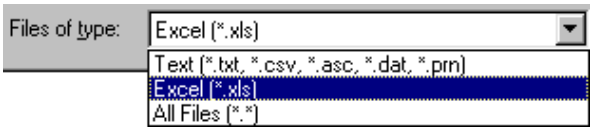
What's New! ProVal®

ProVal version 2.22 **November 2004**

ProVal version 2.22 introduces a whole new **data import** experience**,** explicit **REA post-decrement death benefit** payment forms**,** and optimal values for **Canadian Solvency Liability** calculations. You'll find details about these and other enhancements below.

Census Data

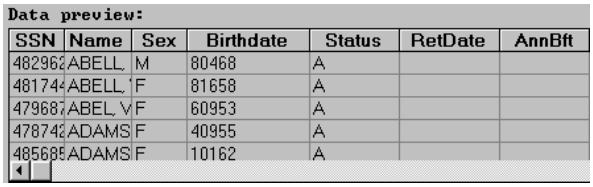
- The Import Data command is now a step-by-step wizard that lets you:
  - Import directly from Excel files. This eliminates the need to save *.xls files as *.csv files. You can still import fixed width and delimited text files.



  - Choose the delimiter character for delimited files.

  - Include field names in the first row of the import file (Excel and delimited files only). ProVal will match the field names in the file against the field names in the data dictionary and add new ones that don't exist.

  - See a "live" preview of the data while you're importing it.

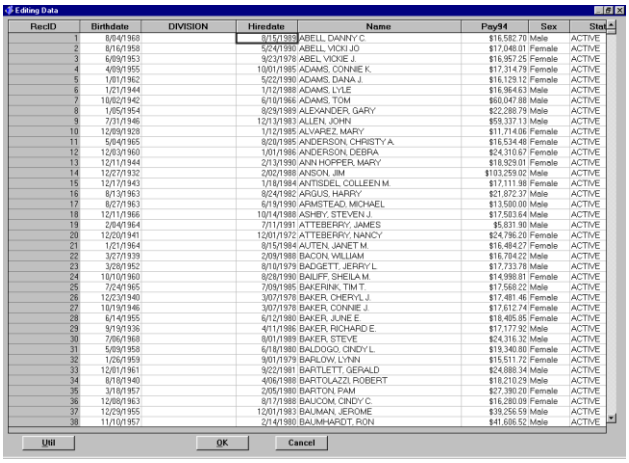


  - Skip setting up a record layout or data dictionary before importing. The wizard will guess at information you haven't provided such as the field types, date formats, column breakpoints for fixed width files, etc. If you wish to provide a record layout, you can simply load it in the first step of the wizard.

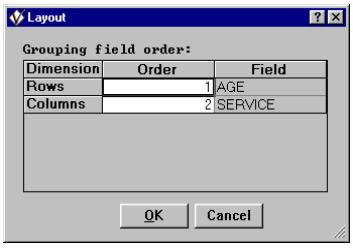
    In addition, you can provide an optional import "schema file" containing record layout and data dictionary information. If you have your own census management system, you might consider enhancing it to produce schema files.

    See Data Import: Schema Files, page 6

- Spreadsheet Edit now lets you maximize the data window to utilize your full screen.

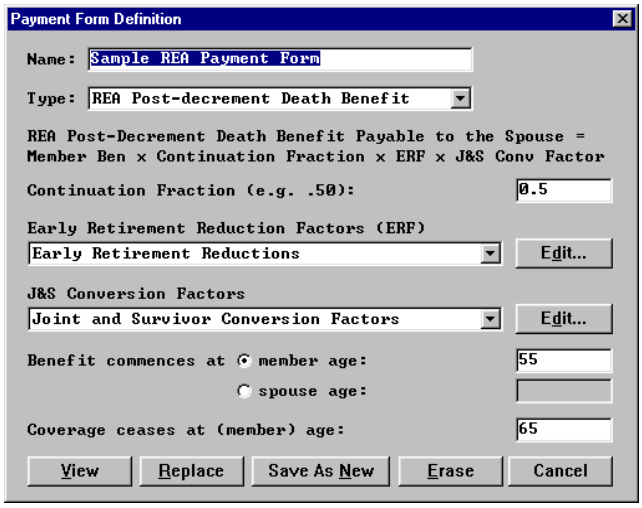


- Frequency Tables now let you explicitly arrange the rows and columns of the table.



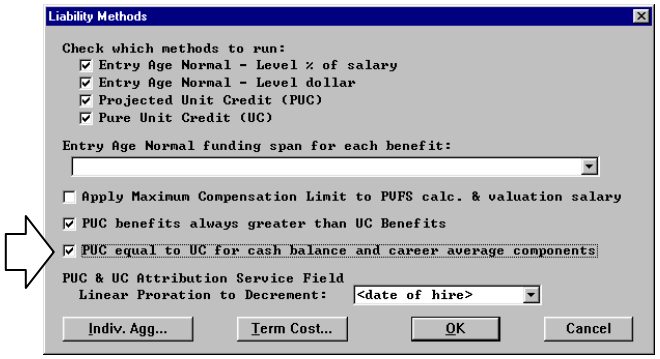
Pension Plans

- Payment forms for explicitly valuing REA post-decrement death benefits have been added to Census Specifications (for current inactives) and Payment Form Definitions (for current actives).



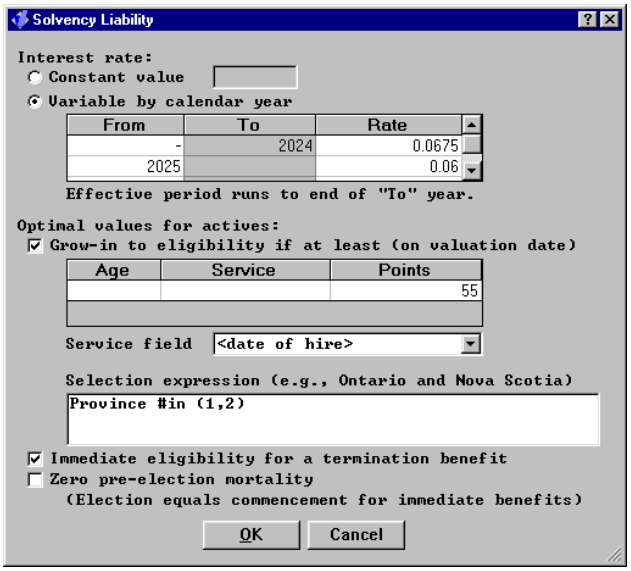
See REA Post-Decrement Death Benefits, page 8

- In valuation assumptions, a new option lets you set "PUC equal to UC for cash balance and career average components" in compliance with the FASB's announcement regarding cash balance plans (EITF Issue No. 03-4).



