Reserving for Long-Term Disability Claims in a Property & Casualty Insurance Environment:
A Hybrid Framework Integrating Tabular Cash-Flow Valuation and Development-Based Diagnostics

Technical Paper

This technical paper reflects observations and analysis from a governance and oversight perspective regarding reserving methodologies applied to long-term disability liabilities within the property and casualty insurance environment. The objective is to contribute to professional discussion on how actuarial methods can best align with the structural characteristics of long-duration disability risks.

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1. Abstract

This paper examines reserving methodologies for Group Long-Term Disability (LTD) insurance portfolios. It evaluates the suitability of traditional property and casualty development-based techniques for long-duration disability liabilities. While methods such as loss development factors (LDF), incurred loss triangles, and Bornhuetter–Ferguson estimators are widely used within P&C reserving practice, LTD liabilities exhibit structural characteristics more closely aligned with life and health insurance products.

The ultimate cost of an LTD claim is determined primarily by the duration of disability and the resulting stream of future benefit payments rather than by claim reporting or settlement emergence patterns. As a result, tabular valuation approaches—based on claimant-level projections of future benefit payments using duration-based termination assumptions—provide a direct representation of the underlying liability structure.

This paper demonstrates how development-based techniques may become sensitive to tail assumptions, changes in case-reserving methodology, and lagging operational experience in long-duration portfolios. Numerical and stochastic illustrations show that portfolios with identical development triangles may produce materially different ultimate liabilities when disability termination dynamics differ.

To address these structural differences, the paper proposes a hybrid reserving framework in which tabular disability valuation provides the primary estimate of liabilities, while development-based techniques serve as diagnostic tools to monitor experience and validate reserve adequacy.

The paper concludes with governance implications for actuarial practice and encourages further dialogue within the actuarial profession regarding best practices for reserving long-duration disability insurance liabilities.

2. Keywords

Long-Term Disability Insurance; Claims Reserving; Tabular Disability Valuation; Disabled Life Reserve; Loss Development Factors; Bornhuetter–Ferguson Method; Disability Termination Risk; Duration Risk; Hybrid Reserving Framework; Stochastic Reserving; Actuarial Governance

3. Executive Summary

Group Long-Term Disability (LTD) insurance exhibits liability characteristics that differ materially from most traditional property and casualty (P&C) lines. While P&C reserving methods such as loss development factors (LDF), Bornhuetter–Ferguson (BF), and severity–frequency(SF) approaches are widely accepted and effective for many short- and medium-tailed lines of business, their application to LTD portfolios with long duration risk (often 6–7 years or longer) raises methodological considerations.

The central thesis of this paper is:

For long-tailed LTD liabilities, the dominant drivers of reserve variability are termination, recovery, mortality, and benefit cash-flow dynamics. Accordingly, tabular, or claimant-level cash-flow methods should serve as the primary reserving framework, with development-based methods used as diagnostic and validation tools.

This paper:

1. Reviews development-based reserving methods and their limitations in long-tailed disability contexts.
2. Explains why LTD severity is inherently life-contingent rather than static.
3. Demonstrates how changes in case reserving methodology can impair triangle comparability.
4. Proposes a structured hybrid framework in which tabular valuation forms the core reserve estimate.
5. Provides governance and communication guidance for Appointed Actuaries.

The intent is not to displace traditional reserving methods, but to clarify their appropriate role in long-duration disability reserving. The central argument of this paper is that LTD reserving should primarily model the future duration of disability, rather than infer ultimate losses from the emergence of historical payments. Tabular disability valuation methods, therefore, provide a structurally aligned framework for estimating LTD liabilities, whereas development-based techniques are most effective when used as diagnostic tools.

4. Introduction

Estimating unpaid claim liabilities requires the selection of actuarial methods that appropriately reflect the structural characteristics of the underlying insurance risk. In property and casualty (P&C) practice, development-based techniques—such as loss development factors (LDF), Bornhuetter–Ferguson (BF), and severity–frequency methods—have long served as foundational tools for reserving. These techniques are particularly effective for lines of business in which claim emergence and settlement follow relatively stable, observable development patterns.

Group Long-Term Disability (LTD) insurance, however, presents a distinct reserving challenge. LTD claims frequently involve payment streams that extend over many years, often until recovery, retirement, or age 65. The ultimate cost of a claim is therefore driven less by reporting or settlement development and more by the evolution of disability duration, recovery probabilities, mortality, and benefit structures.

In practice, reserving approaches for LTD portfolios often reflect the actuary's professional background. Where valuations are performed within a P&C reserving framework, development-based techniques such as triangles, LDF selection, and BF estimates may be used as primary reserving tools. These approaches can provide useful empirical diagnostics, particularly for early claim durations.

However, when applied to long-duration disability liabilities, development-based methods may encounter structural limitations. In particular:

- the ultimate claim cost is highly sensitive to termination dynamics rather than reporting emergence,
- tail factors may dominate reserve estimates,
- changes in case reserving methodology can impair triangle comparability, and
- claim severity is fundamentally a contingent stream of future benefit payments rather than a single realized payment.

For these reasons, disability reserving has historically been grounded in tabular or disabled-life valuation methods, which project claimant-level cash flows based on termination and mortality assumptions derived from experience studies.

This paper examines the relative suitability of development-based reserving techniques and tabular cash-flow valuation methods for LTD liabilities. It proposes a structured hybrid framework in which tabular valuation serves as the primary method for estimating reserves

while development-based techniques are retained as secondary diagnostics to validate reasonableness and detect emerging trends.

The objective is not to displace established P&C reserving practices, but rather to clarify how method selection should reflect the economic and statistical characteristics of long-duration disability liabilities.

4.1 Structural Characteristics of LTD Liabilities

Long-Term Disability (LTD) insurance differs from many traditional property and casualty lines of business in the structural drivers of claim costs. While development-based reserving techniques infer ultimate losses from historical payment emergence patterns, LTD liabilities are fundamentally determined by the duration of disability and the resulting stream of future benefit payments.

Several characteristics distinguish LTD claims from many other insurance liabilities and influence the suitability of reserving methodologies.

First, the ultimate cost of an LTD claim is highly sensitive to termination dynamics, including recovery rates, return-to-work outcomes, mortality, and changes in benefit eligibility. Small variations in termination assumptions can materially alter the projected duration of disability and, therefore, the present value of expected benefit payments.

Second, because LTD claims may extend over many years, tail factors can exert a disproportionate influence on reserve estimates when development-based techniques are applied. When a significant portion of expected claim payments lies beyond the observed development horizon, ultimate loss estimates may become dominated by assumptions regarding late-duration development.

Third, changes in case-reserving methodology can impair the comparability of incurred-loss triangles. If case reserves transition from incremental estimates to forward-looking projections of future benefit payments, apparent development in incurred losses may reflect methodological changes rather than true deterioration in claim experience.

Finally, the severity of an LTD claim is not a single realized payment but rather a contingent stream of future benefits whose value depends on the duration of disability and applicable policy provisions. This structure differs fundamentally from many P&C claims in which the ultimate loss corresponds to a discrete settlement amount.

These characteristics suggest that reserving approaches for LTD portfolios should explicitly consider the duration-driven nature of disability liabilities. The following sections examine how

tabular disability valuation methods and development-based reserving techniques respond to these structural features.

4.2 Scope and Limitations

This paper examines structural differences between tabular disability valuation methods and development-based reserving techniques when applied to long-duration group long-term disability (LTD) liabilities.

The objective of the analysis is not to prescribe specific actuarial assumptions, nor to evaluate the adequacy of reserves for any insurer. Rather, the focus is on comparing methodological frameworks and examining how different reserving approaches respond to the economic drivers of LTD claim liabilities.

