A RISK ASSESSMENT MODEL FOR OFFENDER MANAGEMENT

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Abstract

This paper describes the progress made in the partnership between the Crime Research Centre, University of Western Australia, and the Western Australian Community Justice Services, Department of Justice in developing and establishing a robust, relevant and accurate risk assessment model for community based adult offender management, and what is considered to be a significant step in risk assessment methodology.

The Crime Research Centre has developed a risk estimation instrument, mathematically modelled on the past criminal justice experience of offenders in Western Australia and compressing years of linked events within the WA justice system. The prediction mechanism involves a multi-variable, computer-aided offender assessment system. The prediction mechanism involves a multi-variable hierarchical search engine and performs case-by-case adjustments of risk predictions. The instrument provides for the actuarial collation of like cases and dynamic reviewing of its adjustment parameters by regular updating.

The risk instrument is coupled with a needs assessment of dynamic factors developed by Community Justice Services to form an actuarially based, computer aided offender assessment system, which has been incorporated into case management practices to help prioritise the intensity of officer involvement with offenders under community supervision.

Its application has entailed acceptance both at a conceptual level, and in the more practical aspects of computer keyboard operations and use of questionnaire based devices. Consistency of application by the practitioners is a critical factor, together with their willingness to take on board new methods of case management, particularly at a time of increasing accountability and expectations of effectiveness in offender management.

Background

The West Australian Community Corrections is not dissimilar from other services in parts of the world in facing increasing work pressures in a climate where resources are scarce and demands for performance accountability are rising. In the light of this, the better identification and selective targeting of high risk offenders was seen as critical to ensure a more cost-effective allocation of resources, and the best hope of a positive impact on reduced rates of recidivism.

In the early 1990’s the Western Australia Community Corrections faced rapidly growing work volume and public accountability demands. It became clear that a finite resource base could not sustain equal levels of attention to all offenders, but contemporary case assessment and classification systems were still quite crude and lacked adequate selectivity. We began to re-examine what we expected case management to achieve and how our supervision efforts could be directed to best effect. At around the same time we were influenced by the work of those in North America who were promoting the principle of risk management as a cornerstone of correctional practice. The distinction was made between risk control – those constraints and sanctions placed on an offender to ensure that he/she remains less likely to re-offend while under supervision; and risk reduction – the effort to achieve a permanent reduction in the offender’s likelihood of re-offending. Our developments were to later embody the concepts of ‘risk’ and ‘needs’ in case management practice, but the initial task was seen as how to predict with confidence those offenders who belonged to the higher risk group. As the project progressed, the development of an offender risk profile became supplemented with an appropriate assessment and case management process to address those criminogenic factors that predispose towards offending behaviour.
Limitations of ‘Risk’ Prediction Instruments

One of the major problems of recidivism risk assessment instruments worldwide is that they are almost all fixed rather than dynamic instruments. That is, they are developed at a certain point in time, and are more than likely based on a finite sample of data, collected over a particular point in time, and analysing this using selected offender variables that correlate with the risk of reoffending. The limitations of this are seen that even where the research has been thorough, over time the chosen variables do their job less well because community demographic profiles change. The problem is accentuated when one system adapts or borrows a system designed elsewhere in the world without comprehensive validation against local data. Australian adaptations of the Wisconsin model or of the Canadian Level of Supervision Inventory are cases in point.

A Localised ‘Risk’ Predictive Instrument

As a part of the comprehensive risk assessment system, the Crime Research Centre has developed a predictive risk apparatus, the Adult Actuarial Risk Instrument (AARI). Built from the ground up, and using extensive locally validated data gained from operational information systems over a significant period of time, the AARI has taken five years to develop. It relies upon several separate databases - Police, Prisons, and Community Corrections which have been linked, so that any individual with known risk characteristics can be aligned with a similar group of offenders within the database. Considerations taken in its development and purpose follows.

Defining and Measuring Offending and Risk

A common criticism of existing predictive risk tools is that the parameter values are usually based on behaviour exhibited by a particular group of offenders at a particular time, raising the question of whether such devices are robust (i.e. can be used to predict reoffending behaviour across different or broader groups of offenders), and whether the prediction accuracy would hold true over time.