Canadian Pension Plans

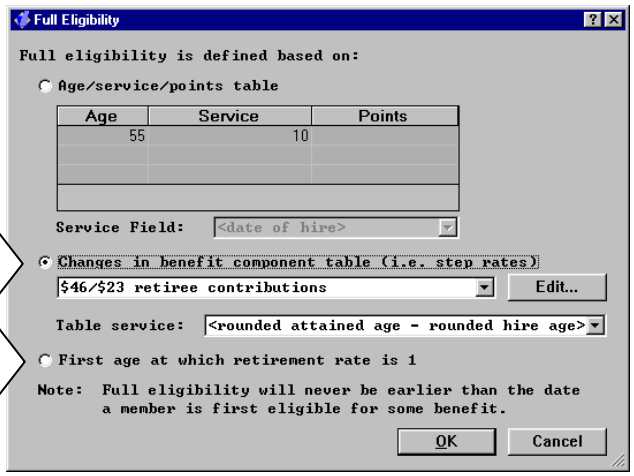
- The Canadian Solvency Liability for actives has been converted from a unit credit liability to an optimal value calculation (note that this will change results). In addition, the following new Solvency Liability options have been added to Valuation Assumptions:
  - Calendar-year based interest rate, independent from the valuation basis.
  - Grow-in rights for members who are employed in Nova Scotia or Ontario (through a selection expression) and who have at least 55 points (or user-specified eligibility criteria) on the valuation date.
  - Immediate eligibility for termination benefits
  - Zero pre-election mortality (election equals commencement for immediate benefits.)



See Canadian Solvency Liability, page 13

OPEB Plans

- The Plan's Full Eligibility can now be defined in two new ways:
  - Last change in a step rate table. Note that this was moved from Benefit Definitions, where it only controlled Full Eligibility for APBO attribution purposes.
  - Earliest age at which the retirement rate is 100%. You might select this option if all benefits are attributed using "linear proration to decrement".



- You can now specify the service field used for step rate tables for Full Eligibility. If a field is selected, it will be used consistently both to

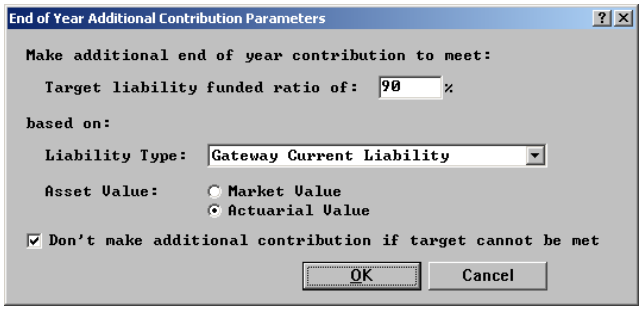
determine full eligibilities and to prorate liabilities. This is in contrast to the default which is to determine full eligibility based on rounded attained age minus rounded hire age, but then calculate proration factors based on exact service.

All Plans

- You can now specify the service field used for tables in Benefit Formula Components and Accrual Basis Components
- In Valuation Assumptions, a new option lets you treat mortality as a rate (i.e., adjust it for competing decrements at each age) while treating all other decrements as probabilities.

Deterministic & Stochastic Forecasts

- In Asset & Funding Policies, a new option lets you define an end of year additional contribution policy to increase contributions when the funded status would otherwise fall below some level (e.g., below 90% CL funded ratio).

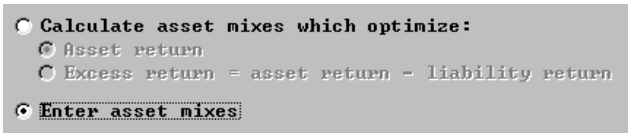


- In addition, you can limit contributions to a percent of payroll (subject to minimum requirements) to cap contributions if the contribution policy would otherwise be above that level.

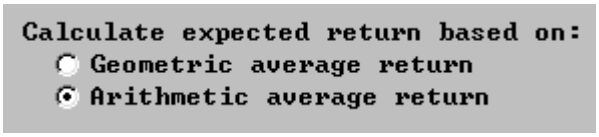
See Contribution Policies, page 10

Efficient Frontiers

- You can now import efficient frontier mixes calculated from another source, for example, the Michaud re-sampled efficient frontier.

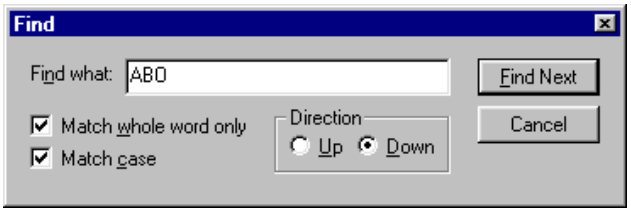


- You can now choose to populate expected returns from simulated results (including imported Capital Market Simulations) based on an arithmetic average. Previously a geometric average was automatically used.

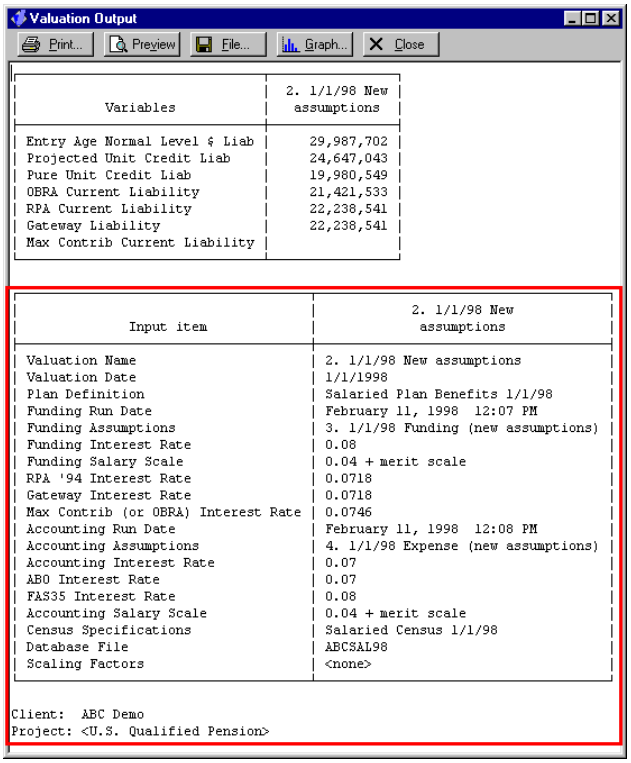


Output & Reporting

- You can now search for phrases in output, which makes it easy to find what you're looking for in long listings.

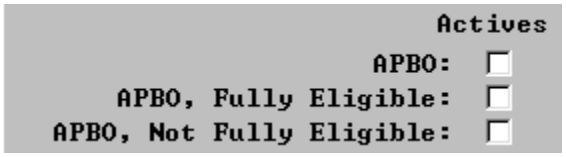


- For commands on the Output menu, the "inputs" information (which can vary in length from one run to the next) has been moved from the top of the listing to the bottom. This makes it easier to build standard spreadsheets around the results by ensuring that the results appear in the same location every time.



- In the OPEB mode, output now includes the APBO for actives not yet fully eligible. Previously users had to subtract the fully eligible APBO from the total active APBO to get this

value.



