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Road to Recovery

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Profiling Customers for Better Service Delivery

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1. Abstract

The TAC has developed a set of client profiles as well as a predictive model to assign clients to those profiles, which is a significant component of the future business model. This paper will examine both the approach to developing the profiles and predictive model as well as the broader business context of the change being undertaken.

Keywords:
Profiling, Service Delivery, Accident Compensation, Automated Acceptance

2. Context – Transport Accident Commission

The Transport Accident Commission (TAC) is Victoria's state-owned, monopoly Compulsory Third Party insurer. The TAC provides no-fault benefits (i.e. treatment and support as well as compensation for loss of earnings and impairment) to those injured in transport accidents.

The TAC commenced on 1 January 1987 and receives approximately 16,000 claims per year, spending more than $1 billion each year on claims costs, comprising:

- Approximately $450 million in health and disability services (covering medical, allied health, rehabilitation and disability services);

- Approximately $550 million in compensation (covering common law damages for economic loss and pain and suffering, impairment lump sums, loss of earnings benefits and death benefits for dependent spouses and children of those killed in transport accidents); and

- Approximately $100 million in other expenses including legal costs, medical reports and investigation costs.

Compensation schemes such as the TAC receive claims from individuals with a broad range of injuries and needs. To effectively manage such a scheme it is important to be able to identify as early as possible which claimants (also referred to as "clients") are likely to recover quickly and need relatively few services, and which clients are likely to have a more protracted recovery and receive a relatively larger volume of services.

The TAC's overarching approach to claims segmentation

For nearly twenty years the TAC has segmented its clients into two broad organisational groups:

1. Those clients with severe physical injuries who are likely to require care and support from the TAC for the remainder of their lives. The majority (between 85% and 90%) of these clients have an acquired brain injury, whilst the remainder (between 10% and 15%) have a spinal injury (paraplegia or quadriplegia).

   These clients represent approximately 1% of one year's accidents. The TAC refers to this group of clients as "Independence" clients (as the goal for these clients is to assist them to maximize their Independence following their transport accident). Within the population of Independence clients, the majority receive significant levels of care and support and they are therefore relatively homogeneous in terms of their service usage.

2. Those clients with less severe physical injuries. These clients represent the remaining 99% of one year's accidents. The TAC refers to this group of clients as "Recovery" clients (as the goal for these clients is to assist them to recover from their transport accident as efficiently as possible). Within the population of Recovery clients there is a broad spectrum – some clients receive only a small number of services (for example GP or Physiotherapy) and claim costs amount to less than $1,000, whilst some clients receive services for several years and cost hundreds of thousands of dollars. The Recovery population in aggregate is therefore far more heterogeneous than the Independence population.

Identification of the TAC's Independence clients is relatively straightforward as they can be identified via their injury soon after their accident.

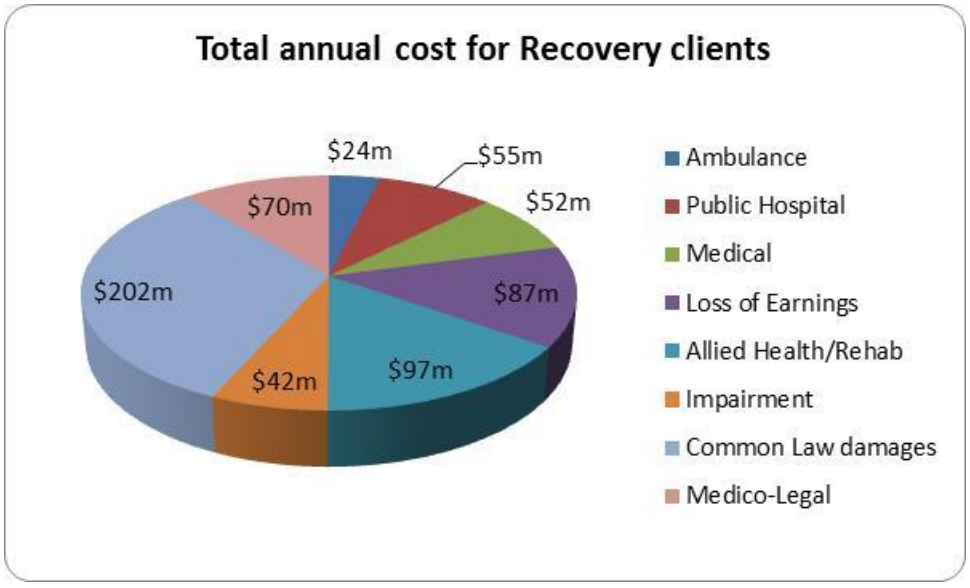
By contrast, segmentation within the TAC's Recovery population is more challenging and has evolved over time. The most recent evolution of this segmentation occurred in 2010 and is referred to as the "Recovery model" (*Pocock et al (2011)* and *Poel and Pocock (2013)*).

The remainder of this paper deals with identification of risk and the segmentation of clients within the Recovery population.

