Run Types

Contents

Overview

mguchiQ is a financial and actuarial system whereby users build models representing their financial obligations. mguchiQ then allows users to run different types of analyses through these models to access different types of information.

This document describes the different run types currently available in mguchiQ.

Note that all results are available in the **web browser** or can be downloaded to **Excel**.

Introduction

mguchiQ is a forward-looking calculation engine that calculates the values of the **functions** of a model for **time periods** out into the future. It produces results along the following lines:

For every **item** in a given data set *(e.g., for every policy in a book of policies)*

For each **time period** (t) from 1 to n *(e.g., a number of months into the future)*

For each **function** in the model specified in the run

Calculate the **value** of that function

mguchiQ can currently create 6 different types of results sets:

Type	Result Set	Description
Deterministic	Aggregate	Performs calculations on individual data items (e.g. policies) for a range of time periods (t) and aggregates the results into a result set. Only the aggregated (book level) results are stored.
	Repetitive	Similar to **Aggregate** result set but applies the chosen **Scenarios** repetitively starting from increasing time intervals. Only the calculated values for the specified time intervals are stored in the result set.
	Individual	Performs calculations for a given time period (t) and stores results per individual data item (e.g. policy). This allows an expansion of the values calculated in the **Aggregate** result set for a chosen time period (t).
	Goal seek	Goal seeks a particular **Function** for each individual data item at a given time period (t)
	Audit	Creates an Excel spreadsheet of the calculations for a chosen data item (e.g. policy). Note that the Excel spreadsheet is populated with actual formulae (not values) so that the models **Functions** can be audited.
Stochastic	Aggregate	Performs an aggregate calculation for each scenario in the stochastic data set, with each scenario's values being stored. Results can be extracted either as the average of all the scenarios or by selecting different percentiles of the calculated data.

Just to recap, when a model is built a number of elements are specified, namely:

Element	Description
Instance Variables	Those variables specific to an individual product (e.g. a policy). Such variables might include a policy holders **Age At Inception, Sum Assured**, etc.
Non-Instance Variables	Those variables shared by more than one individual data item, e.g. a **Yield Curve** or a **Life Table**
Functions	The set of calculations that can be performed by a model on a data item, such as **Net Cash Flow**, **Best Estimate Liability**, etc.
Conditions	A partitioning of the results according to certain criteria, for example a result set for **policy holders younger than 30 years old**
Scenarios	A rerun of the calculations after adjusting any number of the **Non-Instance Variables**, for example a rerun after **changing mortality rates** or a rerun after **shifting a yield curve**

A word on Conditions

Conditions do not add significantly to the execution time of a run as they do not require functions to be recalculated.

A word on Scenarios

When a run is initiated the first result set calculated is called the **Base** Scenario and it has **Absolute** values. The **Base** Scenario uses the input variables as they are initially defined, i.e. without any adjustments.

Adding scenarios to a run necessitates a recalculation as input variables to functions may have changed. mguchiQ does optimize this process so that only those functions affected by the scenario are recalculated. Thus, as a general rule, each extra scenario specified will increase the execution time accordingly. If a single base run takes, say 10 seconds to execute, choosing 3 extra scenarios will increase the execution time by approximately 30 seconds.

When an additional scenario is specified in a run it instructs mguchiQ to recalculate the chosen **Functions** again with an adjusted set of input values, the adjustments being the specification of the scenario, e.g. adjusting mortality rates upwards. This new result set is called an **Absolute** result set for the chosen **Scenario** as it provides absolute values. mguchiQ will also, if instructed, create another result set called a **Difference** result set, which is, on the face of it, the result of subtracting the **Absolute** result set for the scenario from the **Base** result set. In practice the **Difference** result set is not always equal to (**Absolute – Base**), the **Difference** result set may not equal (**Absolute – Base**) if any of the **Functions** in the model are specified with the attribute **Only Positive Difference**. This attribute states that mguchiQ may only add this **Functions** value to the **Difference** result set if the **Difference** is **positive**.

Let's assume we specify the following in our run:

Input	Description
Functions	**NetCF** (net cashflow) **BEL** (best estimate liability)
Conditions	**Juniors** (current age < 30 years)
Scenarios	**Mortality Up** (mortality rates increase)
Scenarios Absolute	**Yes**
Scenarios Difference	**Yes**

This run will produce the following 6 result sets each containing **NetCF** and **BEL**:

Condition	Scenario	Absolute Result Set	Difference Result Set
All	Base	All (Base)	
All	Mortality Up	All (Mortality Up) [absolute]	All (Mortality Up) [difference]
Juniors	Base	Juniors (Base)	
Juniors	Mortality Up	Juniors (Mortality Up) [absolute]	Juniors (Mortality Up) [difference]

Result Types

The following pages describe in detail each of the different run types.