System & Interface

- You can now erase an object within a project without having to get into the "universe". Simply click the Erase button and ProVal will offer to erase or hide the object at your option.

- When replacing an existing Census Specification, ProVal will now refrain from erasing existing results if you are simply adding a data default that doesn't affect existing runs.
- In Client to Client Copy, you can now Browse… to open a client you haven't opened before.
- In Batch Execution, the "Exit ProVal after completion" option has been expanded. You can now tell ProVal to:
  - Remain open
  - Close
  - Logoff the system
  - Shutdown the system
  - Restart the system
- When Client Merge finishes running, the message now makes it clearer that OK will accept the changes and Cancel will undo the changes.
- Before opening a client, ProVal will check for the existence of a file named "~lock.txt" in the client directory. If the file "~lock.txt" is found, the client will not be opened and any text in the file will be displayed as a message to the user. A lock could be put in place, for example, if a user "checked out" a ProVal client to work on it at home.
- A new PROVALW.INI parameter, "[Config] UsageLogFile=", lets you turn on usage tracking. ProVal will record every time a client is either opened or closed to the specified file.

  For more information, read the "PROVALW.INI settings" article in Help > Help Topics > Frequently Asked Questions > General.

Keys & Licenses

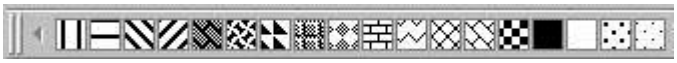
- A new set of PROVALW.INI parameters let you automatically check out or renew your commuter license when starting ProVal. This means you'll never have to remember to check out a license when leaving the office or be without a license if the ProVal License Server should go down.

  For more information, read the "PROVALW.INI settings" article in Help > Help Topics > Frequently Asked Questions > General.

ProVal PS, a desktop toolkit for sponsors of defined benefit and medical plans, continues to be developed parallel to ProVal. The following new features have appeared in ProVal PS since the last release of ProVal:

General

- On the Chart menu, a new Pattern Bar is available which will let you change the "hashing" of individual bars.



WinTech's Virtual Back Office

Need help bringing up new clients, converting cases or experienced help in a ProVal area that's new to you? Why not call upon WinTech's experienced actuaries to fill in? Contact **Mark Ruloff** at (203) 861-5530 for details or to request a quote.

WinTech

500 West Putnam Avenue
Greenwich, CT 06830

tel: (203) 861-5530
fax: (203) 861-5531
email: support@winklevoss.com
website: www.winklevoss.com

Data Import: Schema Files

When importing a data file, you can provide an optional "schema file" that contains record layout and data dictionary information. If you have your own census management system, you might consider enhancing it to produce schema files. This will free users from having to key in information such as field names, types, etc. that was known in the census management system but isn't contained in the data file.

By convention, import schema files end in the ".schema.csv" suffix. For example, if you are importing "<filename.ext>", the corresponding schema file would be named "<filename.ext>.schema.csv" in the same folder. Note that since the schema file's extension is .csv, it can be easily opened and edited with Excel. If "<filename.ext>.schema.csv" doesn't exist, ProVal will look for a "standard" schema file named "schema.csv" in the same folder. Otherwise, ProVal will assume that no schema file exists.

ProVal indicates the name of the data file you're importing and any corresponding schema file in the caption of the Import Data wizard.

Schema example:

```
FIELD,SSN,Social Security Number,SSN,1,9,999-99-9999
FIELD,NAME,Name,CHARACTER,10,39,20
FIELD,SEX,Sex,CODED,40,40
CODE,SEX,,,,,,M,1,MALE
CODE,SEX,,,,,,F,2,FEMALE
FIELD,BIRTHDT,Birth Date,DATE,41,48,YYYYMMDD
FIELD,PAY,Pay,NUMERIC,49,58,"9,999,999.99",100
```

Schema format:

Note that the file contains two different types of records, FIELD and CODE, as indicated in position 1 (pos1).

```
pos1  = Record type, "FIELD" or "CODE"
pos2  = Field name
```

If pos1="FIELD", then

```
pos3  = Field description (optional)
pos4  = Field type, "NUMERIC", "CHARACTER", "CODED", "DATE", or "SSN"
pos5  = Field start position (optional; only relevant for fixed-width data)
pos6  = Field end position (optional; only relevant for fixed-width data)
pos7  = Field format (optional)
          For NUMERIC fields, picture format such as "999,999.99"
          For CHARACTER fields, the display width in characters, e.g., "20"
          For DATE fields, picture format using "YYYY", "MM", "DD", and "/",
            e.g., "YYYYMMDD"
          For SSN fields, picture format such as "999-99-9999"
pos8  = Scaling factor for NUMERIC fields (optional)
```

If pos1="CODE", then

```
pos9  = Field value in import file
pos10 = Field code in ProVal database
pos11 = Field label in ProVal database (optional; default is same as pos9)
```

Notes:

- While the field format (pos7) is optional, it's strongly encouraged for date fields.
- Date formats with 2-digit years "YY" are tolerated, but discouraged since century breakpoints cannot be specified in the schema file.

- Case-sensitive codes are discouraged because there is no way to specify that codes are case-sensitive in the schema file.
- Items with embedded commas should be enclosed in quotes (e.g., the numeric format "9,999,999.99" in the example above).
- Trailing commas can be omitted from each line.
- Rows that don't start with FIELD or CODE will be ignored. This allows comments to be added to the file.

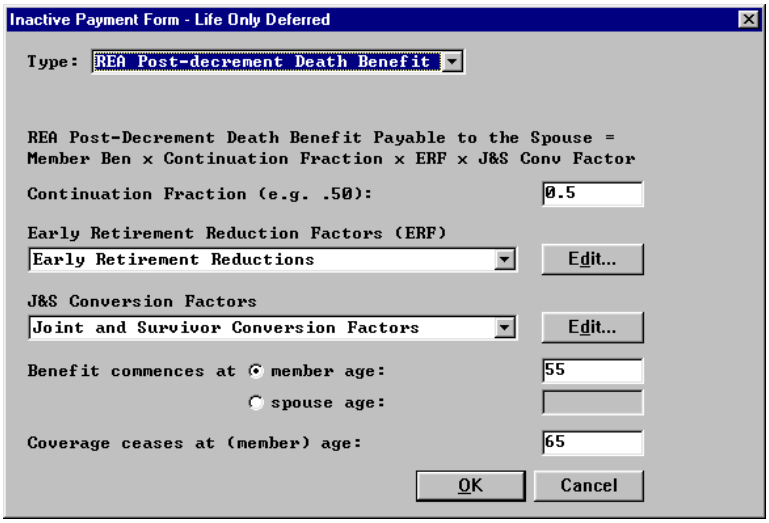
REA Post-Decrement Death Benefits

The REA Post-Decrement Death Benefit provides an annuity to a surviving spouse when an inactive participant dies before receiving any benefits. This "coverage" generally applies to vested terminated and/or disabled participants who are entitled to a benefit but are not yet eligible to commence payment. It is named after the Retirement Equity Act of 1984 ("REA"), which first required plans to provide this type of coverage.