Features of Recovery population

Recovery clients represent 99% of TAC accepted claims with between 15,000 and 16,000 new Recovery clients per year. The TAC spends more than $600 million per year on Recovery clients. Figure 1 shows the composition of this expenditure:

Figure 1 Composition of annual claims expenditure on Recovery clients



As discussed above, within the Recovery population there is a broad spectrum of claims in terms of the services and compensation received and the duration for which services are received.

Figure 2 shows the cumulative distribution of costs within the Recovery population by claim cost quintile. The chart shows that the least expensive 80% of claims represent only 8% of the annual claims costs.

Figure 2 Cumulative Distribution of Recovery costs by claim cost quintile

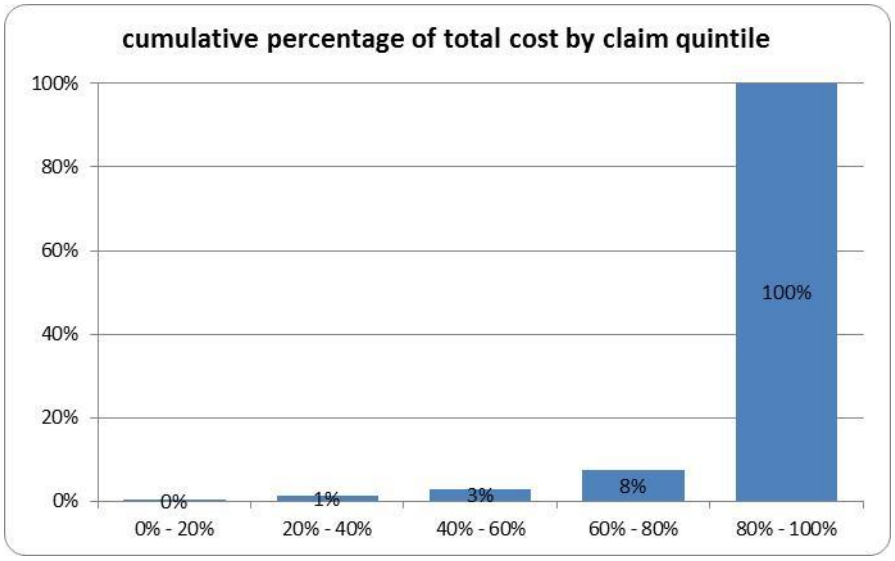
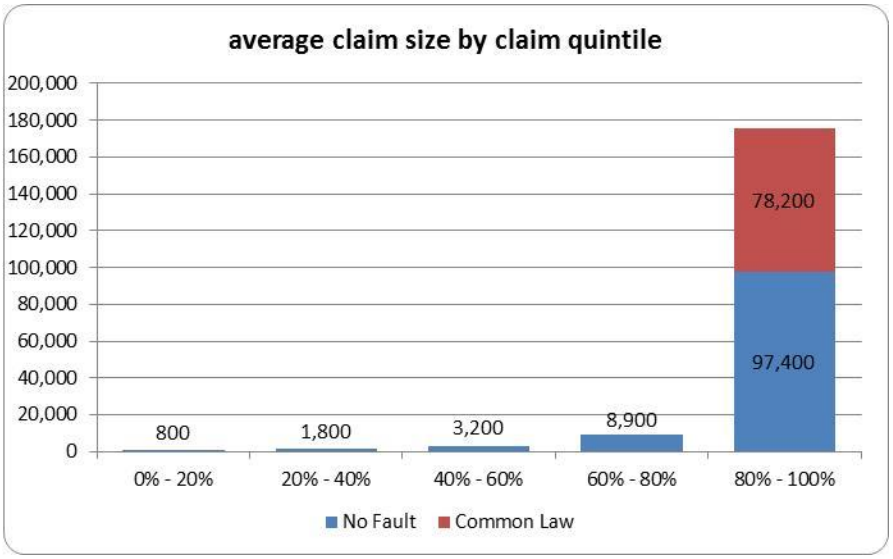


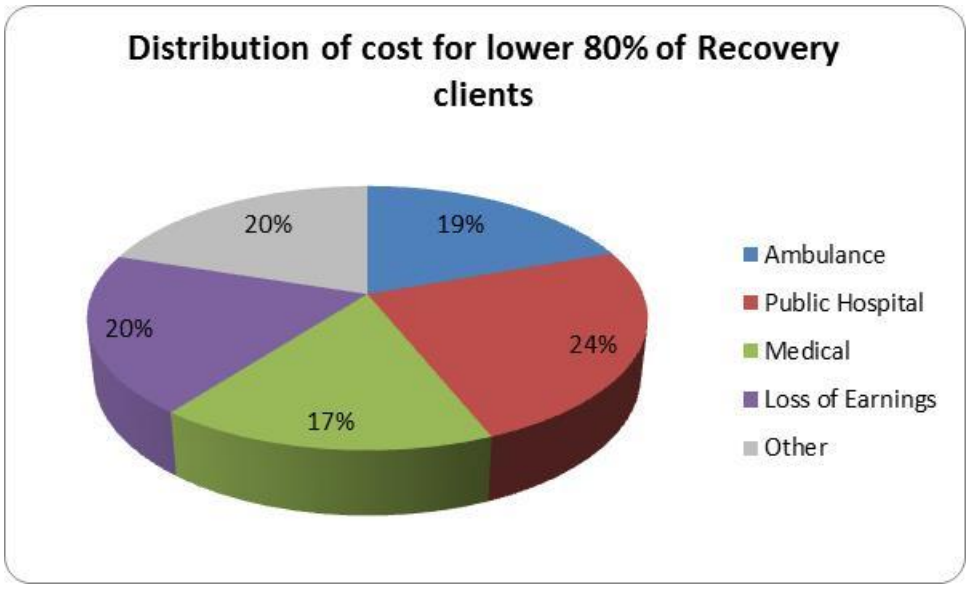
Figure 3 shows the average claim size of the Recovery population by claim quintile. It shows an average claim size for the bottom 80% of the population less than $10,000 with an average claim size for the top 20% of over $175,000.