Deterministic Aggregate

Inputs required:

Input	Description
Functions	Which **Functions** must be included in the result set.
Conditions	Which extra **Conditions** must be included in the result set.
Scenarios	Which extra **Scenarios** must be included in the result set.
Scenarios Absolute	Whether to create **Absolute** result sets for the extra scenarios chosen
Scenarios Difference	Whether to create **Difference** result sets for the extra scenarios chosen

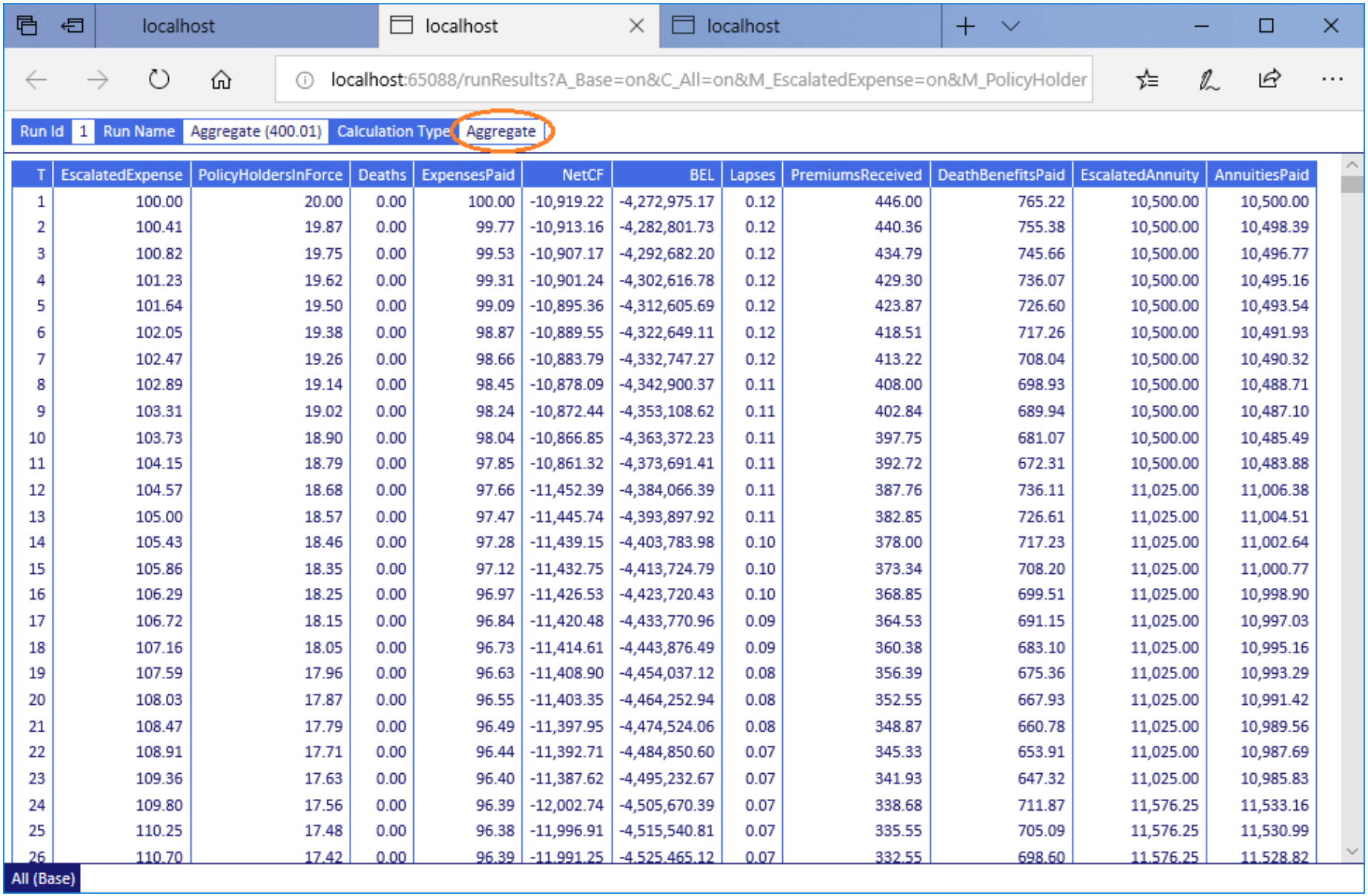
Given a set of data (e.g. a set of policies) calculations are performed as follows …

For each data item (policy)

for each time period from 1 to maxT

for each function chosen

the results are then aggregated per time period t and function.