Typically, a plan provides a spouse's annuity equal to the survivor benefit that would have been paid if the member had survived to the earliest possible retirement date, elected the automatic form of payment for married members, and died immediately.

Inactives

To value a REA Post-decrement Death Benefit for current inactives, set up an additional benefit in Census Specifications > Inactive Data. The benefit amount and payment form field should be the same as used for the member benefit. Code the payment form as "REA Post-decrement Death Benefit" for deferred payment form codes and "<not applicable>" for all other payment form codes.



The "REA Post-decrement Death Benefit" payment form parameters allow you to specify:

- The **Continuation fraction** to the spouse
- Tables of **Early Retirement Reduction** and **J&S Conversion Factors**, based on the age when the participant would start receipt
- The age when the spouse's annuity **commences**. If the member dies after this age, but before the coverage ceases, the spouse's annuity would commence immediately.
- The age when **coverage ceases**. This should be the same as the deferral age for the member's annuity.

The spouse's age, spouse's sex, and percent of the population that have REA coverage are determined by:

- First looking in the database fields specified for beneficiary age and sex. For records where these fields do not contain missing values, ProVal will assume REA coverage applies and use the fields to determine spouse age and sex.
- If these fields contain missing values (the typical case), ProVal will apply the spouse age setback and marital assumptions specified in Valuation Assumptions. A zero REA liability is used for the unmarried portion of the population. Spouses are assumed to be the opposite sex of members.

Actives

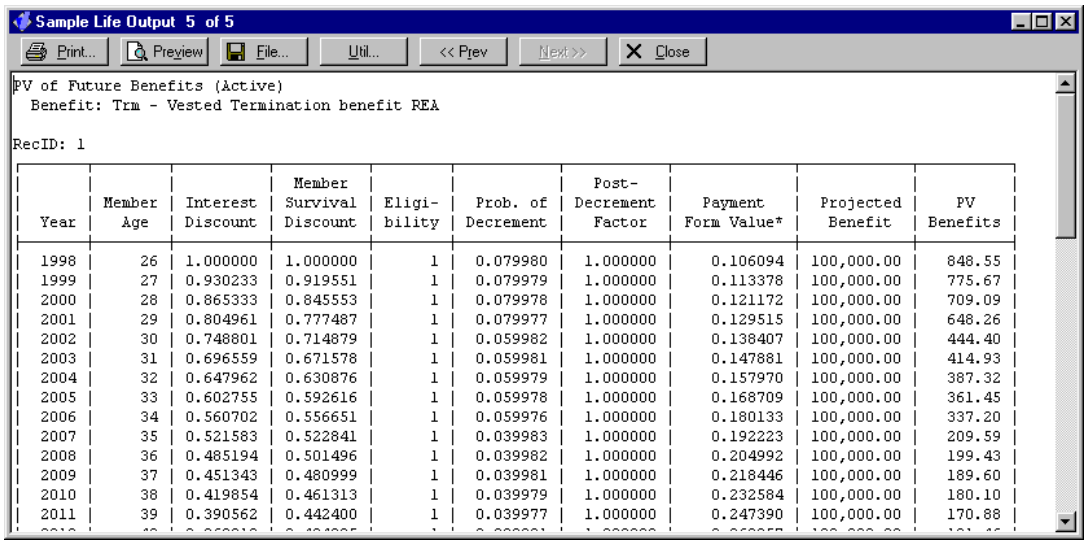
To value a REA Post-decrement Death Benefit for current actives (e.g., future terminations), add an additional Benefit Definition to your Plan Definition with the following characteristics:

- Same **contingency, eligibility,** and **benefit formula** as the member's annuity benefit
- A "REA Post-decrement Death Benefit" **payment form**. The specification of the payment form is identical to the specification for current inactives discussed above.

The spouse's age and percent of the population that have REA coverage are determined by applying the spouse age setback and marital assumptions specified in Valuation Assumptions. A zero REA liability is used for the unmarried portion of the population. Spouses are assumed to be the opposite sex of members.

Sample Lives

For active sample lives, the payment form value for REA benefits incorporates the reduction factors and member probabilities of death.



Sample Life Output 5 of 5

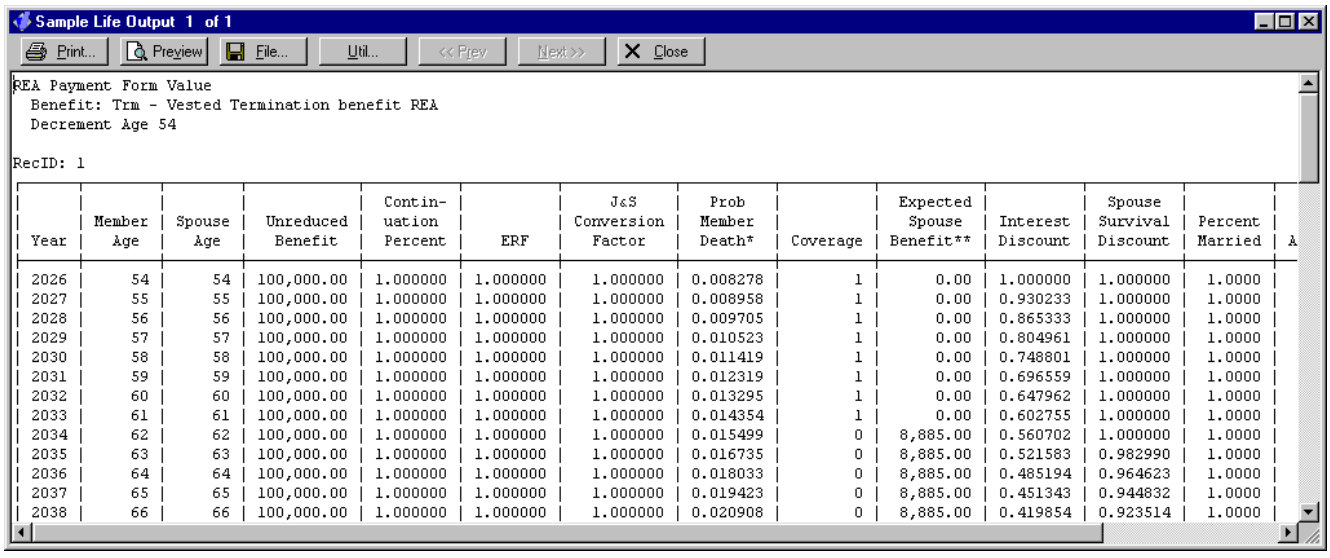
Print... | Preview | File... | Util... | << Prev | Next >> | Close