Figure 3 Average claim size of Recovery claims by claim quintile



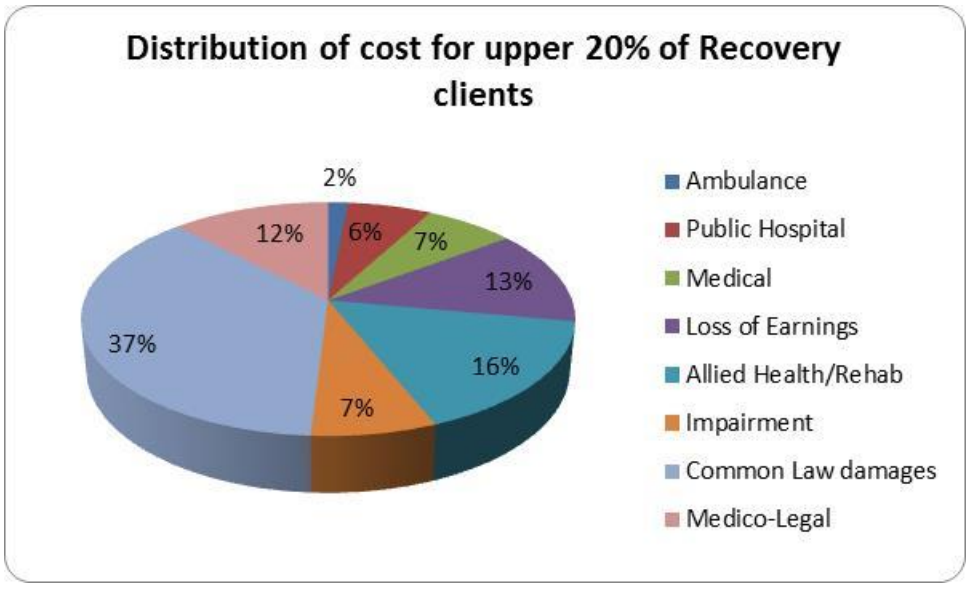
Within the least expensive 80% of Recovery clients, approximately 80% of the cost relates to ambulance, public hospital, medical and loss of earnings benefits, as shown in Figure 4.

Figure 4 Distribution of cost for lower 80% of Recovery clients by cost



By contrast, for the most expensive 20% of Recovery clients (approximately 3,000 per year) a substantial proportion receive lump sum impairment benefits (on a no fault basis) and common law damages (on a fault basis) as well as much higher levels of allied health and rehabilitation expenditure.

Figure 5 Distribution of cost for upper 20% of Recovery clients by cost



Historical Approach to Segmentation within the Recovery population

For many years The TAC has recognised that there exists a spectrum of clients within the Recovery population. Various approaches have been taken over the years to the segmentation of claims within the Recovery population.

Prior to the Recovery model (implemented in 2010), the segmentation approach which was utilised for a number of years took into consideration:

- Return to work needs (i.e. whether the client was working at the time of their accident);
- Their injury type; and
- The length of their hospital stay.

This segmentation approach relied on "business rules" (i.e. certain individual variables) to move claims between teams. All claim movements from one team to another took place manually.

In 2010, the Recovery model was introduced which included a revised approach to segmentation within the Recovery population (*Pocock et al (2011)* and *Poel and Pocock (2013)).* The Recovery model introduced within the TAC the concept of automated segmentation, with claims from within the Recovery population being segmented (at claim acceptance) based on data collected within the claims acceptance process. The segmentation approach introduced within Recovery utilised two multivariate logistic regression models:

- One model which predicted the probability of a claim being "high cost" (defined as receiving a no-fault payment in the seventh month post-accident); and
- One model which predicted the probability of a claim ultimately lodging a serious injury (common law) application.

The results of the two models were combined to allocate each claim into one of two broad claim streams:

- "Active management", within which clients receive a more intensive, proactive level of claims management; and

- "Client assist", within which clients receive a less intensive, more reactive level of claims management.

In addition to the automated streaming of clients, various changes to claims management practices were made to further support clients within the Recovery population. These changes included:

- "Motivational Interviewing" training for rehabilitation co-ordinators, which was designed to improve the quality of their interactions with clients;

- The introduction of the "Recovery Action Plan". This plan is a structured document which exists within the TAC's claims management system, capturing the clients' barriers, interventions and outcomes; and

- The "First Service" project, which implemented a simplified claim acceptance process, based on an algorithm developed using information captured at claim acceptance, and which removed the use of a hard copy claim form, enabling the majority of claims to be accepted over the phone.