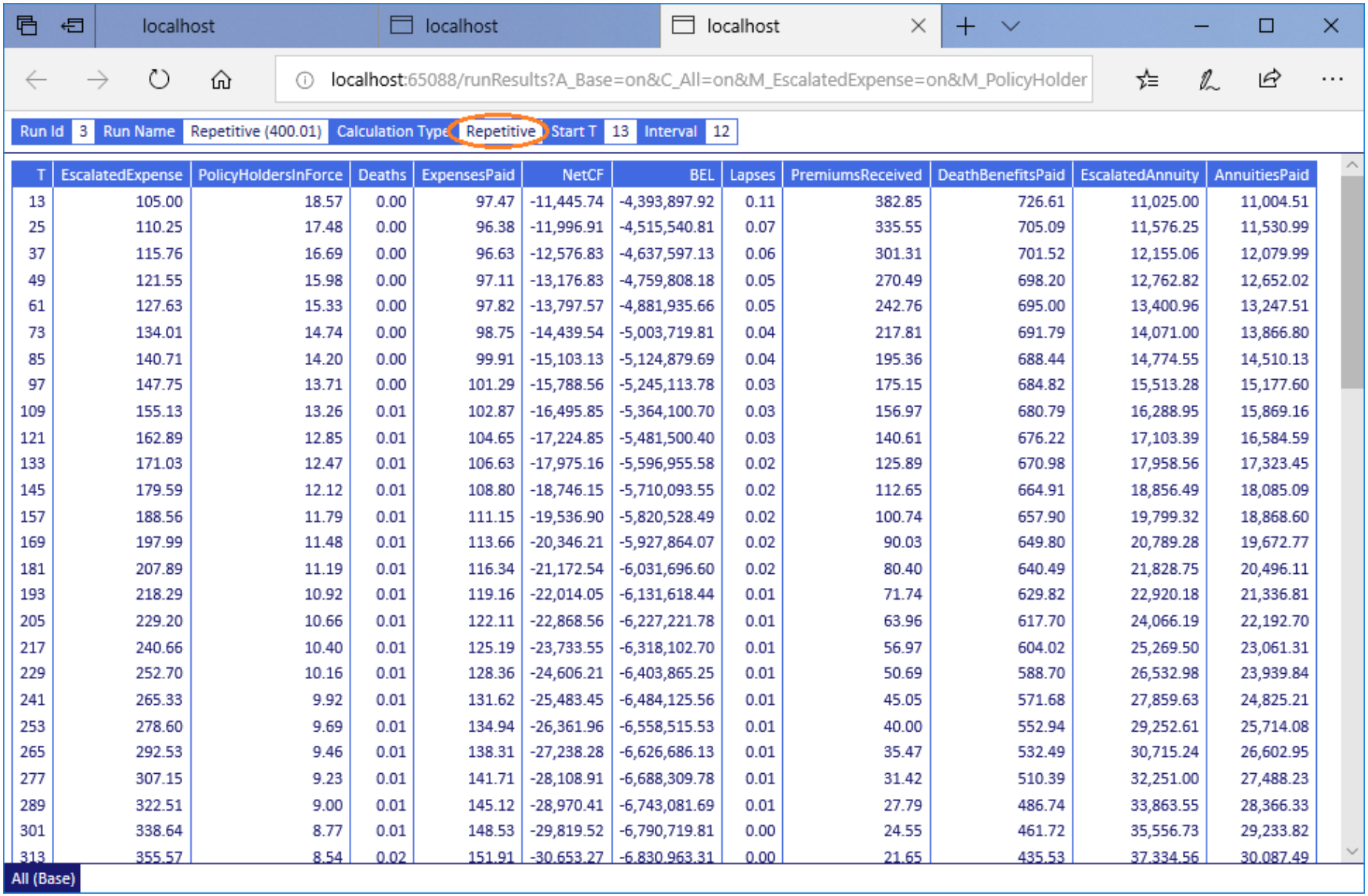
T	EscalatedExpense	PolicyHoldersInForce	Deaths	ExpensesPaid	NetCF	BEL	Lapses	PremiumsReceived	DeathBenefitsPaid	EscalatedAnnuity	AnnuitiesPaid
1	100.00	20.00	0.00	100.00	-10,919.22	-4,272,975.17	0.12	446.00	765.22	10,500.00	10,500.00
2	100.41	19.87	0.00	99.77	-10,913.16	-4,282,801.73	0.12	440.36	755.38	10,500.00	10,498.39
3	100.82	19.75	0.00	99.53	-10,907.17	-4,292,682.20	0.12	434.79	745.66	10,500.00	10,496.77
4	101.23	19.62	0.00	99.31	-10,901.24	-4,302,616.78	0.12	429.30	736.07	10,500.00	10,495.16
5	101.64	19.50	0.00	99.09	-10,895.36	-4,312,605.69	0.12	423.87	726.60	10,500.00	10,493.54
6	102.05	19.38	0.00	98.87	-10,889.55	-4,322,649.11	0.12	418.51	717.26	10,500.00	10,491.93
7	102.47	19.26	0.00	98.66	-10,883.79	-4,332,747.27	0.12	413.22	708.04	10,500.00	10,490.32
8	102.89	19.14	0.00	98.45	-10,878.09	-4,342,900.37	0.11	408.00	698.93	10,500.00	10,488.71
9	103.31	19.02	0.00	98.24	-10,872.44	-4,353,108.62	0.11	402.84	689.94	10,500.00	10,487.10
10	103.73	18.90	0.00	98.04	-10,866.85	-4,363,372.23	0.11	397.75	681.07	10,500.00	10,485.49
11	104.15	18.79	0.00	97.85	-10,861.32	-4,373,691.41	0.11	392.72	672.31	10,500.00	10,483.88
12	104.57	18.68	0.00	97.66	-11,452.39	-4,384,066.39	0.11	387.76	736.11	11,025.00	11,006.38
