Since writing this article I have come across a different and better way of testing some of these assumptions.

The interested reader should consult Goodman, *Some Alternatives to Ecological Correlation*, 64 *Am. J. Soc.* 610 (1959).

SUMMARY

A valid index of juvenile delinquency depends on some assumption about the number of *uncleared* juvenile offenses. This number is not known but may be estimated. Of the five assumptions here considered concerning the relationship of the

cleared juvenile offenses to all known offenses, one assumption is suggested as being the most feasible: The proportions of juvenile and adult offenses cleared do not vary significantly from one year to the next. A way of testing this assumption is suggested.