Current Business Context

The next phase of segmentation within the Recovery model has been driven by the next evolution of the TAC's business strategy. This strategy recognises that for a substantial proportion of TAC clients the ultimate goal is to enable the clients, as much as possible, to manage their own recovery, without the need for direct interaction with the TAC.

A critical component of this strategy is the introduction of the concept of "client profiles". Each client profile defines a group of Recovery clients who exhibit relatively similar service usage.

The following sections provide more detail about:

- the approach to developing the client profiles;
- the approach to predicting the client profile into which clients will fall (at various points in time); and
- the expected outcomes and usage of the client profiles.

3. Approach

The broad approach taken to development of client profiles requires:

- A retrospective classification that can be applied to a claim when the lifetime history of the claim is known (referred to as the "Profile Model"), and

- A prospective method of classifying claims when only a partial history is known (referred to as the "Assignment Model").

Both models were developed using an iterative and interactive approach, so that the ultimate users of the models (i.e. the management of the operational divisions within the TAC managing Recovery clients) could make a judgment on the merits of different options in relation to the models. These options include:

- ***The time period used to develop the models.*** Older claims have more of their history known, but may have been managed differently to more recent claims;

- ***The claims from that time period to be excluded.*** A small group of claims may be so different from the rest that it should form a separate profile, but it is not large enough to justify separate management processes;

- ***The aspects of the claim's history used to classify it.*** For example, claim payments can be grouped to various levels. The payments to be used, and the level to which they should be grouped needs consideration;

- ***The number of profiles to be developed.*** There need to be enough to ensure that each profile's claims are reasonably homogeneous so that their processing and management requirements are similar. However, as the number of profiles increases, so does the difficulty of accurately assigning a claim.

- ***The desired level of assignment accuracy;***

- ***The times at which assignment be reviewed.*** Different assignment models may be needed, depending on how much of the claim history is known.

Profile Model

The Profile Model was constructed by:

1. Selecting a group of claims to analyse;

2. Selecting a number of attributes of those claims at the end of the period, for example total payments for each of eleven selected benefit categories (discussed further below) and the duration of those payments;

3. Applying a technique that splits the claims into "clusters" with similar attributes;

4. Deciding on the number of clusters to adopt which provide suitable separation between the different clusters.

Selected Claims

The original intention was to analyse service use over the first two years following claim lodgement, as this would give a good balance between:

- Using more recent accident years, which are more relevant to future claims; and

- Observing clients for long enough to determine their true service needs.

However, the TAC's "First Service" project (implemented in October 2013) made substantial changes to the information received at claim lodgement. Since this lodgement information would be used to make initial assignments to profiles, it was decided that it would be preferable to use claims lodged since implementation of First Service. This meant that only about one year of claim history would be available.

The effect of a one year period of development was tested on claims from the 2010/11 year. It gave different classifications for 13% of claims based on a 4 clusters model. This difference was regarded as acceptable.

Other time periods were used as necessary to test the value of using variables not currently available but previously used in research studies.

Some groups of claims were excluded from the Profile Model, either because they would not require management, or because they were significantly different types of claims. This included fatal claims and Independence clients, which are segmented and managed separately.

Selected Claim Attributes

The first model used as target variables total cost and duration over the first year for each of the twelve highest level benefit groupings.

With this initial model, some benefits not related to medical treatment tended to dominate the profile characteristics, in particular loss of earnings, lump sum benefits and legal costs. As these benefits are only weakly related to service requirements, they were excluded from further analysis. This left eleven benefit categories: Ambulance, Victorian Public Hospital, Victorian Private Hospital, Other Hospital, Medical Consultations, Medical Other, Paramedical Private, Paramedical Rehab Hospital, Occupational Therapy, Equipment, and Paramedical Other.

Several attempts were made to use different subgroupings of these benefits, but none performed significantly better in terms of assignment accuracy. Activity related variables such as phone calls and tasks performed by TAC staff, and variables collected in research studies were also tested, again with little or no improvement in performance.

All payment and duration variables were transformed by the log of the amount plus one. This reduces the tendency of the clustering method to produce many small clusters containing only a few claims with very large payments (i.e. it reduces the influence of very large claims).

Claim Clustering Method

A standard clustering method available in SAS was used to group claims: the Cluster procedure with Ward's method. There are many different methods available, each of which will produce different clusters. Ward's method tends to produce clusters that have roughly similar numbers of claims. There is no straightforward criterion for choosing between methods, in terms of usefulness to TAC, so no other options were tested.

This procedure produces hierarchical clusters – starting from a single cluster, new clusters are produced by splitting existing clusters. Alternatively, starting from clusters of size 1, larger clusters are produced by joining two clusters. This makes it simpler to see the effect of increasing or decreasing the number of clusters.