13	105.00	18.57	0.00	97.47	-11,445.74	-4,393,897.92	0.11	382.85	726.61	11,025.00	11,004.51
14	105.43	18.46	0.00	97.28	-11,439.15	-4,403,783.98	0.10	378.00	717.23	11,025.00	11,002.64
15	105.86	18.35	0.00	97.12	-11,432.75	-4,413,724.79	0.10	373.34	708.20	11,025.00	11,000.77
16	106.29	18.25	0.00	96.97	-11,426.53	-4,423,720.43	0.10	368.85	699.51	11,025.00	10,998.90
17	106.72	18.15	0.00	96.84	-11,420.48	-4,433,770.96	0.09	364.53	691.15	11,025.00	10,997.03
18	107.16	18.05	0.00	96.73	-11,414.61	-4,443,876.49	0.09	360.38	683.10	11,025.00	10,995.16
19	107.59	17.96	0.00	96.63	-11,408.90	-4,454,037.12	0.08	356.39	675.36	11,025.00	10,993.29
20	108.03	17.87	0.00	96.55	-11,403.35	-4,464,252.94	0.08	352.55	667.93	11,025.00	10,991.42
21	108.47	17.79	0.00	96.49	-11,397.95	-4,474,524.06	0.08	348.87	660.78	11,025.00	10,989.56
22	108.91	17.71	0.00	96.44	-11,392.71	-4,484,850.60	0.07	345.33	653.91	11,025.00	10,987.69
23	109.36	17.63	0.00	96.40	-11,387.62	-4,495,232.67	0.07	341.93	647.32	11,025.00	10,985.83
24	109.80	17.56	0.00	96.39	-12,002.74	-4,505,670.39	0.07	338.68	711.87	11,576.25	11,533.16
25	110.25	17.48	0.00	96.38	-11,996.91	-4,515,540.81	0.07	335.55	705.09	11,576.25	11,530.99
26	110.70	17.42	0.00	96.39	-11,991.25	-4,525,465.12	0.07	332.55	698.60	11,576.25	11,528.82