PV of Future Benefits (Active)
Benefit: Trm - Vested Termination benefit REA

RecID: 1

Year	Member Age	Interest Discount	Member Survival Discount	Eligibility	Prob. of Decrement	Post-Decrement Factor	Payment Form Value*	Projected Benefit	PV Benefits
1998	26	1.000000	1.000000	1	0.079980	1.000000	0.106094	100,000.00	848.55
1999	27	0.930233	0.919551	1	0.079979	1.000000	0.113378	100,000.00	775.67
2000	28	0.865333	0.845553	1	0.079978	1.000000	0.121172	100,000.00	709.09
2001	29	0.804961	0.777487	1	0.079977	1.000000	0.129515	100,000.00	648.26
2002	30	0.748801	0.714879	1	0.059982	1.000000	0.138407	100,000.00	444.40
2003	31	0.696559	0.671578	1	0.059981	1.000000	0.147881	100,000.00	414.93
2004	32	0.647962	0.630876	1	0.059979	1.000000	0.157970	100,000.00	387.32
2005	33	0.602755	0.592616	1	0.059978	1.000000	0.168709	100,000.00	361.45
2006	34	0.560702	0.556651	1	0.059976	1.000000	0.180133	100,000.00	337.20
2007	35	0.521583	0.522841	1	0.039983	1.000000	0.192223	100,000.00	209.59
2008	36	0.485194	0.501496	1	0.039982	1.000000	0.204992	100,000.00	199.43
2009	37	0.451343	0.480999	1	0.039981	1.000000	0.218446	100,000.00	189.60
2010	38	0.419854	0.461313	1	0.039979	1.000000	0.232584	100,000.00	180.10
2011	39	0.390562	0.442400	1	0.039977	1.000000	0.247390	100,000.00	170.88

You can inspect this calculation for actives by viewing the "REA Benefit Payment Form Value" report (this is essentially the same as the sample life report shown for inactives). Note that the calculation is presented as the present value of a spouse's annuity. The "expected spouse benefit" is an expected value, that is, the amount expected to be paid reflecting the probability of the member dying at each age prior to the payment age and the reduction factors applicable for each potential age at death.



Sample Life Output 1 of 1

Print... | Preview | File... | Util... | << Prev | Next >> | Close

REA Payment Form Value
Benefit: Trm - Vested Termination benefit REA
Decrement Age 54

RecID: 1

Year	Member Age	Spouse Age	Unreduced Benefit	Continuation Percent	ERF	J&S Conversion Factor	Prob Member Death*	Coverage	Expected Spouse Benefit**	Interest Discount	Spouse Survival Discount	Percent Married	A
2026	54	54	100,000.00	1.000000	1.000000	1.000000	0.008278	1	0.00	1.000000	1.000000	1.0000	
2027	55	55	100,000.00	1.000000	1.000000	1.000000	0.008958	1	0.00	0.930233	1.000000	1.0000	
2028	56	56	100,000.00	1.000000	1.000000	1.000000	0.009705	1	0.00	0.865333	1.000000	1.0000	
2029	57	57	100,000.00	1.000000	1.000000	1.000000	0.010523	1	0.00	0.804961	1.000000	1.0000	
2030	58	58	100,000.00	1.000000	1.000000	1.000000	0.011419	1	0.00	0.748801	1.000000	1.0000	
2031	59	59	100,000.00	1.000000	1.000000	1.000000	0.012319	1	0.00	0.696559	1.000000	1.0000	
2032	60	60	100,000.00	1.000000	1.000000	1.000000	0.013295	1	0.00	0.647962	1.000000	1.0000	
2033	61	61	100,000.00	1.000000	1.000000	1.000000	0.014354	1	0.00	0.602755	1.000000	1.0000	
2034	62	62	100,000.00	1.000000	1.000000	1.000000	0.015499	0	8,885.00	0.560702	1.000000	1.0000	
2035	63	63	100,000.00	1.000000	1.000000	1.000000	0.016735	0	8,885.00	0.521583	0.982990	1.0000	
2036	64	64	100,000.00	1.000000	1.000000	1.000000	0.018033	0	8,885.00	0.485194	0.964623	1.0000	
2037	65	65	100,000.00	1.000000	1.000000	1.000000	0.019423	0	8,885.00	0.451343	0.944832	1.0000	
2038	66	66	100,000.00	1.000000	1.000000	1.000000	0.020908	0	8,885.00	0.419854	0.923514	1.0000	

Contribution Policies

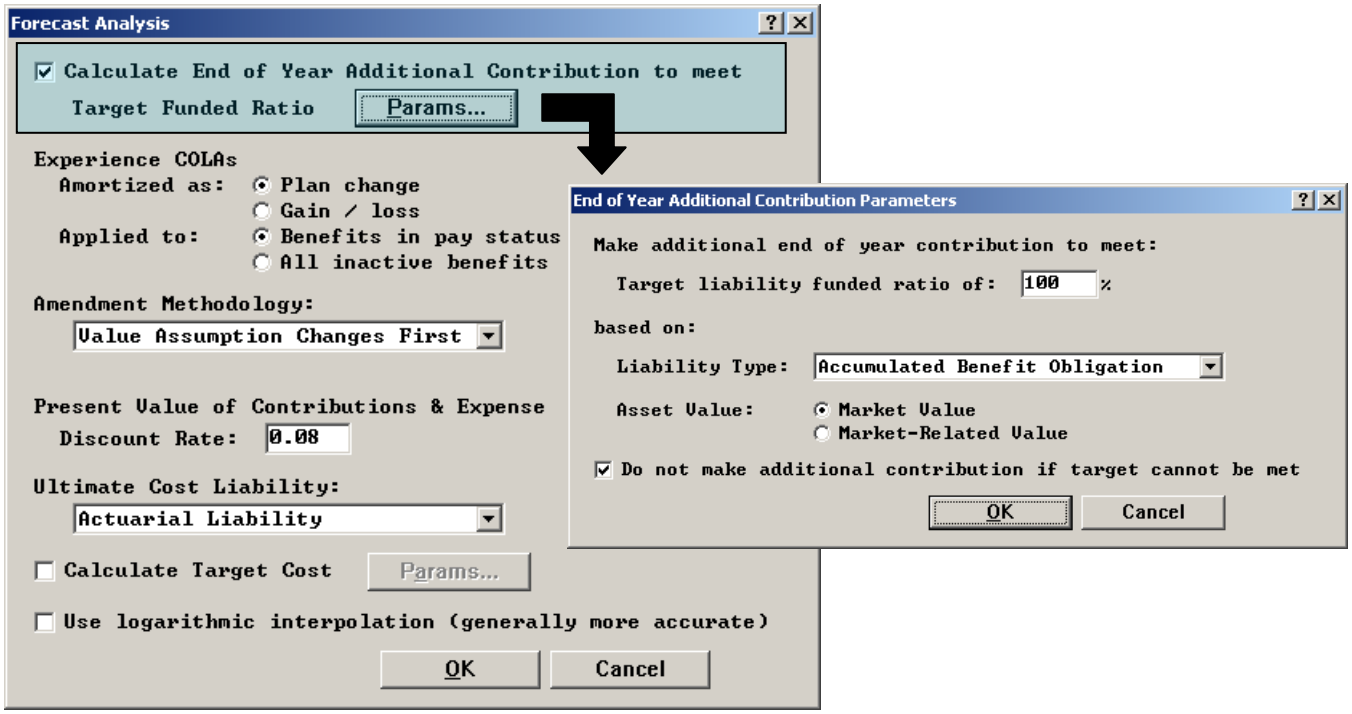
Two new contribution policy options let you:

- Calculate an additional contribution at the end of the plan year to meet a target liability funded ratio.
- Limit the Plan's maximum contribution to a percent of payroll.