Number of Profiles

The attributes being used to determine the clusters are essentially continuous variables, so the boundaries between clusters are somewhat arbitrary. To be useful, the clusters must be relatively homogeneous with respect to service usage. This can be achieved by having a large number of clusters. However, having too many clusters will mean that claims will move more often between clusters as more information is received over time. Balancing these two considerations needs to weigh up the benefits of smaller, more accurate profile groups versus the cost of moving claims between profile groups.

A number of methods for choosing the "right" number of clusters, generally looking for a large improvement in the splitting measure, were considered.

As the clusters are hierarchical, they can be "re-combined" to produce a smaller number of profiles as necessary. Having six profiles seemed to provide sufficient gradation in severity to allow focus on the clients expected to have the highest needs, whilst allowing for different profiles to be used at different stages in the life of a claim.

Note that the assignment of claims to profiles may change as more information becomes available about the claim. If stability of assignment is important, then having fewer profiles will give greater stability.

Assignment Models

The Assignment Models were constructed by:

1. Selecting a group of claims to analyse;

2. Selecting a period of claim development;

3. Selecting a number of attributes of those claims at the end of the period, for example payments for which accounts have been received, for each benefit category;

4. Developing a model that predicts the Profile utilising those attributes;

5. Testing how the model performs on a separate set of claims.

Selected Claims

There were two considerations in determining the claims used to fit the assignment models:

- As discussed above, the First Service project (implemented in October 2013) significantly impacted the information collected at claim lodgement. The decision was therefore made to fit the Assignment Models using claims accepted post the implementation of First Service, as this would give the greatest accuracy when applied to future claims; and
- Development of the Assignment Models requires a Profile to have been calculated for each claim, requiring twelve months' history post claim acceptance.

The combination of these two requirements restricted the available claims to those lodged over seven months in 2013/14, giving 7,410 claims to be used in modelling.

Selected Development Periods

To provide information on how stable assignments were, models were developed at lodgement, and one, two, three, four, six, eight, ten and twelve months after the accident. How the claims are to be managed will determine which of these models are used in practice to allocate clients to Profiles.

Selected Claim Attributes

For the model fit at date of lodgement, all available information was reviewed to decide whether it might be useful in predicting the Profiles.

For models at dates after lodgement, payment totals relating to invoices received by that date were also used as predictors. The same payment groupings were used as for the Profile model.

To determine if the assignment could be improved, further information was provided on phone calls received from clients and various types of tasks performed by TAC staff.

Profile Prediction Method

The original intention was to use the decision tree software CART to predict a profile from the available attributes and invoices received, at lodgement and various stages of development. The related program Treenet was also used to see whether it was more accurate than CART.

Both CART and Treenet are algorithms developed by Salford Systems that automatically produce a series of dichotomous choices relying solely on the input data. They produce a decision tree which can be used to identify the characteristics of homogeneous groups. The key difference between CART and Treenet is that CART produces a single "best fit" tree whereas Treenet produces a weighted average tree based on a large number of different trees.

Both programs predict a probability that a claim will belong to each profile, so there is some measure of the certainty of the predicted profile. They also provide an overall measure of importance for each input variable, which gives an indication of which variables have the greatest influence.

4. Results

The results of the profile and assignment modelling are summarised in the following sub-sections:

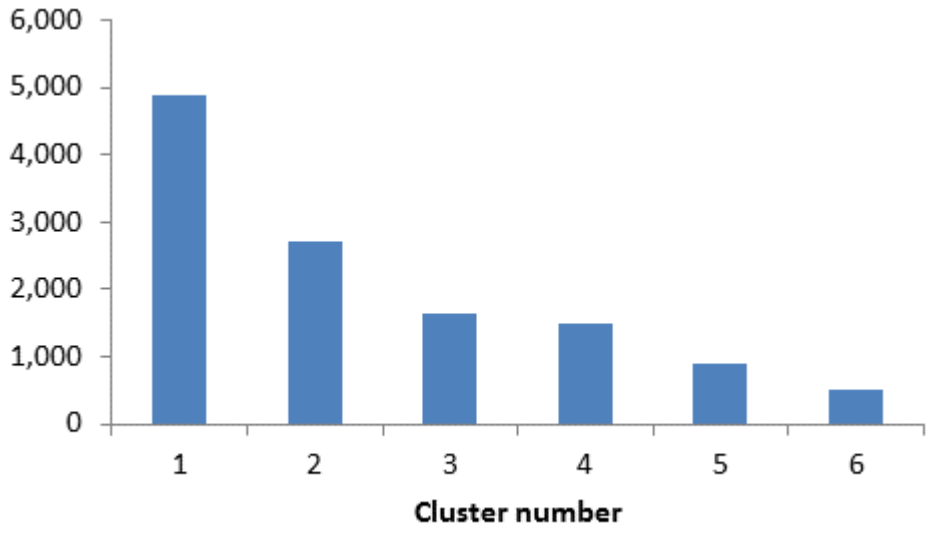
- Number of profiles;
- Cost and duration of profiles;
- Key characteristics of profiles;
- Other characteristics of profiles reviewed;
- Assignment characteristics – cost and duration
- Key variables for assignment models
- Other factors reviewed for assignment.