Deterministic Repetitive

Inputs required:

Input	Description
Start T	The starting point for the repetitive calculations
Interval	The interval from **Start T** to repeat calculations.
Functions	Which **Functions** must be included in the result set.
Conditions	Which extra **Conditions** must be included in the result set.
Scenarios	Which extra **Scenarios** must be included in the result set.
Scenarios Absolute	Whether to create **Absolute** result sets for the extra scenarios chosen
Scenarios Difference	Whether to create **Difference** result sets for the extra scenarios chosen

Similar to an aggregated result set, but scenarios are run repetitively, their effect only starting at the selected intervals. The results for each interval are then stored as aggregated result sets.



T	EscalatedExpense	PolicyHoldersInForce	Deaths	ExpensesPaid	NetCF	BEL	Lapses	PremiumsReceived	DeathBenefitsPaid	EscalatedAnnuity	AnnuitiesPaid
13	105.00	18.57	0.00	97.47	-11,445.74	-4,393,897.92	0.11	382.85	726.61	11,025.00	11,004.51
25	110.25	17.48	0.00	96.38	-11,996.91	-4,515,540.81	0.07	335.55	705.09	11,576.25	11,530.99
37	115.76	16.69	0.00	96.63	-12,576.83	-4,637,597.13	0.06	301.31	701.52	12,155.06	12,079.99
49	121.55	15.98	0.00	97.11	-13,176.83	-4,759,808.18	0.05	270.49	698.20	12,762.82	12,652.02
61	127.63	15.33	0.00	97.82	-13,797.57	-4,881,935.66	0.05	242.76	695.00	13,400.96	13,247.51
73	134.01	14.74	0.00	98.75	-14,439.54	-5,003,719.81	0.04	217.81	691.79	14,071.00	13,866.80
85	140.71	14.20	0.00	99.91	-15,103.13	-5,124,879.69	0.04	195.36	688.44	14,774.55	14,510.13
97	147.75	13.71	0.00	101.29	-15,788.56	-5,245,113.78	0.03	175.15	684.82	15,513.28	15,177.60
109	155.13	13.26	0.01	102.87	-16,495.85	-5,364,100.70	0.03	156.97	680.79	16,288.95	15,869.16
121	162.89	12.85	0.01	104.65	-17,224.85	-5,481,500.40	0.03	140.61	676.22	17,103.39	16,584.59
133	171.03	12.47	0.01	106.63	-17,975.16	-5,596,955.58	0.02	125.89	670.98	17,958.56	17,323.45
145	179.59	12.12	0.01	108.80	-18,746.15	-5,710,093.55	0.02	112.65	664.91	18,856.49	18,085.09
157	188.56	11.79	0.01	111.15	-19,536.90	-5,820,528.49	0.02	100.74	657.90	19,799.32	18,868.60
169	197.99	11.48	0.01	113.66	-20,346.21	-5,927,864.07	0.02	90.03	649.80	20,789.28	19,672.77
181	207.89	11.19	0.01	116.34	-21,172.54	-6,031,696.60	0.02	80.40	640.49	21,828.75	20,496.11
193	218.29	10.92	0.01	119.16	-22,014.05	-6,131,618.44	0.01	71.74	629.82	22,920.18	21,336.81
205	229.20	10.66	0.01	122.11	-22,868.56	-6,227,221.78	0.01	63.96	617.70	24,066.19	22,192.70
217	240.66	10.40	0.01	125.19	-23,733.55	-6,318,102.70	0.01	56.97	604.02	25,269.50	23,061.31
229	252.70	10.16	0.01	128.36	-24,606.21	-6,403,865.25	0.01	50.69	588.70	26,532.98	23,939.84
241	265.33	9.92	0.01	131.62	-25,483.45	-6,484,125.56	0.01	45.05	571.68	27,859.63	24,825.21
253	278.60	9.69	0.01	134.94	-26,361.96	-6,558,515.53	0.01	40.00	552.94	29,252.61	25,714.08
265	292.53	9.46	0.01	138.31	-27,238.28	-6,626,686.13	0.01	35.47	532.49	30,715.24	26,602.95
277	307.15	9.23	0.01	141.71	-28,108.91	-6,688,309.78	0.01	31.42	510.39	32,251.00	27,488.23
289	322.51	9.00	0.01	145.12	-28,970.41	-6,743,081.69	0.01	27.79	486.74	33,863.55	28,366.33
301	338.64	8.77	0.01	148.53	-29,819.52	-6,790,719.81	0.00	24.55	461.72	35,556.73	29,233.82
313	355.57	8.54	0.02	151.91	-30,653.27	-6,830,963.31	0.00	21.65	435.53	37,334.56	30,087.49