Mindful of this, and the nature of reoffending behaviour, research at the Crime Research Centre favoured survival analysis as the methodology of choice in measuring the rate of criminal reoffending. In particular, the Kaplan-Meier \((KM)\) non-parametric estimator of the cumulative distribution function of time-to-fail (ie the Failure function) is an excellent descriptive tool where censoring occurs . . . that is, where failure (reoffending in our case) has not occurred by the cut-off date. This technique requires knowledge of successive events of ‘re-offending’ over an acceptable follow-up period with known lengths of time between events. It was necessary to establish whether the \(KM\) estimator could accurately measure recidivism across different offender groups and over time; and therefore be used to estimate/predict future risk of reoffending.

A clear definition of offending is required., necessarily tempered by the reality of what information is available. In the Western Australian criminal justice system, information on recorded offences committed in the community is collected by Police and court convictions for offences committed are collected by the Department of Justice. Neither however presented as a viable data source for the measurement of reoffending.

Eg reported incidences of offences being committed do not include identification of (alleged) offenders; and court conviction records cannot identify individuals across successive appearances. There was, in any event, insufficient ‘history’ of court convictions to meet our requirements.

However, Police in WA also collect information on every arrest made, whether in the form of a physical arrest or by summons. While such information is neither indicative of every offence that is committed (not all offences result in an arrest, and some offences are prosecuted by agencies other than the Police), nor of every proven offence (i.e. not every arrest results in a conviction), this
dataset is nevertheless the best available indicator of re-offending that is currently available in
Western Australia. Police arrests cover a high proportion of prosecutions coming before the
criminal courts and a high proportion of them result in convictions.

Significantly, this information is available continuously since 1984 and includes data items that
were important in identifying differences in reoffending behaviour, namely sex, aboriginality, arrest
cardinality, age at arrest and most-serious-offence.

The arrest population is the base data used in the AARI. It currently comprises 621,029 arrest
events across 17 years between 1984 and 2000. The response variable is ‘time-to-fail’ with
censoring. Time-to-fail calculations exclude non-street time (ie time spent in prisons or lockups).
Since our research and others indicated that arrest 'cardinality' (i.e. the position in the offender's
arrest 'career') was a crucial explanatory variable, it was a requirement that complete arrest careers
were available. Incomplete careers are thus excluded from the instrument.

**Purpose of the AARI**

In essence, the instrument is designed to estimate the risk of future re-offending for an individual by
identifying all arrest events in the target population that match the individual on important
characteristics. apply survival analysis to those selected events using the KM estimator as a
predictor of ‘risk’. This is, in effect what the AARI does, with an additional step to adjust the
calculated risk measure as required to accommodate differences in important characteristics
between the individual and the ‘average’ of the group of like cases that were found. At the heart of
the AARI is the iterative process that 'seeks out' the matching group from the target population.
Certain issues arise:

**Defining ‘Like’ Events**

On what criteria should ‘like’ events/cases be chosen? Logically, those which match the individual
on those variables which are best at collecting like ‘risk’ propensities. Such groups are more likely
to behave similarly in the future. We found, for example, there were wide variations in risk between
males and females and as a consequence used sex as a grouping variable. The other variables that
were used for grouping were aboriginality, age, arrest cardinality and most-serious-offence.
### Individuals and Arrest Totals

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<thead>
<tr>
<th></th>
<th>Individuals</th>
<th>Arrests</th>
</tr>
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<tr>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboriginal</td>
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<tr>
<td>Non-aboriginal</td>
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<td>403,044</td>
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<tr>
<td>Female</td>
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<tr>
<td>Aboriginal</td>
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<td>35,688</td>
</tr>
<tr>
<td>Non-aboriginal</td>
<td>51,118</td>
<td>88,822</td>
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<td>Totals</td>
<td>226,418</td>
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### Arrest counts