Number of Profiles

Based on various statistical methods for choosing a "good" number of clusters, there are indications that 2, 4 or 5, 8 and 12 clusters produce material improvements (measured as the magnitude of the reduction in cluster variability as cluster numbers increase). However, practical considerations are likely to be more important than these indications – i.e. the number of different groups that can be meaningfully managed.

It was decided that 6 clusters was the appropriate number to adopt as the subsequent clusters split cluster 6 into smaller clusters and was therefore producing groups of claims which were deemed to be too small to justify separate management processes. Figure 6 shows a breakdown of a nominal year's worth of accepted claims into 6 clusters. In general, clusters 1, 2 and 3 are of shorter duration and lower cost, whilst clusters 4, 5 and 6 are of longer duration and higher cost. Further details about the clusters are contained in the following sections.

Figure 6 Expected numbers of claims per year with each profile



Because of the hierarchical nature of the claim clustering method, smaller numbers of clusters can be obtained by joining particular clusters. For example, 4 clusters are

obtained by joining clusters 4-6 from the 6 cluster model shown in Figure 6; two clusters are then obtained by joining clusters 1-3.

Cost and Duration of Profiles

As the clusters are based on the cost and duration of 11 benefit categories, they are most easily distinguished by the averages of these costs and durations. Table 1 shows the average costs. The main features are:

- Profile 1 has the lowest costs, with the vast majority of cost consisting of Ambulance and Medical Other (typically radiology and outpatient costs);
- The main cost within Profile 2 is Victorian Public Hospital. It includes has relatively little paramedical cost, although does containing some Equipment and Paramedical Other (typically occupational therapy, prosthesis and travelling expenses);
- Profile 3 has the second lowest cost after Profile 1. It includes little hospital with its paramedical costs being mostly physiotherapy;
- Profile 4 has slightly higher costs than Profile 2, and has more significant paramedical costs (mostly physiotherapy);
- Profile 5 has higher costs than Profile 4, with much higher cost in Victorian Private Hospitals and Medical Other (particularly in surgery, radiology and pathology);
- Profile 6 has the highest costs in all categories except Paramedical Private.

The contrast between Profiles 2 and 3 is noteworthy - Profile 2 has relatively higher costs in the shorter term, more "acute" areas of Ambulance, Hospital and Medical and the claims are of shorter duration whilst Profile 3 has much lower hospital and medical costs but higher paramedical costs and longer durations.

Table 1 Expected costs per claim within twelve months for each profile

Profile	*Duration*	*Ambulance*	*Hospital*	*Medical*	*Paramedical*	*Total*
	Mths	*$k*	*$k*	*$k*	*$k*	*$k*
1	1	0.8	0.1	0.4	0.0	1.2
2	2	1.7	5.4	2.3	0.3	9.8
3	7	0.9	1.2	0.9	0.9	3.8
4	9	1.8	6.2	3.7	2.4	14.1
5	10	2.7	15.6	8.2	4.7	31.2
6	10	4.6	46.5	15.7	10.8	77.6
All	4	1.4	4.9	2.4	1.2	9.9

Of the benefit categories not used in the clustering, the typical pattern is that the average cost increases in moving through clusters 1 to 6.

Table 2 shows the average durations for selected payments. The main features are:

- Profile 1 has the lowest durations, mostly under a week;
- Profile 2 has durations typically under or around a month;
- Profile 3 is likely to be still having physiotherapy up to six months;
- Profile 4 is likely to be still having physiotherapy up to eight months, and also radiology after several months;
- Profile 5 has longer durations than Profile 4, with time in Victorian Private Hospitals (potentially surgery and/or occupational therapy after several months);
- Profile 6 has the longest durations in most categories.

Table 2 Expected average duration of a claim in selected categories for each profile

Profile	*Victorian Private Hospital*	*Medical Other*	*Paramedical Private*	*Paramedical Rehab Hospital*	*All payments*
	Mths	*Mths*	*Mths*	*Mths*	*Mths*
1	0.0	0.3	0.0	0.0	1.0
2	0.1	1.2	0.0	0.0	2.5
3	0.0	1.0	6.1	0.0	6.7
4	0.0	4.0	7.8	1.4	9.0
5	3.0	5.8	7.8	1.6	9.9
6	2.4	6.2	3.4	7.7	10.3

Key Characteristics of Profiles

Some of the key factors that differ between the profiles, shown in Table 3 are:

- The number of injuries: lowest for Profiles 1 and 3, highest for Profile 6;
- The type of injury: more often soft tissue for Profiles 1 and 3, fractures and internal injuries for Profiles 2, 4, 5 and 6;
- The age of the client: clients in Profile 1 are likely to be younger than average, those in Profile 6 older;
- The type of road user: Profiles 4 and 5 have more motorcyclists than average, Profile 6 has more pedestrians than average;
- The delay in reporting the accident: Profile 6 claims are generally reported earlier than Profile 1 and 3 claims.