The analysis is limited to group LTD insurance portfolios with long-duration benefit structures, where claim costs are primarily determined by disability duration and termination dynamics. Other health insurance products with shorter claim durations may exhibit development patterns more compatible with traditional loss development techniques.

The examples presented in this paper are intended to illustrate structural characteristics of reserving methodologies rather than to represent empirical estimates for any specific portfolio.

5. Literature Review

The actuarial literature addressing claim reserving spans both property and casualty insurance and long-term disability insurance. These two domains have historically developed distinct methodological traditions reflecting the differing characteristics of their liabilities.

5.1 Development-Based Reserving in P&C Insurance

Development-based reserving methods have been extensively documented in P&C actuarial literature.

The Casualty Actuarial Society (CAS) has long promoted development-based techniques as core reserving tools, particularly for lines of business where claim settlement patterns exhibit stable development behavior.

Friedland (2010) provides a comprehensive overview of basic reserving techniques, including paid and incurred loss development methods, the Bornhuetter–Ferguson approach, and expected loss ratio methods. These techniques rely on the premise that historical claim-development patterns provide credible signals of the emergence of ultimate loss.

Subsequent CAS research has explored extensions and limitations of these methods. The CAS Tail Factor Working Party (2013) highlights the sensitivity of ultimate loss estimates to tail factor assumptions, particularly when development triangles extend beyond observable experience. The study notes that small variations in tail assumptions can produce materially different ultimate loss estimates, especially for long-tailed liabilities.

While these methods have proven effective for many lines of P&C business, their reliability depends on several key assumptions:

- stability of development patterns across accident years,
- comparability of case reserving practices,
- and relatively limited tail exposure.

When these assumptions are weakened, development-based methods may become less informative.

5.2 Severity–Frequency Frameworks

Another widely used framework in P&C reserving is the severity–frequency model:

Ultimate Loss = Expected Claim Frequency x Expected Claims Severity

This approach separates the modelling of claim occurrence from the modelling of claim cost. In LTD insurance, however, claim severity itself represents the present value of a contingent stream of future benefit payments.

Severity–frequency models are particularly useful when exposure data are credible, and claim counts are stable. However, in the context of LTD insurance, claim severity is not a static quantity. Instead, the ultimate cost of a disability claim is determined by the present value of a sequence of future benefit payments contingent on recovery and survival.

As a result, severity in LTD insurance is fundamentally dynamic and duration dependent.

5.3 Tabular Valuation in Disability Insurance

The valuation of disability insurance liabilities has traditionally relied on tabular methods analogous to those used in life insurance.

In these frameworks, the liability associated with each claim is calculated as the expected present value of future benefit payments, incorporating:

- disability termination probabilities,

- mortality,
- benefit structure,
- and discounting assumptions.

Termination assumptions are typically derived from large-scale experience studies.

The Canadian Institute of Actuaries (CIA) has published termination studies for Group LTD business that provide duration-based recovery and termination rates. Similarly, the Society of Actuaries (SOA) has conducted extensive research on group LTD termination patterns in North America.

These studies demonstrate that disability termination rates vary materially by:

- duration since disability,
- age of claimant,
- diagnosis category,
- and other factors.

This evidence supports the use of duration-based tabular models for disability reserving.

The use of tabular methods for disability valuation has long been embedded within life and health actuarial practice. Disabled life reserve techniques are conceptually analogous to life insurance policy valuation, where liabilities are determined by the expected present value of future contingent benefits. The similarity between disability income benefits and other life-contingent cash flows has historically led to the development of valuation frameworks grounded in survival modelling rather than loss development analysis.

5.4 Interaction Between Case Reserving and Development Methods

A recurring theme in the literature is the interaction between case reserving practices and development-based reserving techniques.

Incurred loss triangles rely on the assumption that case reserves provide reasonably consistent estimates of ultimate claim cost. When case reserving practices change materially—such as transitioning from incremental case estimates to forward-looking disabled-life projections—the comparability of incurred triangles may be impaired.

In such circumstances, observed development patterns may reflect changes in reserving methodology rather than underlying claim experience.

This issue has received increasing attention in recent actuarial discussions as insurers adopt more sophisticated claim-level reserving frameworks.

Table - Comparison of Reserving Methodologies

Reserving Method	Primary Data Source	Strengths	Limitations for LTD
Chain Ladder	Paid or incurred loss triangles	Simple, widely used, transparent	Highly sensitive to tail factors and case reserve adequacy
Bornhuetter–Ferguson	Expected loss ratios combined with development patterns	Stable for immature accident years	Still relies on development assumptions
Frequency–Severity	Claim counts and average costs	Useful for monitoring trends	Does not capture duration dynamics
Tabular Disabled Life Reserve (DLR)	Claimant-level projections	Captures duration risk and benefit structure	Requires detailed claimant data and assumptions
Hybrid Framework	Tabular projections with development diagnostics	Aligns liability estimation with LTD risk drivers while preserving triangle diagnostics	Requires reconciliation between methods

6. The Case for Tabular Cash-Flow Valuation

Long-Term Disability (LTD) insurance differs from most traditional property and casualty lines in that the ultimate claim cost is determined primarily by the duration of disability and the associated stream of benefit payments, rather than by the timing of claim reporting or settlement.

In a typical LTD contract, once a claimant satisfies the elimination period and begins receiving benefits, the insurer is exposed to a contingent stream of future payments that may extend for many years. Benefits typically continue until one of several termination events occurs:

- recovery and return to work,
- death of the claimant,
- attainment of the maximum benefit age (often age 65), or
- other policy-specific termination provisions.

The economic liability associated with an LTD claim is therefore best understood as the present value of a sequence of contingent future benefit payments, rather than as a single payment whose ultimate amount emerges gradually through a settlement process.

Tabular or disabled-life valuation methods address this structure directly by projecting the expected stream of future benefit payments at the claimant level. These methods estimate the expected present value (EPV) of future benefits by combining assumptions regarding:

- duration-based termination rates, which govern the probability that a claim remains active at each future duration.
- mortality, which affects long-duration claims.
- benefit structure, including maximum benefit periods and indexing features.
- offset provisions, such as integration with government disability benefits; and
- discounting, reflecting the time value of money for long-duration liabilities.

Formally, the liability associated with an LTD claim can be expressed as:

$$Reserve = \sum_{t=1}^{T} B_t \times P(\text{claim active at time } t) \times v^t$$

where:

- $B_t$represents the benefit payable at time t,
- $P(\text{claim active at time } t)$reflects the probability of continued disability based on termination assumptions,
- $v = (1 + i)^{-1}$represents the discount factor at interest rate i, and
- T represents the maximum benefit duration (often age 65).

This formulation mirrors the valuation framework used in life and health insurance for disability income benefits. It recognizes that the dominant uncertainty in LTD liabilities arises from duration risk, rather than from claim reporting or settlement dynamics.

Empirical support for duration-based valuation is provided by termination-experience studies, such as the Canadian Institute of Actuaries Group LTD Termination Study and similar studies conducted by the Society of Actuaries. These studies demonstrate that disability termination probabilities vary significantly by duration since disability, age, diagnosis category, and other claimant characteristics. The presence of strong duration dependence reinforces the appropriateness of tabular valuation frameworks.

6.1 Disability Survival Dynamics

The probability that a claimant remains disabled at duration $t$can be expressed as a function of duration-based termination probabilities:

$$S_i(t) = \prod_{k=1}^{t}(1 - q_{i,k})$$

Where:

- $q_{i,k}$represents the probability that claimant $i$terminates disability at duration k, reflecting recovery, return-to-work outcomes, mortality, or benefit eligibility changes.