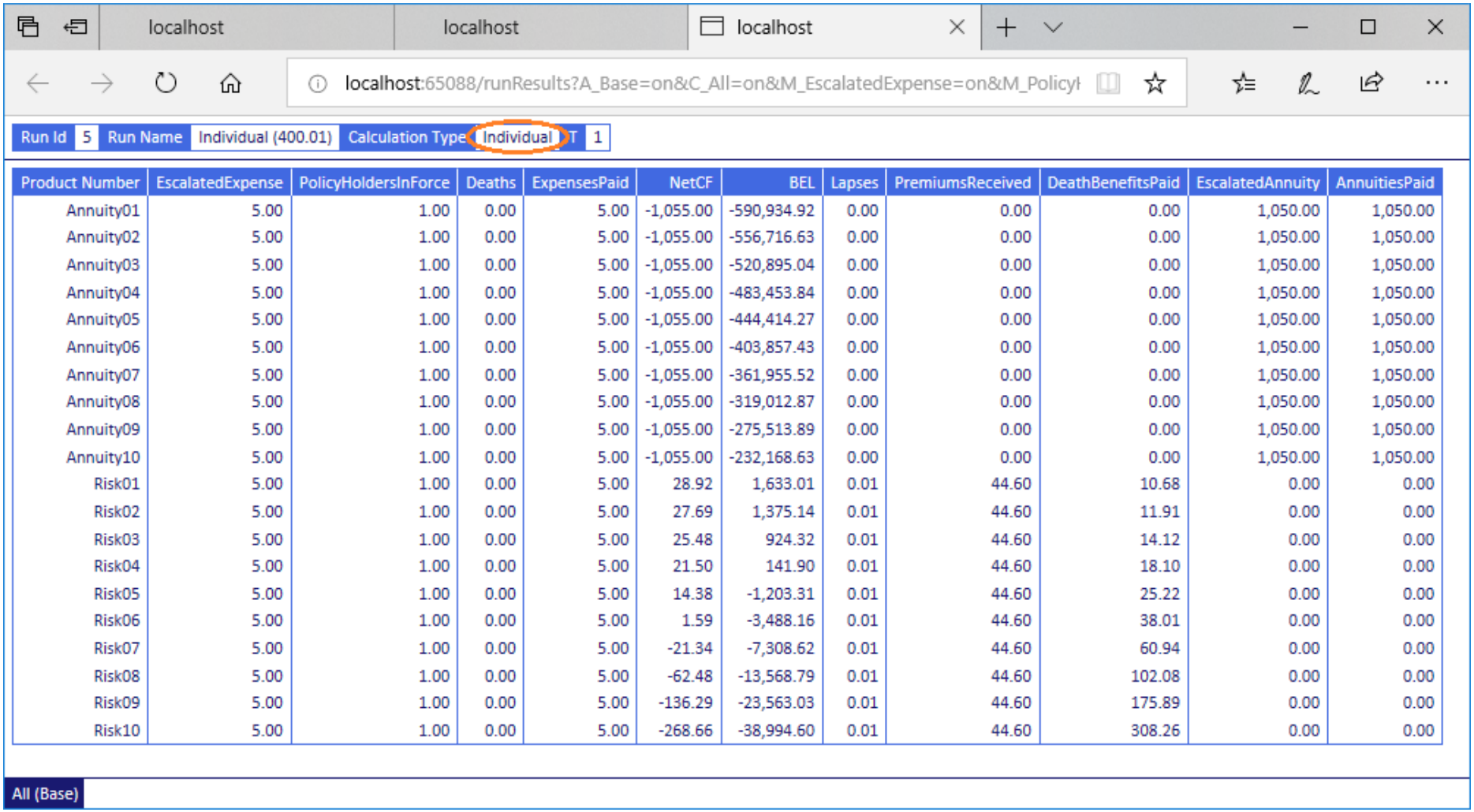
Deterministic Individual

Inputs required:

Input	Description
T	Which time period (t) the calculations must be performed for.
Functions	Which **Functions** must be included in the result set.
Conditions	Which extra **Conditions** must be included in the result set.
Scenarios	Which extra **Scenarios** must be included in the result set.

Given a set of data (for example a set of policies) calculations are performed on each data item (policy) for the given **Time Period** (t). Each individual data items' **Function** values are stored in the result set. Any additional **Conditions** and **Scenarios** specified in the run will create extra **Absolute** result sets.

In arriving at values for **t** may have initiated calculations all the way to **MaxT**.