Table 3 Other attributes differing between profiles

Profile	*Number of injuries*[1]	*Soft Tissue*[2]	*Fractures*[2]	*Age*[1]	*Motorcyclist*[3]	*Pedestrians*[3]	*Report Delay*[1]
		%	%	Years	%	%	Days
1	3	40	9	38	12	5	24
2	6	11	31	42	19	8	16
3	5	39	17	41	14	4	20
4	6	18	41	42	30	8	12
5	9	10	37	44	37	7	11
6	14	3	42	50	21	19	9

Notes:
1. Average for each profile
2. Percentage of claims in this profile having this as the main injury
3. Percentage of claims in this profile having this as the road user type

Other Characteristics of Profiles Reviewed

Some of the other factors considered and tested in the Assignment Models were found to differ between the profiles, including the number of incoming phone calls on the claim and the number of "tasks" (administrative actions) recorded on the claims system.

Table 4, shows the distribution of the number of incoming phone calls by profile. Profiles 1, 2 and 3 have a higher proportion of clients who make no phone calls, whereas Profiles 4, 5 and 6 have a higher proportion of the clients who make more than 20 phone calls.

Table 4 Percentage of profile in each of incoming phone call categories

Profile	*Number of incoming phone calls*			
	0	*1-5*	*6-20*	*21+*
	%	%	%	%
1	40	50	9	1
2	25	52	20	3
3	8	51	36	6
4	1	20	50	28
5	0	7	46	47
6	0	4	31	65

Treenet versus CART for Assignment

The results described below were obtained using the Treenet software. For those with an understanding of the algorithms, Treenet was used rather than CART because:

- Similar but slightly more accurate results were obtained using Treenet. If it was useful to see the chain of decisions used to make the assignment, and a small loss in accuracy was not important, it might be preferable to use CART;

- The probabilities produced by Treenet were more useful as they were directly related to the assignment. If the probabilities are not used to prioritise claims for management action, this would not matter.

Accuracy of Assignment Models

The accuracy of assignment to a profile depends on:

- The stage of development of the claim – the more payment information that is available, the easier it is to predict the payments at one year post accident;
- The number of profiles;
- The software used to derive the assignment.

Table 5 shows the assignment accuracy based on for 2, 4 and 6 profiles, at four time points: lodgement, 1, 3 and 6 months after the accident. Accuracy is measured as the proportion of claims assigned to the correct profile.

Table 5 Summary of assignment accuracy

Assignment Time	*Number of Profiles*		
	2	*4*	*6*
	%	*%*	*%*
Lodgement	79	54	48
1 Month	81	58	53
3 Months	89	76	72
6 Months	93	90	87

Using the information available at lodgement, 79% of claims are assigned to the correct profile for a two profile model, 54% are correctly assigned for a four profile model and 48% correctly assigned for a six profile model.

Not surprisingly the accuracy improves over time as more information becomes available. By three months post-accident 72% of claims are correctly assigned within the six profile model (compared to 48% at lodgement).

The accuracy also varies by assigned profile. 75% of all claims assigned profile 1 at lodgement will be correctly assigned, but only about 25% of claims assigned to profiles 3, 4 and 5 will be correctly assigned. As the claim matures, the assignment accuracy improves considerably. At six months' development, 87% of claims are correctly assigned for a six profile model. Table 6 shows the accuracy at lodgement and 1, 3 and 6 months after the accident.

Table 6 Assignment accuracy to 6 profiles by profile assigned

Profile assigned	*% correctly assigned as profile 1-6*			
	Lodgement	*1 month*	*3 months*	*6 months*
	%	%	%	%
1	75	77	86	94
2	54	57	74	92
3	23	30	55	76
4	22	27	52	70
5	28	34	56	79
6	40	52	79	88

Some mis-assignments may be less important than others, depending on how the profiles will be implemented in practice. For example, if claims in Profile 4, 5 and 6 will be managed in a similar manner for the first few months post lodgement then they could be grouped together and regarded as a single profile for that period (i.e. regarded as "Complex" claims), with the remaining profiles being "Simple".

Whilst the assignment accuracy in the early durations is less than might be desirable, a reasonably large proportion of claims move to an adjacent profile. For example, most claims that are incorrectly assigned Profile 1should be Profile 2 and similarly, those assigned Profile 6 should be Profile 5. As more information becomes available a greater proportion of claims are correctly assigned to their Profile.

It is also possible to refine the assessment of the likelihood of claims being correctly assigned to Profiles by reviewing the probabilities resulting from the Treenet modelling. Those claims with a high probability of being in a particular Profile are, obviously, more likely to be correctly assigned than those with low probabilities.

Assignment Characteristics – Cost and Duration

Despite the apparent difficulty of assigning claims to the correct one of six profiles at lodgement, the pattern of average payments for assigned profiles is still quite similar to the pattern for the actual profiles.

Table 7 shows the average cost for the claims assigned to each profile at lodgement. The colours are intended to highlight the different pattern in costs between the claims assigned to Profiles 2 and 3. The red values indicate the higher cost of those two profiles and the green are the lower, so claims assigned to Profile 2 have relatively higher costs in the "traditional" medical areas but relatively lower in paramedical.

The different pattern in costs between claims assigned to Profiles 2 and 3 is similar to the pattern noted for the Profile Model. Claims assigned to profile 2 have, on average, relatively higher costs in the "traditional" medical areas of Ambulance, Hospital and Medical but relatively lower in Paramedical.