Substituting this expression into the reserve formulation shows that the ultimate liability of an LTD claim depends directly on the survival dynamics of disability duration.

$$Reserve_i = \sum_{t=1}^{T} B_{i,t} \cdot \left(\prod_{k=1}^{t}(1 - q_{i,k})\right) \cdot v^t$$

This formulation highlights that LTD liabilities are fundamentally driven by disability duration dynamics. Small changes in termination probabilities may compound over time and materially alter the present value of expected benefit payments.

Unlike development-based reserving techniques that infer ultimate losses from historical payment emergence, tabular valuation models estimate the present value of future benefit payments directly from disability survival dynamics.

6.2 Economic Structure of LTD Claim Severity

An important distinction between LTD and many P&C coverages lies in the definition of claim severity.

For most P&C lines, claim severity represents the total cost of resolving a claim, which may emerge gradually as claims are settled or paid. Development-based methods infer the ultimate claim amount from historical emergence patterns.

In contrast, the severity of an LTD claim is not a single realized amount but rather the present value of a contingent sequence of benefit payments. The ultimate cost of the claim depends on the duration of disability and the probability of termination at each future duration.

Consequently, LTD claim severity can be expressed conceptually as:

$$Severity = \sum_{t=1}^{T} Benefit_t \times Survival_{Disability}(t)$$

where $Survival_{Disability}(t)$represents the probability that the claimant remains disabled at duration t.

This formulation highlights that the primary driver of LTD severity is disability survival, which is governed by termination and recovery dynamics rather than by settlement timing.

6.3 Duration Risk as the Primary Source of Liability Uncertainty

Because LTD claims often extend over long periods, relatively small changes in termination assumptions can lead to significant differences in ultimate liability.

For example, a modest reduction in termination rates may lengthen the expected duration of disability and increase the present value of benefit payments. Conversely, improvements in recovery outcomes or vocational rehabilitation programs may reduce expected duration and lower ultimate claim costs.

This sensitivity to duration assumptions contrasts with many P&C lines where claim duration is relatively short, and severity uncertainty is driven primarily by settlement outcomes rather than by extended payment streams.

As a result, the principal source of reserving uncertainty in LTD portfolios is duration risk, not reporting emergence.

6.4 Alignment with Claim Management and Operational Practices

Tabular valuation methods also align closely with the operational realities of disability claim management.

Claims departments routinely evaluate each claimant's expected future benefit exposure based on:

- medical prognosis,
- vocational rehabilitation potential,
- claimant age and occupation, and
- policy benefit structure.

Modern claims management systems increasingly incorporate claimant-level projections of expected benefit duration. Tabular reserving methods, therefore, reflect the same conceptual framework used by claims professionals to evaluate individual claims.

Development-based reserving techniques, by contrast, rely on historical aggregate patterns that may not fully capture evolving claim management practices, rehabilitation initiatives, or changes in claimant demographics.

6.5 Integration with Discounting and Long-Duration Liability Measurement

Another advantage of tabular valuation is its natural integration with discounting for long-duration liabilities.

Because benefit payments may extend many years into the future, the time value of money becomes an important component of the liability measurement. Tabular models incorporate discounting directly within the projected cash-flow framework, allowing termination risk and interest rate assumptions to interact consistently.

Development-based methods, in contrast, often estimate undiscounted ultimate losses and apply discounting as a separate adjustment. This separation may obscure the interaction between duration risk and interest rate assumptions.

6.6 Implications for Reserving Method Selection

The analysis above does not suggest that development-based reserving methods lack value in LTD portfolios. Rather, it highlights that these methods operate indirectly through historical development patterns, whereas tabular methods model the underlying economic drivers of disability liabilities directly.

Accordingly, tabular valuation methods provide a natural primary framework for estimating LTD liabilities, particularly for mature claims and long-duration portfolios. Development-based methods may still serve a valuable role as diagnostic tools to validate early development patterns, detect emerging trends, and provide reasonableness checks.

Section 7 examines how the development-based techniques behave when applied to long-duration LTD portfolios and illustrates the circumstances under which tabular and development-based estimates may diverge.

7. Structural Challenges for Development-Based Methods in Long-Term Disability Reserving

Development-based reserving techniques—including paid loss development, incurred loss development, and the Bornhuetter–Ferguson (BF) method—are widely used in property and casualty reserving. These methods rely on the assumption that historical loss development patterns provide credible signals regarding ultimate losses.

In the context of long-duration disability insurance, however, the structural characteristics of the underlying liability introduce several challenges for development-based techniques. These challenges arise from three primary sources:

1. changes in case reserving methodology,
2. sensitivity to long-tail development factors, and
3. Operational changes affecting claim duration dynamics.

Each of these factors can weaken the statistical assumptions underlying development-based reserving methods.

7.1 Case Reserving Methodology Changes

Incurred loss development methods rely heavily on the stability and comparability of case reserves across accident years.

In the incurred development framework, ultimate losses are estimated as:

$$Ultimate = Incurred_t \times LDF_{t \to Ultimate}$$

where

$$Incurred_t = Paid_t + CaseReserves_t$$

and $LDF_{t \to Ultimate}$represents the selected loss development factor from development age to ultimate.

A key implicit assumption of this framework is that case reserves provide reasonably consistent estimates of ultimate claim cost across accident years. When this assumption holds, development patterns observed in the triangle reflect genuine claim emergence and settlement dynamics.

However, when case reserving practices change materially—for example, transitioning from incremental reserve estimates to forward-looking disabled-life projections—the comparability of incurred losses across accident years may be disrupted.

Under such circumstances:

- earlier accident years may contain case reserves that represent partial or incremental estimates of ultimate claim cost, while
- more recent accident years may incorporate claimant-level projections of future benefit payments extending to maximum benefit duration.

This shift effectively moves recognition of ultimate claim cost earlier in the claim lifecycle.

In the incurred triangle, this change may manifest as reduced subsequent development for more recent accident years. However, this reduction does not necessarily reflect an improvement in claim experience; rather, it reflects a change in the timing of reserve recognition.

Conversely, the transition period may result in apparent adverse development as older accident years adjust to the new reserving standard.

Thus, development observed in incurred triangles may represent a mixture of:

- true claim emergence,
- changes in case reserving philosophy, and
- operational adjustments to claims management practices.

When such structural shifts occur, the statistical stability required for development-based methods becomes weakened.

7.2 Tail Factor Dominance in Long-Tailed Portfolios

A second challenge arises from the influence of tail factors in long-duration portfolios.

In development-based reserving, ultimate losses are often estimated as:

$$Ultimate = Observed\ Loss \times Completion\ Factor$$

where the completion factor is the product of development factors extending from the current development age to ultimate.

For example:

$$Completion\ Factor = LDF_{12} \quad \times LDF_{24-36} \times LDF_{36-4} \times LDF_{48-60} \times TailFactor$$

For long-duration LTD claims, a large proportion of future benefit payments may occur many years after the observed development period. As a result, the completion factor—and therefore the ultimate reserve estimate—may become heavily dependent on tail assumptions rather than directly observed claim experience.

In contrast, tabular disability valuation methods estimate the present value of remaining benefit payments directly through the survival function of disability duration, allowing the liability estimate to respond immediately to changes in termination dynamics.

As accident years mature, the observed portion of losses increases, and the completion factor approaches unity. However, for long-tailed liabilities such as LTD, a substantial portion of ultimate losses may remain in the tail beyond the observed development period.

In these situations, the tail factor becomes a dominant determinant of the reserve estimate.

To illustrate, suppose the observed incurred losses at development age 60 months are $100 million. If the selected tail factor is 1.10, the ultimate loss estimate becomes:

$$Ultimate = 100M \times 1.10 = 110M$$

If the tail factor increases slightly to 1.15:

$$Ultimate = 100M \times 1.15 = 115M$$

This represents a 4.5% increase in ultimate losses resulting from a relatively small change in the tail assumption.