Product Number	EscalatedExpense	PolicyHoldersInForce	Deaths	ExpensesPaid	NetCF	BEL	Lapses	PremiumsReceived	DeathBenefitsPaid	EscalatedAnnuity	AnnuitiesPaid
Annuity01	5.00	1.00	0.00	5.00	-1,055.00	-590,934.92	0.00	0.00	0.00	1,050.00	1,050.00
Annuity02	5.00	1.00	0.00	5.00	-1,055.00	-556,716.63	0.00	0.00	0.00	1,050.00	1,050.00
Annuity03	5.00	1.00	0.00	5.00	-1,055.00	-520,895.04	0.00	0.00	0.00	1,050.00	1,050.00
Annuity04	5.00	1.00	0.00	5.00	-1,055.00	-483,453.84	0.00	0.00	0.00	1,050.00	1,050.00
Annuity05	5.00	1.00	0.00	5.00	-1,055.00	-444,414.27	0.00	0.00	0.00	1,050.00	1,050.00
Annuity06	5.00	1.00	0.00	5.00	-1,055.00	-403,857.43	0.00	0.00	0.00	1,050.00	1,050.00
Annuity07	5.00	1.00	0.00	5.00	-1,055.00	-361,955.52	0.00	0.00	0.00	1,050.00	1,050.00
Annuity08	5.00	1.00	0.00	5.00	-1,055.00	-319,012.87	0.00	0.00	0.00	1,050.00	1,050.00
Annuity09	5.00	1.00	0.00	5.00	-1,055.00	-275,513.89	0.00	0.00	0.00	1,050.00	1,050.00
Annuity10	5.00	1.00	0.00	5.00	-1,055.00	-232,168.63	0.00	0.00	0.00	1,050.00	1,050.00
Risk01	5.00	1.00	0.00	5.00	28.92	1,633.01	0.01	44.60	10.68	0.00	0.00
Risk02	5.00	1.00	0.00	5.00	27.69	1,375.14	0.01	44.60	11.91	0.00	0.00
Risk03	5.00	1.00	0.00	5.00	25.48	924.32	0.01	44.60	14.12	0.00	0.00
Risk04	5.00	1.00	0.00	5.00	21.50	141.90	0.01	44.60	18.10	0.00	0.00
Risk05	5.00	1.00	0.00	5.00	14.38	-1,203.31	0.01	44.60	25.22	0.00	0.00
Risk06	5.00	1.00	0.00	5.00	1.59	-3,488.16	0.01	44.60	38.01	0.00	0.00
Risk07	5.00	1.00	0.00	5.00	-21.34	-7,308.62	0.01	44.60	60.94	0.00	0.00
Risk08	5.00	1.00	0.00	5.00	-62.48	-13,568.79	0.01	44.60	102.08	0.00	0.00
Risk09	5.00	1.00	0.00	5.00	-136.29	-23,563.03	0.01	44.60	175.89	0.00	0.00
Risk10	5.00	1.00	0.00	5.00	-268.66	-38,994.60	0.01	44.60	308.26	0.00	0.00

