Breakage – The magic of a loyalty programme

A real-world example of how actuaries solve the breakage analytics problem in an airline frequent flyer programme

Breakage modelling is the primary focus of actuaries in loyalty programmes. In this context, breakage refers to the miles or points that are earned but never redeemed and eventually expire. The purpose of breakage modelling is to estimate the percentage of earned miles that will ultimately expire (this is referred to as the breakage assumption on earned miles), or to estimate the percentage of an outstanding miles balance that will ultimately expire (this is referred to as the breakage assumption on outstanding miles). As expected, the breakage assumptions, whether on earned or outstanding miles, are strongly correlated with the expiry rules of the loyalty programme, as well as their dynamic changes due to market trends and customer expectations. Therefore, it is crucial for a breakage model to be responsive to potential changes in programme rules, initiatives, and member transaction behaviours.

This article discusses the 'why', 'how', and 'what' of a simplified breakage modelling approach. It also intends to provide inspiration for the wider application of actuarial techniques.

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WHY DOES BREAKAGE MATTER?

The key objective of breakage modelling is liability management. While this might sound more relevant to insurance valuation, loyalty programmes come with a liability for future redemption costs, similar to how insurance companies reserve for future claims. It involves valuing the dollar equivalent of a mile and forecasting the likelihood that the mile will ultimately be redeemed. IFRS 15 is the guiding accounting standard for the calculation of the fair value of miles and the loyalty liability. Since an earned mile will either be redeemed or expire, the following equation applies:

$$\textit{Probability (Redemption)} + \textit{Probability (Breakage)} = 1$$

Loyalty programmes are transforming globally to become increasingly customer-centric. One consequence of this transformation is the relaxation of miles or points expiry rules. In general, there are two types of expiry rules: time-based and activity-based. Under time-based rules, miles expire after a predefined period. Under activity-based, miles will not expire as long as there is at least one eligible transaction within a predefined period. The more relaxed the expiry rule, the lower the breakage rate.

A BRIEF INTRODUCTION TO THE METHODOLOGY

To create and validate breakage assumptions, various modelling approaches exist in the market. Inspired by these methodologies, an internal, simplified model for predicting ultimate breakage was developed. Under an activity-based expiry rule, the outstanding miles balance can be allocated into buckets based on the *time since last activity* (TSLA). The transition rate is the percentage of miles in a bucket that move to the next, while the rejuvenation rate is the percentage of miles that restart from the first bucket. In our programme, miles expire if there is no transaction activity for 18 months. Generalising from an 18-month to an x-month activity-based expiry rule is a straightforward exercise.

Considering the relationship between breakage, rejuvenation, and transition: when a mile keeps transitioning on a monthly basis from one TSLA bucket to the next, it eventually expires after transitioning through the 18th TSLA bucket. The breakage rate in the 19th month since a mile is earned is the product of all assumed transition rates for each TSLA bucket. Rejuvenation is also important because, when the miles balance in a member's account is rejuvenated due to a transaction, the miles are reset to be 18 months away from expiry. It will then take another 18 transitions for the miles to expire.

This finding tells us that, after a mile is earned – regardless of the number of rejuvenations and transitions it undergoes (in any sequence) – as long as the mile experiences a rejuvenation at any TSLA bucket followed by 18 consecutive transitions, it becomes breakage. The number of consecutive transitions before the last rejuvenation must be fewer than 18, of course. No matter how far into the future we project, the mile's journey can be described as permutations of transitions and rejuvenations at different TSLA buckets. The only additional criterion is that there must not be more than 17 transitions followed by a rejuvenation at any time before the mile begins its final journey of one last rejuvenation followed by 18 continuous transitions, which leads to expiry. With this, breakage modelling can be simplified into decision trees of rejuvenation and transition.

THE SIMPLIFIED BREAKAGE MODEL

The input for this breakage model is the actual breakage experience by accrual month and the number of months since the miles were earned. This is calculated by dividing the actual miles expired by the total miles earned in each accrual month. The output is the expected ultimate breakage rate. The breakage model consists of two parts:

1. Reverse engineering the product of transition and rejuvenation rates at different TSLA buckets, using actual breakage rates.
2. Projecting breakage for any month since miles were earned, which can extend up to 360 months or more, equivalent to over 30 years. Over time, the breakage rate will tend to 0.

Let us define the following:

- t as a positive integer
- $T(t)$ as the transition rate at TSLA bucket t
- $R(t)$ as the rejuvenation rate at TSLA bucket t
- $B(t)$ as the breakage rate at time-t since miles earned
- $X(t) = R(t)$, where $t = 1$
- $X(t) = T(1) \times T(2) \times T(3) \times \cdots \times T(t-1) \times R(t)$, where $t \geq 2$

To calculate X(t):

For $t = 1$,

$$X(t) = \frac{B(t+19)}{B(19)}$$

For $t = 2$,

$$X(t) = \frac{B(t+19)}{B(19)} - \frac{B(t+18)}{B(19)} \times X(1)$$

For $t = 3$,

$$X(t) = \frac{B(t+19)}{B(19)} - \frac{B(t+18)}{B(19)} \times X(1) - X(2) \times X(1)$$

For $4 \leq t \leq 18$,

$$\begin{aligned} X(t) = {} & \frac{B(t+19)}{B(19)} - \frac{B(t+18)}{B(19)} \times X(1) - \left[\frac{B(t+18)}{B(19)} - \frac{B(t+17)}{B(19)} \times X(1)\right] \times X(1) \\ & - \left[\frac{B(t+17)}{B(19)} - \frac{B(t+16)}{B(19)} \times X(1)\right] \times X(2) \\ & - \left[\frac{B(t+16)}{B(19)} - \frac{B(t+15)}{B(19)} \times X(1)\right] \times X(3) - \ldots \\ & - \left[\frac{B(22)}{B(19)} - \frac{B(21)}{B(19)} \times X(1)\right] \times X(t-3) - X(2) \times X(t-2) \end{aligned}$$

To calculate B(t):

For $t \geq 38$,

$$\begin{aligned} B(t) = {} & B(t-1) \times X(1) + B(t-2) \times X(2) + B(t-3) \times X(3) + \cdots + B(t-17) \times X(17) \\ & + B(t-18) \times X(18) \end{aligned}$$

The more actual breakage experience a loyalty programme accumulates, the more credible and reliable the model output becomes, just as with any other actuarial model. However, this model is particularly useful for loyalty programmes running on an activity-based expiry rules that are still in the relatively early stages of either programme launch or expiry rule change. Only $2x + 1$ months of actual normal experience is needed to provide an acceptable indication of the ultimate breakage rate, in the case of an x-month activity-based expiry rule.

Breakage modelling and assumption setting will continue to remain as one of the key priorities for actuaries working in loyalty programmes. We manage the financial liability and ensure compliance with accounting standards such as IFRS 15. The methodology discussed in this article is an example of how we – as actuaries – add value to breakage analytics problem-solving in a non-traditional field. We have attempted to understand and predict ultimate breakage rates, with an emphasis on the concept of miles rejuvenation and transition under activity-based expiry rules. As market dynamics and customer engagement are constantly evolving, actuarial techniques will always be relevant to empower strategic decision making in optimizing loyalty programme value, driving long-term sustainable success in this unique landscape.

If you are interested to discuss breakage models and possible future enhancements, feel free to reach out to ann_cheung@cathaypacific.com. ■