For long-duration disability portfolios in which claim payments may extend well beyond the triangle's development horizon, this sensitivity can become substantial.

Importantly, the tail factor in this framework represents a statistical extrapolation of historical development patterns. It does not explicitly model the underlying drivers of disability duration, such as:

- claimant recovery probabilities,
- mortality,
- vocational rehabilitation outcomes, or
- age-related termination dynamics.

Thus, development-based methods estimate the remaining liability indirectly through extrapolation rather than through explicit modelling of disability duration. Because LTD claims may continue for many years after disability onset, development triangles often observe only the early portion of the liability emergence pattern.

7.3 Structural Mismatch Between Development Patterns and Duration Risk

The ultimate cost of an LTD claim depends primarily on the duration of disability rather than on the timing of claim reporting or settlement.

If the monthly benefit payable to a claimant is denoted by B, the ultimate cost of the claim can be expressed as:

$$UltimateCost = \sum_{t=1}^{T} B \times P(\text{claim active at time } t)$$

where $P(\text{claim active at time } t)$represents the probability that the claimant remains disabled at duration t.

Termination rates governing disability duration may vary by:

- claimant age,
- diagnosis,
- duration since disability onset,
- and treatment or rehabilitation outcomes.

These termination dynamics directly determine the expected duration of benefit payments.

Development-based methods, however, observe only the historical pattern of payments and case reserve adjustments. They do not explicitly incorporate termination probabilities.

As a result, the impact of changes in termination experience may take several calendar years to emerge in development triangles.

This lag can be particularly important when claims management initiatives—such as enhanced vocational rehabilitation programs or improved return-to-work processes—alter the dynamics of disability duration.

7.4 Operational Changes and Triangle Lag

Operational changes in claims management may affect claim duration patterns more rapidly than development-based methods can detect.

Examples include:

- introduction of early intervention programs,
- enhanced vocational rehabilitation services,
- improved litigation management strategies, and
- changes in claimant eligibility or adjudication processes.

Such initiatives may reduce the expected duration of disability claims, thereby lowering ultimate claim costs.

However, development-based reserving methods rely on historical emergence patterns that may take several years to reflect these changes.

During the transition period, triangles may continue to reflect historical duration patterns rather than the updated operational environment.

In contrast, tabular cash-flow valuation models can incorporate updated termination assumptions immediately, allowing the reserve estimate to respond more directly to changes in claim management effectiveness.

7.5 Implications for Long-Duration Disability Portfolios

The challenges described above do not imply that development-based reserving techniques are inappropriate for LTD portfolios. Rather, they highlight structural limitations when such methods are applied as primary valuation tools for liabilities driven by long-duration payment streams.

In particular:

- case reserve methodology changes may impair triangle comparability,
- tail factors may dominate ultimate estimates, and
- operational changes affecting duration may take time to emerge in development patterns.

These characteristics suggest that development-based methods are best suited as diagnostic tools for monitoring experience rather than as primary drivers of ultimate liability estimates.

Tabular cash-flow valuation frameworks, by contrast, directly incorporate the economic drivers of disability liabilities—namely duration, termination probabilities, and benefit structure—and therefore provide a more structurally aligned basis for estimating long-duration LTD reserves.

8. Proposed Hybrid Reserving Framework

The analysis in the preceding sections suggests that development-based reserving methods and tabular cash-flow valuation methods capture different aspects of LTD liabilities.

Development-based methods infer ultimate losses from historical development patterns, while tabular models estimate the present value of future benefit payments based on disability duration dynamics.

Given these structural differences, this paper proposes a hierarchical reserving framework in which:

- tabular cash-flow valuation provides the primary estimate of liabilities, and
- development-based techniques serve as diagnostic tools used to validate experience patterns and identify inconsistencies.

This approach preserves the analytical strengths of both frameworks while aligning the primary liability estimate with the economic structure of LTD claims.

8.1 Primary Estimate: Claimant-Level Tabular Cash-Flow Valuation

Under the proposed framework, the primary reserve estimate is derived from claimant-level cash-flow projections.

For each claim, the reserve equals the expected present value of future benefit payments:

$$Reserve = \sum_{t=1}^{T} B_t \times P(\text{active at } t) \times v^t$$

Where:

- B_t= benefit payment at duration t
- $P(\text{active at } t)$= probability the claimant remains disabled at time t
- $v = (1 + i)^{-1}$= discount factor
- T= maximum benefit duration (often age 65)

Termination probabilities are typically derived from disability termination tables calibrated from industry experience studies.

Key segmentation variables include:

- claimant age
- duration since disability onset
- diagnostic grouping
- occupation class
- policy benefit structure

Such segmentation aligns well with well-established findings in disability research that termination rates vary materially across these dimensions.

By explicitly modelling termination dynamics, tabular valuation methods capture the principal drivers of LTD liability.

8.2 Development-Based Methods as Diagnostic Tools

Although tabular methods provide the primary estimate of reserves, development-based techniques remain valuable diagnostic tools.

Traditional development-based reserving relies on loss triangles constructed from historical claim data.

Let:

$$L_{i,j}$$

represent cumulative losses for accident year $i$at development age j.

The development factor between ages $j$and $j+1$is:

$$f_j = \frac{\sum_i L_{i,j+1}}{\sum_i L_{i,j}}$$

Ultimate losses are estimated using a chain-ladder framework:

$$Ultimate_i = L_{i,j} \times \prod_{k=j}^{n} f_k$$

where the product of development factors represents the completion factor from development age $j$to ultimate.

Development-based methods, therefore, infer ultimate losses from historical emergence patterns rather than modelling the underlying economic drivers of claim cost.

These methods remain useful for:

- identifying shifts in development patterns,
- detecting data anomalies, and
- validating consistency between case reserving and observed claim emergence.

However, their reliability depends on the stability of historical development patterns.

8.3 Tail Factor Dominance in Long-Duration Portfolios

In long-tailed LTD portfolios, development-based reserve estimates become highly sensitive to tail assumptions.

Suppose cumulative incurred losses for an accident year at development age $j$are $L_{i,j}$. The ultimate loss estimate is:

$$Ultimate_i = L_{i,j} \times CompletionFactor_j$$

where

$$CompletionFactor_j = \prod_{k=j}^{n} f_k$$

If the remaining development beyond age $j$is represented by a tail factor TF, then:

$$CompletionFactor_j = \prod_{k=j}^{m} f_k \times TF$$

where m is the final observed development period.

For long-duration liabilities, a significant portion of ultimate losses may lie beyond the observed development window.

Consider the following example:

Observed incurred losses at development age 60 months:

$$L_{i,60} = 100M$$

Selected tail factor:

$$TF = 1.12$$

Ultimate estimate:

$$Ultimate = 100M \times 1.12 = 112M$$

If the tail factor increases slightly to 1.16:

$$Ultimate = 100M \times 1.16 = 116M$$

This small change in tail selection produces a 3.6% increase in ultimate losses.

For portfolios with liabilities exceeding $100M, such sensitivity can materially affect reserve estimates.

Importantly, the tail factor is typically derived from historical development patterns rather than from explicit modelling of disability duration.

8.4 Structural Mismatch Between Triangles and Duration Risk

The ultimate cost of an LTD claim is determined primarily by the duration of disability.

If the monthly benefit payment is B, the expected cost of the claim can be expressed as:

$$ExpectedCost = \sum_{t=1}^{T} B \times S(t)$$

where:

$$S(t) = P(\text{claim remains active at duration } t)$$

represents the disability survival function.

Termination probabilities determine how quickly the survival function declines.

A modest reduction in termination rates lengthens the expected duration of disability and increases the expected present value of benefits.