Overall, the Figures in Table 7 match reasonably closely with those for the profiling in Table 1.

Table 7 Expected medical costs to one year for each profile as assigned at lodgment

Assigned Profile	*Ambulance*	*Hospital*	*Medical*	*Paramedical*[1]	*Total*[1]
	$k	*$k*	*$k*	*$k*	*$k*
1	0.8	0.1	0.4	0.2	1.5
2	**1.7**	**4.0**	**1.9**	**0.5**	8.1
3	**0.5**	**0.3**	**0.5**	**0.6**	1.9
4	1.6	5.1	3.2	1.8	11.6
5	2.2	10.7	5.5	3.0	21.4
6	4.7	41.0	14.1	7.2	67.0
All	1.4	4.9	2.4	1.2	9.9

Notes:
1. Excludes Vocational and Home Services

Table 8 shows the average duration for the claims assigned to each profile at lodgement. As for the actual profiles, the durations generally increase as the assigned profile number increases.

Table 8 Expected medical durations (in months) to one year for each profile as assigned at lodgment

Assigned Profile	*Ambulance*	*Hospital*	*Medical*	*Paramedical*[1]	*Total*[1]
1	0.0	0.0	0.8	1.1	1.4
2	0.1	0.2	1.6	1.8	2.4
3	0.0	0.1	1.8	3.2	3.5
4	0.1	0.6	4.5	5.3	6.2
5	0.2	1.9	5.5	6.1	7.0
6	1.0	2.2	7.1	7.8	8.6
All	0.1	0.5	2.4	3.0	3.6

Notes:
1. Excludes Vocational and Home Services

Key Variables for Assignment Models

The importance rating supplied by both Treenet and CART gives an indication of what variables are most influential in making assignments.

At lodgement, the five most important variables are:

1. Number of injuries;
2. Details of the most significant injury, for example, soft tissue, fractures or lacerations;
3. Age at accident;

4. Hospital name (smaller hospitals grouped);

5. Road user type, for example, passenger, driver or motorcyclist.

As time elapses the importance of particular characteristics changes. For example, after three months, three of the top five are payments or durations while by six months only two of the lodgement variables remain in the top 20, with none in the top 5, i.e. the payment and duration information dominates the predictability.

Other Factors Reviewed for Assignment

A number of other factors were reviewed as part of the assignment process. These included various pieces of information collected in relation to the activity of claims (e.g. numbers of phone calls and tasks) as well as details relating to pyscho-social questions asked by the TAC. Each of these proved to provide insights into the assignment of claims on their own but did not add to the accuracy of the assignment when considered in combination with the other claim charactertistics available (particlularly the claim payment information).

5. Intended usage – some considerations

Whilst the TAC has not yet fully implemented the insight gained from the analysis presented within this paper, it has commenced examination of how this insight may inform future claims management practice. Some broad considerations in relation to how the profiles may be used are as follows:

Evolution of claim segmentation - the development of profiles comprising claims with similar service usage across different benefit types represents a further evolution in claim segmentation relative to previous approaches adopted by the TAC. The most recent segmentation approach made use of a simpler set of target variables (e.g. "active at six months") whereas the approach outlined in this paper allows for a more sophisticated approach by considering service usage across a number of different benefit types and durations.

Targeted level of outlier claims - the distribution of service usage within each profile allows thresholds to be set to generate a desired level of "outlier" claims for each profile. For example a threshold could be set to result in 5% of claims within a particular profile being outlier claims.

Further, as each profile is built on the distribution of services for different benefit types, thresholds can be set for individual benefit types or for combinations of benefits.

Determination of future claims "streams" - An important consideration is how the different profiles are to be combined to form different claims management "streams". For example, clients in the "simpler" profiles (i.e. 1, 2 and 3) are more likely to be suitable for a "light touch/no touch" claims management model and may be combined into a single stream.

Likewise clients in the more "complex" profiles (i.e. 4, 5 and 6) are likely to benefit from more active management and may be combined into a single stream.

In this example there would effectively only be two different claims management streams. However thresholds to detect outliers could still be set separately for each profile within a stream. For example clients in profile 1 may have different thresholds to those in profile 2.

When to re-segment and the balance between accuracy and pragmatism – Assignment models have been constructed at a number of defined points in time post-lodgement (and in fact could be constructed at *any* desired point in time). In theory claims could therefore be resegmented each month, or more often if desired.

It is important, however, to strike the right balance between accuracy (i.e. allocating the claim to the "right" profile) and pragmatism (i.e. minimising the number of claim transitions). The authors do not propose to expand on this topic as it is worthy of a paper of its own!

6. Conclusion

For a no fault scheme such as the TAC which receives claims from individuals with a broad range of injuries and needs, it is important to continue to examine the approach to segmentation, to be confident that clients are receiving services that are beneficial to their needs and that administrative resources are being effectively allocated. The approach set out in this paper represents a further evolution from previous approaches adopted by the TAC and is consistent with contemporary approaches to customer segmentation used across a broad range of organisations. It is hoped, via the use of the techniques set out in this paper, that organisations such as the TAC are able to continue to improve their ability to support those unfortunate enough to be injured in transport or workplace accidents.

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