Both features are discussed in more detail below.

Forecast Analysis

ProVal's forecasting capabilities have been enhanced with a new parameter to calculate an additional contribution at the end of the plan year to meet a target liability funded ratio in the following plan year. This parameter is found in the Forecast Analysis topic of the Asset & Funding Policy (finally, a reason to open this screen).



The liability types available for the target funded ratio calculation are:

- Actuarial Liability
- RPA '94 Current Liability (U.S. Qualified Mode only)
- Gateway Current Liability (U.S. Qualified Mode only)
- Projected Benefit Obligation
- Accumulated Benefit Obligation
- Present Value of Future Benefits
- Expected Benefit Obligation
- Solvency Liability (Canadian Mode only)

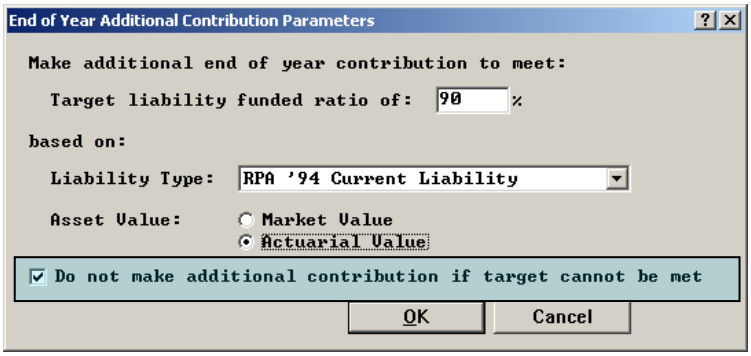
If a funding liability is selected, then either the market value or the actuarial value of assets is available to calculate the target funded ratio. If an accounting liability is selected, then either the accounting market value or the market related value of assets is available to calculate the target funded ratio.

Some contribution scenarios where this feature will be useful are:

- To avoid an additional funding charge by contributing an amount to fund 90% of the RPA current liability on an actuarial value of assets basis.
- To avoid a reduction to shareholder's equity by contributing an amount to fund the ABO on a market value of assets basis.
- To avoid an unfunded solvency liability in Canadian mode.

Note that the above scenarios do have some limitations. For example, there are other ways to avoid an additional funding charge (e.g. having a 90% funded ratio in 2 of the last 3 years). This new parameter only takes into consideration a target liability funded ratio in the following plan year.

ProVal also includes the option to only make this additional contribution if the target liability funded ratio can be met. For example, if a company would like to avoid an additional funding charge, but the contribution needed exceeds the maximum tax deductible contribution (or the maximum % of pay specified in the new parameter below), they can choose to not make any additional contribution for that plan year.

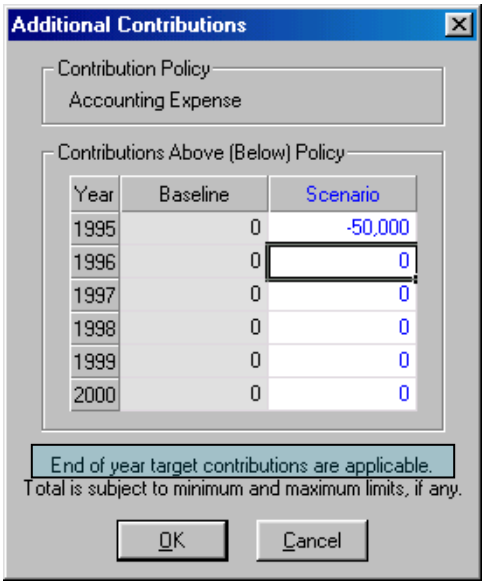


Since the end of year target contribution is dependent on the liability value in the following year, this parameter will have no effect on a Valuation Set or the last year of a forecast. In addition, the contribution is always assumed to be made on or after the last day of the plan year. Accordingly, there will be no interest adjustment applied to this contribution for funding or accounting purposes.

ProVal PS

The end of year target contribution policy has some interesting implications in ProVal PS. In the Disclosure and Budgeting tool, the current year contribution that is originally populated will reflect any end of year additional contribution in the underlying deterministic forecast, and the details button will show its calculation. This contribution, along with all contributions for the plan year, can be viewed in the contribution schedule. However, if any changes are made (to the contribution schedule, "scenario" or "next year" assumptions), the additional end of year target contribution is not recalculated for two reasons:

1) It cannot be known because the following year's liabilities are no longer considered known, and
2) A point of the tool is to allow the user to specify exactly what their contributions will be and when they will be made, so it's inappropriate to override that decision with this policy.

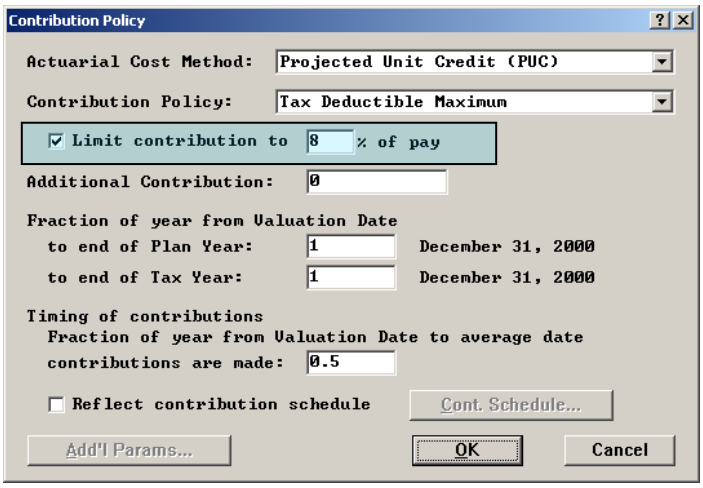


When changes are made, the contribution policy display will lump any original end of year target contribution in with the additional contribution.

In the Financial Sensitivities tool, the end of year target additional contribution will be recalculated when changes (interest rates, inflation, etc.) are made to the forecast assumptions. Thus, it may not be possible to effectively specify negative or lower additional contributions for future plan years because the re-calculation of the end of year target additional contribution will override them. Note that whether or not the end of year target contribution policy applies is indicated by a note on the Additional Contributions dialog.