Development-based reserving methods do not explicitly incorporate termination probabilities. Instead, they observe the aggregate pattern of claim payments and case reserve adjustments over time.

Consequently, the relationship between development factors and disability duration is indirect.

Changes in termination dynamics may take several calendar years to emerge in development triangles.

This creates a structural lag between:

- operational changes affecting disability duration, and
- reserve estimates derived from development-based techniques.

Tabular valuation models, by contrast, incorporate termination assumptions directly and therefore respond immediately to changes in duration dynamics.

8.5 Numerical Illustration: Identical Development Patterns with Different Duration Risk

To illustrate the structural limitations of development-based reserving for long-duration disability liabilities, consider two hypothetical LTD portfolios with identical historical payment patterns but different underlying termination dynamics.

The following simplified example illustrates how development triangles may produce identical reserve estimates despite materially different underlying disability duration risk.

Assume both portfolios contain 1,000 open claims with identical historical payment experience over the first three development years.

Observed Paid Development

Development Year	Cumulative Paid Losses
Year 1	$20M
Year 2	$40M
Year 3	$55M

The corresponding paid development factors are:

$$f_{1-2} = \frac{40}{20} = 2.00$$

$$f_{2-3} = \frac{55}{40} = 1.375$$

Suppose historical experience suggests the following additional development factors:

Development Factors

3-4	1.15
4-5	1.10
Tail	1.08

The completion factor from development age 3 to ultimate becomes:

$$CompletionFactor = 1.15 \times 1.10 \times 1.08 = 1.366$$

Ultimate losses estimated using the chain ladder method are therefore:

$$Ultimate = 55M \times 1.366 = 75.1M$$

Under the development-based framework, both portfolios would therefore produce an identical reserve estimate.

Portfolio A: Higher Termination Rates

Assume Portfolio A has an annual termination probability of 18%.

Under a tabular valuation model, the expected duration of disability is relatively short, producing a projected ultimate liability of approximately:

$$Ultimate_A \approx 72M$$

Portfolio B: Lower Termination Rates

Now assume Portfolio B has an annual termination probability of 14%, reflecting a population with more persistent disabilities.

Under the tabular valuation framework, the expected duration of disability increases materially. The projected ultimate liability becomes:

$$Ultimate_B \approx 88M$$

Implications

Both portfolios produce identical development triangles over the first three years, yet their ultimate liabilities differ by approximately $16 million, or more than 20% of the reserve estimate.

The difference arises because the ultimate liability of an LTD claim depends primarily on future duration dynamics, which are governed by termination probabilities.

Development-based methods infer ultimate losses from historical payment emergence patterns. However, these patterns may not uniquely identify the underlying duration risk driving the liability.

In contrast, tabular valuation methods explicitly incorporate termination dynamics, allowing reserve estimates to respond directly to changes in disability duration.

As noted, the above example illustrates that development-based methods may produce similar reserve estimates for portfolios whose true economic liabilities differ materially. As a result, triangles alone may not fully capture the risk profile of long-duration disability portfolios.

Interpretation for Reserving Practice

The purpose of this example is not to suggest that development-based methods lack value. Rather, it demonstrates that triangles observe the timing of payments, while the economic liability of LTD claims is driven by the future duration of disability.

When the experience of termination shifts due to demographic changes, rehabilitation programs, or claim management initiatives, tabular valuation methods can incorporate these changes immediately. Development-based methods may require several years of observed experience before the impact becomes visible in development patterns.

For this reason, development-based techniques are best interpreted as diagnostic indicators of experience, while tabular cash-flow projections provide a more direct measure of the underlying liability.

8.6 Stochastic Implications of Duration Risk in LTD Reserving

While the preceding sections demonstrate structural differences between tabular and development-based reserving frameworks, further insight can be obtained by examining the sources of uncertainty in LTD liabilities using stochastic analysis.

In development-based reserving models, variability in ultimate losses arises primarily from uncertainty in development factors. In tabular disability valuation models, uncertainty arises from variation in disability duration, governed by termination probabilities.

Understanding the relative magnitude of these sources of variability is important when selecting an appropriate reserving framework.

8.6.1 Variance in Development-Based Reserving

In a standard chain-ladder framework, ultimate losses for accident year i are estimated as:

$$Ultimate_i = L_{i,j} \times \prod_{k=j}^{n} f_k$$

where $f_k$represents the development factor between development periods.

Under stochastic reserving models such as Mack's model, the variance of the ultimate estimate is approximately:

$$Var(Ultimate_i) \approx L_{i,j}^2 \times \sum_{k=j}^{n} Var(f_k)$$

This formulation implies that reserve uncertainty is driven primarily by variability in the selected development factors.

In practice, development factor variability tends to decline as accident years mature, since a larger proportion of ultimate losses has already emerged.

8.6.2 Variance in Tabular LTD Valuation

In a tabular disability valuation model, the liability for a claim is determined by the expected present value of future benefit payments:

$$Reserve = \sum_{t=1}^{T} B_t \times S(t) \times v^t$$

where $S(t)$represents the probability that the claimant remains disabled at duration t.

If termination probabilities are denoted by q_t, the survival probability is:

$$S(t) = \prod_{k=1}^{t} (1 - q_k)$$

Uncertainty in termination rates introduces variability in the survival function, which in turn affects the present value of future benefit payments.

The variance of the liability estimate therefore depends on the variability of the termination assumptions:

$$Var(Reserve) \approx \sum_{t=1}^{T} B_t^2 \times Var(S(t)) \times v^{2t}$$

Because LTD claims often extend over many years, small variations in termination probabilities accumulate over multiple durations.

8.6.3 Illustration of Duration Sensitivity

Consider a simplified example where:

- monthly benefit = $2,500
- expected duration = 5 years
- discount rate = 4%

If the annual termination probability is 15%, the expected duration of disability is approximately:

$$E[Duration] \approx \frac{1}{q} = \frac{1}{0.15} \approx 6.7 \text{ years}$$

If termination decreases to 13%, expected duration increases to:

$$E[Duration] \approx \frac{1}{0.13} \approx 7.7 \text{ years}$$

This represents an increase in expected claim duration of roughly 15%, which directly increases the present value of future benefit payments.

In contrast, development-based models may not immediately capture this change, as it must first appear in observed payment patterns.

8.6.4 Implications for Reserving Risk

The stochastic analysis suggests that, for long-duration disability portfolios, reserve uncertainty is driven primarily by termination dynamics rather than by variability in development factors.

This observation has several implications:

1. Models that explicitly incorporate termination probabilities may better capture the primary drivers of reserve risk.
2. Development-based models may understate the sensitivity of reserve estimates to changes in disability duration.
3. Diagnostic use of development triangles should be supplemented by sensitivity testing of termination assumptions.

8.6.5 Role of Stochastic Diagnostics

Under the hybrid framework proposed in this paper, stochastic analysis can serve as an additional diagnostic tool.

Sensitivity testing of termination assumptions, mortality, and discount rates can help quantify the range of possible liability outcomes.

Such testing may include:

- scenario analysis of termination rate shifts,
- stochastic simulation of disability duration, and
- stress testing of tail liabilities.

These diagnostics complement development-based monitoring tools, providing a more comprehensive view of the uncertainty in LTD portfolios' reserves.

8.7 Reconciliation Principle

When case reserves incorporate forward-looking projections of ultimate claim costs, development-based estimates may result in apparent bulk development on known claims. This can arise when the valuation framework does not explicitly reconcile the interaction between claimant-level case reserving and aggregate development techniques.

A fundamental distinction between tabular valuation and development-based reserving lies in the level of analysis at which liabilities are estimated.