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<tr>
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<th>Male Non-aboriginal</th>
<th>Female Aboriginal</th>
<th>Female Non-aboriginal</th>
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<td>51,110</td>
<td>226,286</td>
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<td>2</td>
<td>7,722</td>
<td>69,839</td>
<td>4,337</td>
<td>14,356</td>
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<td>6,530</td>
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<td>3,229</td>
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<td>4</td>
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<td>426</td>
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<td>30-39</td>
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<td>3,616</td>
<td>1,168</td>
<td>313</td>
<td>10,522</td>
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<td>40-49</td>
<td>2,721</td>
<td>1,562</td>
<td>628</td>
<td>123</td>
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<td>50-59</td>
<td>1,351</td>
<td>662</td>
<td>293</td>
<td>86</td>
<td>2,392</td>
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<tr>
<td>60-69</td>
<td>683</td>
<td>341</td>
<td>153</td>
<td>57</td>
<td>1,234</td>
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<tr>
<td>70-79</td>
<td>324</td>
<td>150</td>
<td>94</td>
<td>34</td>
<td>602</td>
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<tr>
<td>80-89</td>
<td>153</td>
<td>92</td>
<td>49</td>
<td>30</td>
<td>324</td>
</tr>
<tr>
<td>90-99</td>
<td>75</td>
<td>31</td>
<td>25</td>
<td>28</td>
<td>159</td>
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<td>82</td>
<td>11</td>
<td>2</td>
<td>72</td>
<td>167</td>
</tr>
<tr>
<td>TOTAL</td>
<td>93,475</td>
<td>403,044</td>
<td>35,688</td>
<td>88,822</td>
<td>621,029</td>
</tr>
</tbody>
</table>
Group Size

The reliability of a risk estimate is related largely to group size – though there is also a dependence upon how many uncensored cases are in the group (at an extreme, if all cases are censored there is no risk estimate). In the AARI, we chose an arbitrary minimum group size of 100, below which risk estimation is not performed.

Finding ‘Like’ Cases

Inevitably, finding a ‘like’ group of 100 or more cases that exactly match the characteristics of the offender being assessed may be impossible. This, of course, depends on the size of the event population and their distribution within the grouping variables. Generally, events that are ‘popular’ will find matching groups of large \( n \) but others won’t. The strategy chosen in the AARI is to search for the most ‘optimal’ group, according to an iterative search mechanism which traverses hierarchical variable structures in a pre-determined order.

Setting Individualised Risk

The instrument is on occasion expected to find the desired group at some ‘distance’ from the offender along one or more of the predictor variables. For example, the found group may have an average age within its membership of 25.6, whereas our individual’s age might be 19.5. The instrument has an adjustment mechanism which compensates for these differences along important vectors according to pre-determined regressions. The resulting risk estimate is tailored precisely to the characteristics of the subject offender.

Risk Matrix

The instrument is actuarial in that it calculates risk on the basis of the currently available data. It is possible to include each new arrest event into the database (and hence calculations) as soon as it becomes available. Also ‘old’ events can be archived at such time as they may be considered irrelevant or misleading. In theory, the instrument could be configured to iteratively search for the 'best' matching group at every invocation. In practice, however, it was found to be vastly more efficient, and virtually costless to pre-calculate risk probabilities according to the same iterative procedure and store the results in a 'risk matrix'. The matrix also greatly facilitated evaluation of the instrument's predictive accuracy, whilst maintaining its ‘actuarial’ nature by regeneration following regular updates of the target population.
Below, for example, are the KM estimates for the entire arrest population.

KM Group Estimates of Failure for Entire Arrest Population

<table>
<thead>
<tr>
<th>Group</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
<th>4 years</th>
<th>5 years</th>
<th>ever</th>
</tr>
</thead>
<tbody>
<tr>
<td>allpriors</td>
<td>0.58</td>
<td>0.69</td>
<td>0.74</td>
<td>0.77</td>
<td>0.79</td>
<td>0.85</td>
</tr>
<tr>
<td>all</td>
<td>0.44</td>
<td>0.54</td>
<td>0.59</td>
<td>0.62</td>
<td>0.64</td>
<td>0.71</td>
</tr>
<tr>
<td>allnopriors</td>
<td>0.21</td>
<td>0.29</td>
<td>0.34</td>
<td>0.38</td>
<td>0.40</td>
<td>0.50</td>
</tr>
</tbody>
</table>

where all = all arrest events between 1984 and 2000
allnopriors = all FIRST arrest events between 1984 and 2000
allpriors = all 2nd and subsequent arrest events between 1984 and 2000

<table>
<thead>
<tr>
<th>Group Sizes</th>
<th>n</th>
<th>fails</th>
</tr>
</thead>
<tbody>
<tr>
<td>all</td>
<td>621,029</td>
<td>394,937</td>
</tr>
<tr>
<td>allnopriors</td>
<td>226,286</td>
<td>96,279</td>
</tr>
<tr>
<td>allpriors</td>
<td>394,743</td>
<td>298,658</td>
</tr>
</tbody>
</table>
Below, the workings of the AARI are diagrammed.