Contribution Policy

Since the end of year target contribution policy could generate very volatile contributions, plan sponsors may want to limit their contribution to a maximum percent of payroll (subject to statutory constraints). For example, the plan sponsor may prefer to avoid an additional funding charge, but may not be willing to contribution more than 10% of payroll in any given plan year. Accordingly, a new parameter to limit contributions to a percent of payroll has been added to the Contribution Policy topic of the Asset & Funding Policy. This limit is applied after the contribution policy and additional target end of year contributions are calculated, but before any specified additional contributions.



Exhibits

The implications of both of the new contribution policy parameters will be available in the Summary of Employer Contribution Exhibit. Here is a preview:

Development of Employer Contribution (Tax Deductible Maximum)

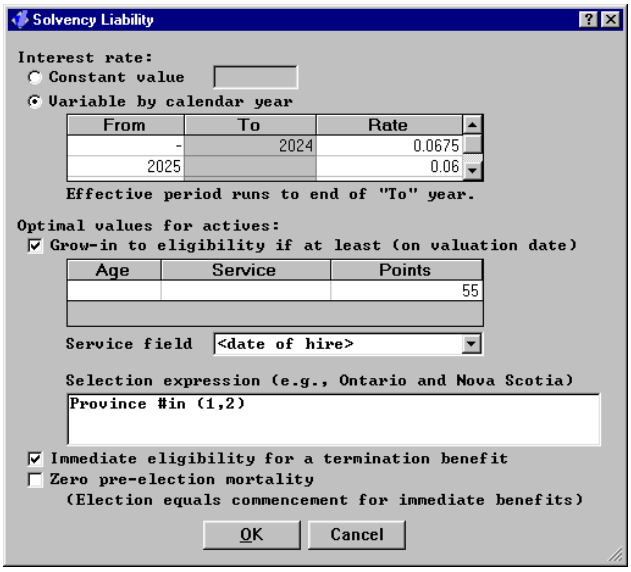
	2004
1. Preliminary funding policy contribution	$17,070,747
2. Percentage of payroll contribution limit	
(a) Payroll	19,633,726
(b) Contribution limit: 25% x (a)	4,908,431
(c) Limited contribution: lesser of (1) and (b)	4,908,431
3. Additional contribution	0
4. Funding policy contribution: (2)(c)+(3), not less than 0	4,908,431
5. Statutory constraints	
(a) Minimum contribution	5,808,340
(b) Maximum contribution	17,070,747
(c) Adjustment to statutory constraints	899,909
6. Preliminary contribution: (4)+(5)(c)	5,808,340
7. End of year additional contribution	
(a) EOY Actuarial Liability	49,558,555
(b) EOY asset target: 100% x (a)	49,558,555
(c) Preliminary EOY Actuarial Assets	36,006,746
(d) Contribution necessary to meet (b)	11,293,175
(e) Maximum EOY contribution: [min ((2)(b),(5)(b))]-(6)	0
(f) Constrained contribution: lesser of (d) and (e)	0
(g) EOY additional contribution: (f) if (d)=(f); 0 otherwise	0
8. Employer contribution: (6)+(7)(g)	$5,808,340

Canadian Solvency Liability

The Canadian Solvency Liability is essentially a plan termination liability, assuming:

- Immediate decrement on the valuation date as if the plan sponsor shut down operations. Decrement occurs at the beginning of the year, regardless of decrement timing in valuation assumptions. This affects the amount of accrued benefits, eligibility, and payment form values.
- Only retirement and termination benefits are considered in the calculation.
- Immediate vesting (eligibility) for termination benefits.
- A graded interest rate (x% for 15 years, y% thereafter). Per recent guidance, an annuity purchase rate should be used for "older" participants (e.g., over age 55).
- Accrued benefits are valued, à la unit credit liabilities. However, only those benefits (or benefit features, such as early retirement subsidies) which the member is currently eligible for are valued, unless grow-in rights apply (see below).
- Commencement at the optimal (most valuable) age. For example, a terminated member may be entitled to a deferred pension commencing at age 65, with a subsidized early retirement pension. To determine the liability, we need to determine the value of the pension at all possible commencement ages (55 to 65) and take the greatest of these values. Besides subsidized early retirement, a participant might be eligible for a more generous payment form, such as a bridge benefit, at later ages.
- Grow-in rights. If a member is employed in Ontario or Nova Scotia and has 55 points (age + service) on the valuation date, they are assumed to become eligible for any benefits that they would have been eligible for had they continued as a member. That is, the optimal value above is computed assuming that participants with 55 points grow-in to eligibility, rather than just valuing the benefit(s) for which they are currently eligible.

With ProVal version 2.22, the Canadian Solvency Liability for actives has been converted from a unit credit liability to an optimal value calculation (note that this will change results). In addition, the following new Solvency Liability options have been added to Valuation Assumptions:



- Calendar-year based interest rate, independent from the valuation basis.
  - If assuming separate rates for "younger" and "older" participants, then you'll need to run separate valuations.
  - For forecasting, be aware that ProVal's "calendar-year" rates will wear-away over time. That is, if the rates are 6.75% through 2024 and 6% thereafter, then the valuation rate will be 6% in years 2024 and beyond.
- Grow-in rights for members who are employed in Nova Scotia or Ontario (through a selection expression) and who have at least 55 points (or user-specified eligibility criteria) on the valuation date.
- Immediate eligibility (i.e., vesting) for a termination benefit. If a participant isn't currently eligible for a termination benefit, this option will make them eligible for the first termination benefit(s) they are projected to become eligible for.
- Zero pre-election mortality (election equals commencement for immediate benefits). This is generally useful for immediate retirement benefits. For deferred termination benefits, you will still need to zero out the pre-commencement rates (e.g., age 65) in the mortality table used for terminated vested participants.

Terminology

Before defining the optimal value calculation, let's define some terms. An ongoing traditional Unit Credit (UC) liability is equal to:

$$\text{UC liability} = \sum_{\substack{\text{Benefit} \\ i}} \sum_{\substack{\text{Decrement} \\ \text{at time } t}} v^t \cdot {}_t p_x^{(\tau)} \cdot q_{x+t}^{(i)} \cdot Elig_{x+t}^{(i)} \cdot pdp_{x+t}^{(i)} \cdot BenefitUC_{x+t}^{(i)} \cdot \ddot{a}_{x+t}^{(i)}$$

where:

v^t = interest discount from decrement to valuation date, at pre-decrement interest rate

${}_t p_x^{(\tau)}$ = probability of surviving all decrements and remaining in active status from valuation date to decrement

$q_{x+t}^{(i)}$ = probability of decrement for benefit *i*

$Elig_{x+t}^{(i)}$ = eligibility for benefit *i* at decrement (0 if not eligible, 1 if eligible)

$pdp_{x+t}^{(i)}$ = probability of receipt for benefit *i* at decrement (typically 1). Useful for valuing alternative forms, such as 80% election of lump sums and 20% election of annuities.

$BenefitUC_{x+t}^{(i)}$ = projected benefit *i* at decrement under the unit credit cost method. In general for retirement benefits, this is the accrued benefit with projected early retirement reductions at age $x+t$.