Under tabular valuation, liabilities are estimated at the individual claimant level. For each claim, expected future benefit payments are projected using assumptions regarding termination probabilities, mortality, benefit structure, and discounting. The resulting present value of expected future payments represents the case reserve for that individual claim.

Formally, the reserve for claim $i$can be expressed as:

$$Reserve_i = \sum_{t=1}^{T_i} B_{i,t} \times P_i(\text{active at } t) \times v^t$$

where:

- $B_{i,t}$represents the benefit payable for claimant $i$at duration t,
- $P_i(\text{active at } t)$represents the probability that the claimant remains disabled at duration t,
- $v = (1+i)^{-1}$is the discount factor, and
- $T_i$represents the maximum benefit duration applicable to the claim.

The total liability is then obtained by aggregating across all open claims:

$$TotalReserve = \sum_{i=1}^{N} Reserv\, e_i$$

This approach represents a bottom-up valuation framework in which the aggregate reserve equals the sum of claimant-specific projections.

Development-based methods operate differently. Paid or incurred loss triangles estimate ultimate losses on a bulk basis, using development factors derived from historical aggregate data:

$$Ultimate_i = L_{i,j} \times \prod_{k=j}^{n} f_k$$

where $L_{i,j}$represents cumulative losses for accident year $i$at development age j, and the product of development factors represents the completion factor to ultimate.

This represents a top-down extrapolation, where ultimate liabilities are inferred from historical development patterns observed in aggregate experience.

Interaction with Case Reserve Strengthening

When case-reserving practices evolve from incremental estimates to forward-looking claimant-level projections, the timing of reserve recognition shifts. Case reserves may increase materially because the full expected duration of future benefit payments is recognized earlier in the claim lifecycle.

If development-based reserving methods continue to apply historical completion factors calibrated under earlier reserving practices, the resulting estimates may produce apparent bulk development on known claims.

This occurs because historical development factors implicitly assume that case reserves represent only partial estimates of ultimate claim cost. When case reserves are strengthened through claimant-level projections, this assumption may no longer hold.

Applying unchanged development factors to strengthened case reserves may therefore lead to an overstatement of bulk IBNR, as the development framework anticipates reserve emergence that has already been recognized within the case reserves.

Risk of Double Counting

Under these circumstances, the total reserve can be expressed as:

$$TotalReserve = CaseReserves + BulkIBNR$$

If case reserves already incorporate projections of ultimate benefit payments derived from tabular valuation, the remaining bulk reserve should represent only:

- claims that have occurred but have not yet been reported, and
- residual uncertainty not captured within claimant-level projections.

If development factors continue to reflect historical levels of case reserve adequacy, the resulting bulk IBNR may inadvertently incorporate uncertainty already reflected in the strengthened case reserves. This can result in a form of double counting, where both the tabular case reserves and the development-based IBNR include allowances for the same underlying uncertainty.

Importance of Methodological Alignment

In practice, many LTD portfolios are valued within broader P&C reserving environments where development-based techniques are widely used. While these methods are well-suited for many P&C lines of business, their application to LTD liabilities requires careful consideration of the underlying valuation framework.

In the author's experience, development-based techniques are sometimes applied to LTD portfolios without fully considering the interaction between claimant-level tabular projections and aggregate development assumptions. When this occurs, development factors may be applied mechanically to incurred losses without adjusting for the strengthened case reserve methodology.

The reconciliation principle proposed in this paper emphasizes that development-based diagnostics should be interpreted within the context of the underlying tabular valuation framework. Explicit reconciliation between the two approaches helps ensure that reserve estimates remain internally consistent and that improvements in case reserving practices do not inadvertently inflate aggregate reserve estimates.

8.8 Practical Implementation

The hybrid framework proposed in this paper can be implemented within existing actuarial valuation processes while preserving familiar diagnostic tools used in P&C reserving practice.

Under this framework, reserving responsibilities are separated into two complementary layers: a primary liability estimation framework and a diagnostic validation framework.

Primary Liability Estimate

The primary reserve estimate is derived from claimant-level tabular cash-flow projections. Each claim is evaluated individually, with expected future benefit payments projected until recovery, termination, or the maximum benefit age.

This projection incorporates:

- segmentation by claimant age, disability duration, and diagnostic category,
- termination and mortality assumptions derived from industry experience studies,
- explicit modelling of benefit structures and offsets, and
- discounting of future benefit payments to reflect the time value of money.

The resulting present value estimates represent the best estimate of ultimate claim costs based on the underlying economic drivers of disability liabilities.

Because this framework operates at the claimant level, it directly captures the impact of changes in:

- termination experience,
- claim management practices,
- rehabilitation outcomes, and
- demographic shifts in the insured population.

Diagnostic Framework

Development-based methods continue to play an important role as diagnostic tools for monitoring experience and validating reserve adequacy.

Within the hybrid framework, development-based techniques may include:

- paid loss development triangles,
- incurred loss development triangles,
- Bornhuetter–Ferguson estimates for immature accident years, and
- frequency–severity diagnostics.

These tools provide valuable insights into historical patterns of claim development and can help identify emerging shifts in experience.

However, their role is interpretive rather than determinative. Development patterns should be evaluated in conjunction with the underlying tabular projections rather than serving as the primary driver of reserve estimates.

Monitoring Consistency Between Frameworks

A key operational step in implementing the hybrid framework is the ongoing monitoring of consistency between the tabular reserve estimate and development-based diagnostics.

Significant divergence between the two approaches should trigger an investigation into potential causes, including:

- changes in termination experience,
- shifts in case reserving practices,
- operational changes in claims management, or
- data quality issues affecting triangle construction.

Through this process, development-based techniques serve as a validation mechanism that enhances governance and transparency without overriding the structurally appropriate tabular valuation framework.

Role of Triangles in the Hybrid Framework

Within this structure, development triangles remain valuable tools for:

- monitoring early development patterns,
- validating claims emergence trends, and
- identifying anomalies in historical data.

However, triangles primarily serve as experience-monitoring tools rather than as primary valuation engines for long-duration LTD liabilities.

This hierarchy preserves the strengths of traditional P&C reserving diagnostics while ensuring that the primary liability estimate remains aligned with the duration-driven nature of disability insurance risk.

Governance and Professional Competence

A key governance implication of this framework is the need to ensure that actuaries responsible for LTD reserving have a sufficient understanding of both reserving paradigms.

Actuaries performing LTD valuations should therefore be familiar with:

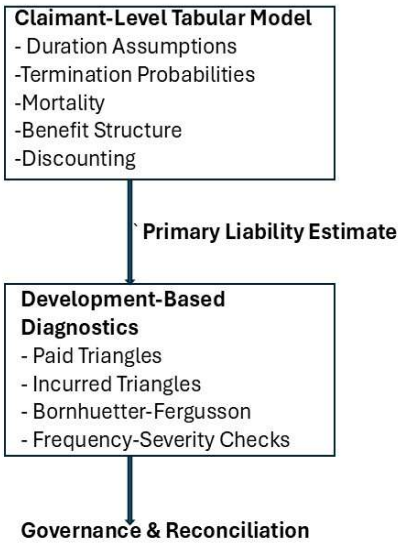
- tabular disability valuation techniques
- disability termination studies
- claimant-level cash-flow modelling
- development-based reserving diagnostics

This cross-disciplinary competence is particularly important when LTD portfolios are valued within organizations whose actuarial practice is primarily rooted in property and casualty reserving methodologies.

Ensuring that both perspectives are incorporated into the reserving framework improves:

- methodological consistency
- reserve transparency
- and the reliability of liability estimates for long-duration disability portfolios.

Liability Valuation Framework Diagram



9. Governance

The analysis presented in this paper has implications not only for actuarial methodology but also for governance and professional practice in the valuation of long-duration disability liabilities.