**Actuarial Risk Model**

**Risk data**: arrest events of interest
- currently from 1984 to 2000
- contains 621,029 arrest events
- Response variable: time-to-fail (exc. nonstreet-time)
- Variables: sex, race, nth_age, nth_arrest, nth_offence

**Risk Estimation Process**
- Stepwise and max group Kaplan-Meier estimates for:
  - one-level fail class (0,1)
  - groups of minimum size of 100 events
- Group membership determined by hierarchical structure of explanatory variables.

**Risk matrix**
- each completed cell contains Kaplan-Meier group estimate of risk of failing within 1, 2, 3, 4, 5 years or ever

**Population contingency tables**
- produces regressions for confidence intervals

**Evaluation data**: all events of interest
- currently from 1984 to 2000
- contains 541,000 Adult arrest events
- Contains adjusted risk estimates from the instrument
- Used for:
  - Evaluation: risk prediction accuracy
  - Population contingency tables
to produce regressions for confidence intervals

**Iterative Risk Search Engine**
- derives group risk estimate using an iterative search procedure

**Risk Adjustment process**
- adjusts individual stepwise and max KM estimates according to inbuilt regressions on major explanatory variables
- includes confidence Intervals for each risk estimate

**Adjusted Risk estimate... Example**

<table>
<thead>
<tr>
<th>FOR</th>
<th>M N age 19.5 offence 211 at arrest 1 bailflag N postcode 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESULT after 7 iterations (1 group-3 iterations) was:</td>
<td></td>
</tr>
<tr>
<td>Probs Padjs Confid. Int</td>
<td>Row id = 101844</td>
</tr>
</tbody>
</table>

| **1 yr** | 0.283 | 0.445 | 0.351 | 0.543 |
| **2 yr** | 0.380 | 0.554 | 0.446 | 0.658 |
| **3 yr** | 0.470 | 0.643 | 0.530 | 0.742 |
| **4 yr** | 0.485 | 0.557 | 0.531 | 0.764 |
| **5 yr** | 0.502 | 0.672 | 0.548 | 0.776 |
| **max** | 0.524 | 0.691 | 0.574 | 0.787 |

<table>
<thead>
<tr>
<th>Age:</th>
<th>group 3 (19+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offence:</td>
<td>anco (211)</td>
</tr>
</tbody>
</table>
Evaluation

This predictive accuracy of the instrument was tested by way of comparison of predicted risk estimates against actual outcomes that occurred. A number of scenarios were constructed to test across different offender groups, iterative regimes, base population datasets and adjustment mechanisms – in all cases the instrument returned highly accurate results over time, but with variations for certain groups under certain conditions. Most notable was a degree of decline in accuracy for ‘outlier’ offenders. For example, accuracy declined for low-risk offenders in a group that tended to be mainly high risk and vice versa.

An example follows:

The Establishment of Risk Assessment in Case Management Practices

Accurate risk assessment in itself does not equal good case management. Accuracy in targeting and prioritising those offenders who are high risk of offending is one albeit highly significant element in effective case management. Developing and establishing a robust, relevant and accurate risk assessment model for offender management was seen as a prime step towards effective case management. At one level, it makes little sense to undertake concentrated casework, counselling or programs for low risk offenders. Lauen cites a body of evidence that the recidivism rate of low-risk offenders subject to intensive supervision may even be increased. Regardless of why this might be so, the added value of supervision in providing enhanced community protection is negligible, and there will be less time available to work with those who do represent a greater threat to community safety.

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Not unlike other Community Corrections Services, the development of an offender management strategy in the past decade has been effected by the principles of risk and needs, developing an offender classification system according to the assessed risk of recidivism and criminogenic needs. The Andrews and Bonta\(^2\) position that an integrated case management package must be consistent with the principles of risk, need and responsivity, was taken as a given. As an initial step in developing an improved model, the risk, needs and reassessment devices as modified from the Wisconsin CMC system were used. It was fortunate at that time (1995) that the Victorian Corrective Services had adapted Wisconsin model. This fulfilled a transitional need during the development of the purpose-designed Western Australian model. It also laid the way at the operational level, progressing a paradigm shift in offender management practices from classification according to seriousness of offence to predicted risk of re-offending.