$\ddot{a}_{x+t}^{(i)}$ = payment form value (e.g., annuity value) for benefit *i*; present value of $1 benefit at decrement

The optimal value calculation is similar in form to the UC liability. The differences are:

- Since termination/retirement happens on the valuation date, the pre-decrement interest and survival discount, $v^t \cdot {}_t p_x^{(\tau)}$, are replaced by post-decrement assumptions. Notably, the survival discount is simply for mortality. If "zero pre-election" mortality is selected, ${}_t p_x^{(\tau)}$ is replaced by 1.
- The probability of decrement, $q_{x+t}^{(i)}$, is not relevant (recall that we assume everyone decrements immediately). So, instead of a weighted sum of decrement age terms, $\sum_{\substack{\text{Decrement} \\ \text{at time } t}} q_{x+t}^{(i)} \cdot terms$, the optimal value is the maximum of decrement age terms: $\max(terms)\big|_{\text{Decrement at time } t=0,1,2,3,\ldots}$. In this context, "decrement age" is a misnomer; "election age" might be more accurate. In finding the optimal value, we look for the most valuable election age, which is really a proxy for the most valuable commencement age that was stated in the solvency liability definition. Of course, if the payment form is payable immediately upon decrement (as retirement benefits often are), the election age and commencement age are identical.
- If multiple retirement benefits exist (e.g., a regular benefit and a bridge benefit), the commuted values are summed together (across benefits) before taking the maximum value across decrement ages. The same is true if multiple termination benefits exist.
- Death and disability benefits are ignored.
- Since all actives terminate or retire on the valuation date, employee contribution "benefits" (which offset normal cost for ongoing liabilities) are ignored.

Solvency liability with grow-in rights

Assuming grow-in rights apply, the solvency liability = max of *(a)* and *(b)*, where

(a) = termination optimal value

$$= \max\left(\sum_{\substack{\text{Term Benefits} \\ i}} v^t \cdot {}_t p_x \cdot Elig^{(i)*}_{x+t} \cdot pdp^{(i)}_{x+t} \cdot BenefitUC^{(i)}_{x+t} \cdot \ddot{a}^{(i)}_{x+t} \right) \Bigg|_{\text{Decrement at time } t=0,1,2,3,..}$$

Note: $Elig^{(i)*}_{x+t}$ is adjusted for immediate eligibility, if elected.

(b) = retirement optimal value. Same as *(a)*, but for retirement benefits.

Solvency liability without grow-in rights

If grow-in rights do not apply, projected eligibility $Elig^{(i)}_{x+t}$ in the equations above is replaced by eligibility on the valuation date $Elig^{(i)}_{x}$.

Numeric example

The following example is based on a male participant age 45 who is entitled to a $1,000 annual termination benefit, deferred to 65. He is projected to be eligible for early retirement at age 55, with reduction factors of 6% per year from age 65. Grow-in rights apply. Payment form values are based on GA83M @ 8% and are assumed to be paid monthly.

Termination Optimal Value: $1,000 deferred-to-65 annuity

Year	Age	Interest Discount	Mortality Discount	Eligibility	Accrued Benefit, b.o.y.	Payment Form Value	Present Value
2004	45	1.000000	1.000000	1	1,000.00	1.627234	1,627.23
2005	46	0.925926	0.997817	1	1,000.00	1.761257	1,627.23
2006	47	0.857339	0.995351	1	1,000.00	1.906870	1,627.23
2007	48	0.793832	0.992574	1	1,000.00	2.065181	1,627.23
2008	49	0.735030	0.989460	1	1,000.00	2.237417	1,627.23
2009	50	0.680583	0.985984	1	1,000.00	2.424929	1,627.23
2010	51	0.630170	0.982129	1	1,000.00	2.629201	1,627.23
2011	52	0.583490	0.977883	1	1,000.00	2.851868	1,627.23
2012	53	0.540269	0.973233	1	1,000.00	3.094733	1,627.23
2013	54	0.500249	0.968172	1	1,000.00	3.359783	1,627.23
2014	55	0.463193	0.962692	0	1,000.00	3.649220	0.00
2015	56	0.428883	0.956790	0	1,000.00	3.965470	0.00
2016	57	0.397114	0.950458	0	1,000.00	4.311239	0.00
2017	58	0.367698	0.943673	0	1,000.00	4.689618	0.00
2018	59	0.340461	0.936388	0	1,000.00	5.104186	0.00
2019	60	0.315242	0.928538	0	1,000.00	5.559129	0.00
2020	61	0.291890	0.920034	0	1,000.00	6.059351	0.00
2021	62	0.270269	0.910775	0	1,000.00	6.610628	0.00
2022	63	0.250249	0.900635	0	1,000.00	7.219857	0.00
2023	64	0.231712	0.889476	0	1,000.00	7.895276	0.00
2024	65	0.214548	0.877140	0	1,000.00	8.646812	0.00
						Termination Optimal Value	**1,627.23**

Retirement Optimal Value: $1,000 immediate annuity, reduced 6% per year from 65

Year	Age	Interest Discount	Mortality Discount	Eligibility	Accrued Benefit b.o.y.	Payment Form Value	Present Value
2004	45	1.000000	1.000000	0	0.00	11.556700	0.00
2005	46	0.925926	0.997817	0	0.00	11.463929	0.00
2006	47	0.857339	0.995351	0	0.00	11.366930	0.00
2007	48	0.793832	0.992574	0	0.00	11.265661	0.00
2008	49	0.735030	0.989460	0	0.00	11.160039	0.00
2009	50	0.680583	0.985984	0	0.00	11.049938	0.00
2010	51	0.630170	0.982129	0	0.00	10.935136	0.00
2011	52	0.583490	0.977883	0	0.00	10.815361	0.00
2012	53	0.540269	0.973233	0	0.00	10.690269	0.00
2013	54	0.500249	0.968172	0	0.00	10.559449	0.00
2014	55	0.463193	0.962692	1	400.00	10.422457	1,859.00
2015	56	0.428883	0.956790	1	460.00	10.278749	1,940.23
2016	57	0.397114	0.950458	1	520.00	10.127775	1,987.77
2017	58	0.367698	0.943673	1	580.00	9.969105	2,006.30
2018	59	0.340461	0.936388	1	640.00	9.802503	2,000.05
2019	60	0.315242	0.928538	1	700.00	9.627934	1,972.76
2020	61	0.291890	0.920034	1	760.00	9.445534	1,927.81
2021	62	0.270269	0.910775	1	820.00	9.255605	1,868.21
2022	63	0.250249	0.900635	1	880.00	9.058673	1,796.67
2023	64	0.231712	0.889476	1	940.00	8.855440	1,715.62
2024	65	0.214548	0.877140	1	1,000.00	8.646812	1,627.23
						Retirement Optimal Value	**2,006.30**

Solvency Liability

Solvency Liability	**2,006.30**