9.1 Implications for Reserving Practice

Long-Term Disability insurance sits at the intersection of property and casualty reserving techniques and life and health disability valuation frameworks. As a result, actuaries responsible for reserving LTD portfolios must often draw upon methodologies and experience studies traditionally associated with different actuarial practice areas.

Development-based reserving techniques, including paid and incurred loss triangles and Bornhuetter–Ferguson methods, are foundational tools within property and casualty actuarial practice. These methods are well-suited to many lines of business where claim settlement patterns follow relatively stable development paths.

However, the valuation of LTD liabilities requires explicit consideration of the duration-driven nature of disability risk, which is typically modelled using tabular disability valuation techniques.

For this reason, actuaries performing LTD reserving should possess a working understanding of both approaches.

Actuaries responsible for LTD liability valuation should be able to:

- interpret claimant-level tabular projections of future benefit payments
- understand termination and disability survival assumptions derived from experience studies
- evaluate how case reserves incorporate projected disability durations
- reconcile claimant-level reserve projections with aggregate development diagnostics

Where development-based reserving techniques are applied without explicit consideration of the tabular valuation framework underlying disability liabilities, there is a risk that reserve estimates may be influenced more by historical development assumptions than by the economic drivers of disability duration.

Ensuring that both perspectives are incorporated into the reserving process improves the robustness of liability estimates and strengthens governance over long-duration disability portfolios.

From a professional practice perspective, this suggests that actuarial oversight of LTD portfolios may benefit from cross-disciplinary familiarity with both P&C reserving and disability valuation techniques.

Such integration helps ensure that reserving frameworks remain aligned with the underlying risk structure of the insurer being evaluated. This observation is consistent with broader actuarial standards emphasizing that the selection of methods should reflect the nature of the underlying liability and the characteristics of the available data.

9.2 Implications for Actuarial Practice

First, development-based reserving techniques should be interpreted within the context of the underlying liability structure. For LTD claims, where the ultimate cost is driven primarily by disability duration, tabular cash-flow models provide a direct representation of the expected liability.

Second, development-based techniques remain valuable diagnostic tools. Paid and incurred loss triangles provide useful insight into historical claim emergence patterns and may help identify anomalies in experience. However, their role may be better understood as supporting diagnostics rather than as primary valuation engines.

Third, reserving governance for LTD portfolios may benefit from cross-disciplinary actuarial expertise. Because LTD liabilities exhibit characteristics associated with both property and casualty and life and health insurance products, reserving frameworks may benefit from incorporating elements of both actuarial practice areas.

Finally, the reconciliation between claimant-level case reserves and bulk development-based estimates is an important component of reserve governance. Explicit reconciliation procedures can help reduce the risk of double-counting uncertainty and improve transparency in liability estimation.

9.3 Areas for Future Research

Several areas may warrant further research within the actuarial community.

First, empirical analysis comparing the predictive accuracy of tabular disability valuation models and development-based reserving techniques for LTD portfolios could provide valuable insight into the relative strengths of each framework.

Second, stochastic reserving approaches that explicitly incorporate uncertainty in disability termination rates may offer a more comprehensive representation of reserve risk than models that rely solely on variability in development factors.

Third, further research into hybrid reserving frameworks integrating claimant-level projections with aggregate development diagnostics may help refine best practices for long-duration disability portfolios.

Finally, as claims management practices continue to evolve through rehabilitation programs, return-to-work initiatives, and advances in medical treatment, ongoing monitoring of disability duration dynamics will remain an important component of actuarial analysis.

10. Conclusion

Long-Term Disability insurance presents reserving challenges that differ materially from those encountered in most traditional property and casualty lines of business. While development-based reserving techniques such as loss development factors, incurred triangles, and Bornhuetter–Ferguson methods are well-established in P&C practice, their suitability depends on the structural characteristics of the underlying liabilities.

The analysis presented in this paper demonstrates that LTD liabilities are fundamentally duration-driven obligations, where the ultimate claim cost depends primarily on the expected duration of disability and the associated stream of future benefit payments. In this context, the key drivers of reserve uncertainty arise from termination probabilities, mortality, and benefit structures rather than from claim reporting or settlement patterns.

Development-based reserving methods infer ultimate losses from historical emergence patterns. For many lines of business, this approach provides a reliable and efficient framework for estimating unpaid claims. However, when applied to long-duration disability liabilities, these techniques may encounter structural limitations. In particular:

- Development triangles may become sensitive to tail factors when large portions of the liability lie beyond the observed development horizon
- Changes in case reserving methodology can affect the comparability of incurred loss triangles
- Development patterns may respond slowly to operational changes affecting disability duration

The numerical and stochastic illustrations presented in this paper demonstrate that two LTD portfolios with identical historical development patterns may nonetheless produce materially different ultimate liabilities if their termination dynamics differ. This result highlights an important limitation of development-based techniques: triangles observe the timing of payments, while the economic liability of LTD claims is driven by future disability duration.

To address these structural differences, this paper proposes a hybrid reserving framework in which tabular disability valuation methods provide the primary estimate of liabilities, while development-based techniques serve as diagnostic tools to monitor experience and validate reserve adequacy.

Under this framework:

- claimant-level tabular projections capture the economic drivers of disability liabilities, including termination dynamics and benefit structures
- development-based diagnostics provide insight into historical claim emergence patterns and help identify anomalies in experience
- reconciliation procedures ensure that case reserves and bulk development assumptions

remain internally consistent

This hierarchy preserves the strengths of traditional P&C reserving diagnostics while aligning the primary liability estimate with the duration-driven nature of disability insurance risk. It clarifies their appropriate role within the valuation hierarchy for long-duration disability liabilities.

The analysis also highlights important governance implications. Because LTD reserving draws upon both P&C reserving techniques and disability valuation methodologies traditionally associated with life and health insurance, actuaries responsible for these portfolios benefit from familiarity with both frameworks. Cross-disciplinary understanding strengthens the ability to interpret development diagnostics, evaluate claimant-level projections, and ensure that reserving assumptions remain aligned with the insurer's underlying economic characteristics.

The intent of this paper is not to suggest that development-based reserving methods lack value. Rather, it emphasizes that method selection should reflect the structural characteristics of the liabilities being evaluated. For long-duration disability portfolios, integrating tabular valuation methods with development-based diagnostics provides a more comprehensive and robust framework for estimating policy liabilities.

As LTD portfolios continue to evolve alongside advances in claims management, rehabilitation practices, and actuarial modelling techniques, further research into hybrid reserving approaches may help refine best practices for valuing long-duration disability insurance liabilities.

While both tabular and development-based methods may be applied within accepted actuarial practice, long-duration disability liabilities are fundamentally survival-contingent streams of future payments whose economic value depends on claim duration, benefit timing, and the time value of money. Methods that explicitly model these structural elements naturally align with modern discounted cash-flow valuation frameworks such as IFRS 17. Recognizing this structural relationship may help improve the transparency and interpretability of disability reserve estimates and support continued confidence in actuarial analysis in long-duration claim environments.

The author welcomes comments and discussion from members of the Canadian Institute of Actuaries on the methodology and observations presented in this paper.

11. Discussion Questions

This paper explores the interaction between tabular disability valuation methods and development-based reserving techniques in the context of long-duration LTD liabilities. The author welcomes discussion from the actuarial community on several related topics.

1. **Role of Tabular Valuation in LTD Reserving**
   Should claimant-level tabular cash-flow models be considered the primary valuation framework for long-duration LTD portfolios, with development triangles used primarily for diagnostic purposes?

2. **Interpretation of Development Patterns**
   How should actuaries interpret development patterns in incurred or paid triangles when case reserves incorporate forward-looking claimant-level projections?

3. **Tail Factor Selection in LTD Portfolios**
   To what extent do tail factors used in development-based reserving adequately reflect disability duration dynamics?