**Developing the Risk Assessment Model**

With the consolidation of the model, a certain degree of adaptation had to occur giving consideration to the practical aspects of the model’s output, how it was to be displayed on screen in combination with other information. One decision that had to be made was to what degree of refinement was really necessary. An indicator of strength of prediction, (ie. number of iterations undertaken in the model to produce an acceptable result) was dispensed with as it was found in practice to have little value in determining supervision levels. Another refinement was made in clarify the time period of the prediction. There were a number of prediction time scales originally developed as part of the project, being available for a 1 year, 2, 5 or infinite time period. The 2 year period was chosen as this was commensurate with WA legislation, most Community Orders being for a maximum of 2 years.

One variable that was necessary to be modified to retain the accuracy of the system was the number of prior arrests for the individual. The number of prior events did have a major effect on the predicted risk. Allowance therefore had to be made for input of recent events. This is the only variable able to be modified on screen, and from piloting the system, a number of prior arrests exceeding 7 had no further influence on the predictive rating.

How the computed ‘risk’ was to be displayed was also deliberated upon. The initial model’s output, a 3 figure decimal figure was considered too detailed for the purpose and subsequently approximated with a % figure. With the limitations of the existing computer system, and bearing in mind the perception of the practitioners, having ‘risk’ displayed as a % probability was considered more acceptable than any graphic image or translation into a specific descriptive status such as ‘fair’, ‘minimal’ or ‘high risk’. The model’s output was considered to be a decision support system, in this case helping the practitioner decide upon a supervision level, taking into account other factors. It was considered necessary to display an indicator of the severity of the current offences. This had no bearing on the prediction, but served as a safeguard against certain offence types being disregarded in view of their low risk rating. The criteria for inclusion were gained from WA legislation where certain offence types disqualify an offender from certain services eg. the Bail Amendment Act, Criminal Code reflecting Parole assessment criteria.

**Introduction of the ‘Case Needs’ Assessment**

The AARI was complemented with a ‘Case Needs’ assessment, having individual ratings of the eight domains, reflecting dynamic risk factors. The individual ratings were recorded in the computer system. These domains had their origins in the work undertaken by the Canadian Corrective Services, but strengthened by the local research as part of this project undertaken by the UWA Crime Research Centre, studying a number of offender files. The original seven domains were consequently expanded to eight, with a differentiation between alcohol and other drugs. These eight domains are rated on a 0 – 3 rating, with interference with offender functioning being the significant factor.

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The eight domains are thus:
- Occupation/employment
- Marital /Family
- Associates/Social Interaction
- Alcohol Use
- Substance Use
- Community Functioning
- Personal/Emotional Orientation
- Attitude

A study of the operational data collected over the more recent 12 month period has been undertaken and the correlation between the assessed actuarial risk and case need scores for individual. The Pearson coefficient showed a positive correlation although not as strong as might have been expected.

**Future Maintenance of the System**

As the database grows over the years, AARI maintenance will face decisions about the optimum weighting to be assigned to historical data which may no longer reflect current criminal justice experiences. Whatever the degree of refinement, accuracy and comprehensive nature of the instrumentality, it should also be borne in mind the degree of acceptance by the practitioners themselves of an actuarially based, computer-aided offender assessment system, and its incorporation into case management practices. Its application entails acceptance both at the conceptual level, and in the more practical aspects of computer keyboard operations and use of questionnaire based devices. This latter aspect is important when one realises that data integrity is dependant on the commitment of the practitioners to data entry, more so with the ‘Case Needs’ assessment. Consistency of application by the practitioners is seen as a critical factor, together with their willingness to take on board new methods of case management, particularly at a time of increasing accountability and expectations of effectiveness in offender management.

The application of this particular risk assessment is for a specific correctional context, that is to prioritise the intensity of intervention with offenders who have already been placed under some form of community supervision. In its simplest sense, the Case Needs is seen as a supplement, prioritising the most beneficial areas for change in the individual case. As can be seen the AARI has a high level of predictive accuracy. What is emphasised as a final point is that the current instrument has been developed for a specific application, and caution is expressed in its use in other contexts, without being clear as to what is to be predicted, and for what purpose. This particular adaptation of the AARI has been tailored to predict the probability of re-arrest of an individual, something which is virtually identical to prediction of reoffending. It is used for case management planning, and its application is founded on the principles of risk and need in offender management. It is considered unwise to directly apply the instrument into other correctional practices, in for example to sentencing advice, or parole release decisions without further investigations.