4. **Cross-Disciplinary Actuarial Practice**
   What level of familiarity with disability termination modelling should be expected of actuaries responsible for reserving LTD portfolios within P&C environments?

5. **Governance and Reserving Oversight**
   What governance frameworks best ensure that reserving methodologies remain aligned with the structural characteristics of long-duration insurance liabilities?

The author hopes these questions encourage further dialogue within the actuarial profession regarding best practices for reserving long-duration disability insurance liabilities.

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Appendix – Consistency of Tabular Disability Valuation with Discounted Cash Flow Measurement under IFRS 17

While the primary focus of this paper is the methodological application of tabular reserving techniques in long-duration disability environments, financial reporting frameworks such as IFRS 17 require insurance liabilities to be measured on a discounted cash-flow basis.

The tabular methodology already incorporates the structural elements necessary for such valuation—namely, claim survival probabilities, benefit payment timing, and discounting. Development-based reserving approaches commonly used in practice, however, are generally derived from undiscounted historical development patterns.

The purpose of this appendix is therefore to clarify how disability claim projections produced by tabular methods interact with financial reporting requirements under IFRS 17, and to illustrate why the tabular framework aligns naturally with discounted liability measurement.

A1. Financial Reporting Requirements

Under IFRS 17, insurance liabilities are measured as the present value of expected future cash flows associated with insurance obligations.

For incurred claims, the measurement of the Liability for Incurred Claims (LIC) typically includes:

- expected future benefit payments
- explicit discounting reflecting the time value of money
- a risk adjustment for non-financial risk

Conceptually:

$$\textit{Insurance Liability} = \textit{Present Value of Future Cash Flow} + \textit{Risk Adjustment}$$

Accordingly, insurers must project future claim payments and their expected timing to determine the present value of claim liabilities.

This framework naturally aligns with actuarial models that explicitly generate future claim cash flows.

A2. Tabular LTD Reserving Framework

The tabular approach has historically been used to value disability claims because LTD liabilities are fundamentally survival-contingent benefit streams.

Under the tabular framework, expected future payments are determined using:

- benefit payment levels
- claim continuation probabilities
- payment timing
- discounting assumptions

A simplified representation of the tabular reserve is:

$$Reserve = \sum_{t=1}^{n} B_t \times S_t \times v^t$$

Where:

B_t= benefit payment expected at time t

S_t= probability the claim remains active at time t

v^t= discount factor reflecting interest

This formulation explicitly captures:

- claim survival probabilities
- payment timing
- the time value of money

As a result, the tabular reserve represents the present value of expected future claim payments, which is conceptually consistent with the discounted cash flow framework used in modern insurance liability valuation.

A3. Incorporation of Financial Reporting Yield Curves

The discounting component in a tabular valuation need not rely on a fixed actuarial interest assumption. Discount factors may instead be derived from the yield curves used in financial reporting.

In practice, this can be achieved by applying the appropriate financial reporting discount rates directly within the tabular calculation.

For example:

$$Reserve = \sum_{t=1}^{n} B_t \times S_t \times v_t$$

Where:

v_t represents discount factors derived from the relevant financial reporting yield curve.

In this formulation, the tabular model directly produces discounted future cash flows consistent with the valuation framework required under IFRS.

A4. Development-Based Reserving Methods

Development methods estimate ultimate claims using historical development patterns derived from cumulative claims triangles.

Common approaches include:

- chain ladder development factors
- Bornhuetter-Ferguson techniques
- loss development factor methods

These approaches generally estimate ultimate claim costs without discounting.

While development triangles provide useful insights regarding claim emergence and historical development patterns, the resulting estimates typically do not explicitly model:

- future payment timing
- claim survival probabilities
- interest discounting

As a result, development-based estimates generally represent undiscounted ultimate claim costs rather than the present value of expected future claim obligations.

A5. Practical Application Under IFRS

In practice, many insurers separate the actuarial claim projection from the financial reporting valuation required under IFRS 17.

A simplified workflow may include:

1. Generation of projected claim cash flows using a disability claim model (often tabular).
2. Application of financial reporting discount curves to those projected payments.
3. Addition of a risk adjustment for non-financial risk.

Within this structure, the tabular model effectively functions as a cash-flow generator, while financial reporting determines the valuation of those cash flows.

A6. Illustration – Tabular Projection vs Development Estimate

The following simplified example illustrates the structural difference between tabular disability valuation and development-based reserving.

Assume a disabled claimant receives an annual benefit of $10,000, and the expected claim continuation follows the pattern below.

Year	Probability Claim Continues	Expected Payment
1	100%	10,000
2	90%	9,000
3	80%	8,000
4	70%	7,000
5	60%	6,000

Total expected undiscounted payments = $40,000

Assume a discount rate of 4%.

Year	Expected Payment	Discount Factor	Present Value
1	10,000	0.962	9,620
2	9,000	0.925	8,325
3	8,000	0.889	7,112
4	7,000	0.855	5,985
5	6,000	0.822	4,932

Total present value reserve = $35,974

This represents the liability produced by a tabular disability valuation.

The reserve explicitly reflects:

- claim survival
- payment timing
- interest discounting

Now consider the same experience viewed through a paid claims development triangle.

Accident Year	12 Months	24 Months	36 Months	48 Months	60 Months
AY1	10,000	19,000	27,000	34,000	40,000

A development approach would estimate the Ultimate claim cost ≈ $40,000

However, this estimate contains no explicit information regarding the timing of the remaining payments.

To convert the development estimate into a discounted liability consistent with financial reporting requirements, additional assumptions must be introduced regarding:

- payment timing
- claim duration patterns
- interest discounting

In effect, these steps reconstruct the cash-flow structure already present within the tabular framework.

A7. Why Development Methods May Appear to Perform Adequately

Development triangles may appear to produce reasonable estimates in disability environments because historical development patterns implicitly reflect the combined effects of:

- recovery rates
- mortality
- benefit duration limits
- claim settlement patterns

Under relatively stable conditions, these historical patterns may approximate ultimate claim costs.

However, this approximation is indirect and does not explicitly represent the structural drivers of disability claim liabilities.

When financial reporting frameworks require explicit modelling of payment timing and discounting, differences between development-based estimates and tabular valuations may become more apparent.

A8. Implications for Long-Duration Disability Reserving

The distinction between the methodologies becomes particularly relevant in LTD reserving because:

- claim durations often extend over many years
- The timing of benefit payments is relatively predictable
- The impact of discounting can be material

In such environments, tabular reserving frameworks align naturally with discounted cash flow valuation approaches such as those required under IFRS 17, while development methods typically require additional modelling steps to produce equivalent valuations.

A9. Appendix Summary

Key observations include:

• Tabular disability valuation is structurally consistent with discounted cash-flow measurement. The tabular framework explicitly models claim survival probabilities, benefit payment timing, and discounting, thereby producing the present value of expected future claim payments.

• Discounting within a tabular framework can incorporate financial reporting yield curves. Rather than relying on a fixed actuarial interest assumption, discount factors can be derived directly from the market-based yield curves used for financial reporting under IFRS 17.

• Development-based reserving methods estimate undiscounted ultimate claim costs. Additional assumptions regarding payment timing and discounting are therefore typically required to translate development estimates into discounted liability measurements.

Key Structural Insight

Long-Term Disability claims represent survival-contingent streams of future benefit payments.

Valuation frameworks that explicitly model claim survival, benefit timing, and discounting—such as tabular disability methods—naturally produce the present value of expected future payments.

Development-based reserving approaches, by contrast, generally estimate undiscounted ultimate claim costs and require additional assumptions regarding payment timing and discounting to produce a valuation consistent with IFRS 17.