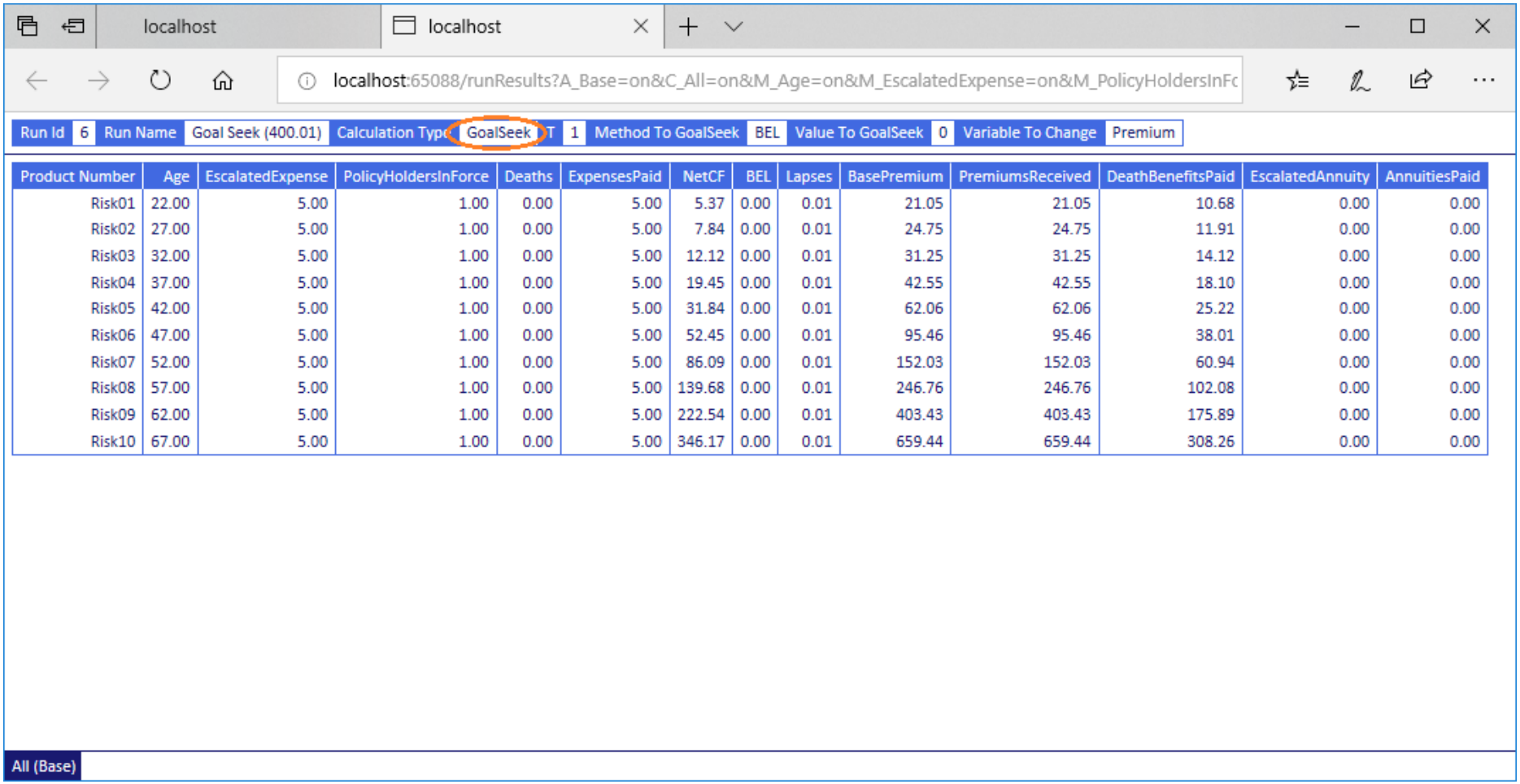
Deterministic Goal Seek

Inputs required:

Input	Description
T	Which time period (t) the calculations must be performed for.
Function To Goal Seek	Which Function will be goal seeked to Value To Goal Seek
Value To Goal Seek	The value to goal seek for the given Function.
Variable To Change	The Instance Variable to change for each iteration of the goal seek.
Functions	Which **Functions** must be included in the result set.
Conditions	Which extra **Conditions** must be included in the result set.
Scenarios	Which extra **Scenarios** must be included in the result set.

Given a set of data (for example a set of policies) calculations are performed on each data item (policy) for the given **Time Period** (t). A Newton Raphson interation sequence is performed on each data item (policy) whereby the **Variable To Change** is adjusted until the value of the **Function to Goal Seek** equals the **Value To Goal Seek**. Each individual data items' **Function** values are stored in the result set. Any additional **Conditions** and **Scenarios** specified in the run will create extra Absolute result sets.

In the example below, a goal seek methodology is used to calculate the premium for a series of life policies that have the same death benefit, but start at different policy holder ages. As can be expected the premiums increase with the starting age of the policy holder.



Product Number	Age	EscalatedExpense	PolicyHoldersInForce	Deaths	ExpensesPaid	NetCF	BEL	Lapses	BasePremium	PremiumsReceived	DeathBenefitsPaid	EscalatedAnnuity	AnnuitiesPaid
Risk01	22.00	5.00	1.00	0.00	5.00	5.37	0.00	0.01	21.05	21.05	10.68	0.00	0.00
Risk02	27.00	5.00	1.00	0.00	5.00	7.84	0.00	0.01	24.75	24.75	11.91	0.00	0.00
Risk03	32.00	5.00	1.00	0.00	5.00	12.12	0.00	0.01	31.25	31.25	14.12	0.00	0.00
Risk04	37.00	5.00	1.00	0.00	5.00	19.45	0.00	0.01	42.55	42.55	18.10	0.00	0.00
Risk05	42.00	5.00	1.00	0.00	5.00	31.84	0.00	0.01	62.06	62.06	25.22	0.00	0.00
Risk06	47.00	5.00	1.00	0.00	5.00	52.45	0.00	0.01	95.46	95.46	38.01	0.00	0.00
Risk07	52.00	5.00	1.00	0.00	5.00	86.09	0.00	0.01	152.03	152.03	60.94	0.00	0.00
Risk08	57.00	5.00	1.00	0.00	5.00	139.68	0.00	0.01	246.76	246.76	102.08	0.00	0.00
Risk09	62.00	5.00	1.00	0.00	5.00	222.54	0.00	0.01	403.43	403.43	175.89	0.00	0.00
Risk10	67.00	5.00	1.00	0.00	5.00	346.17	0.00	0.01	659.44	659.44	308.26	0.00	0.00

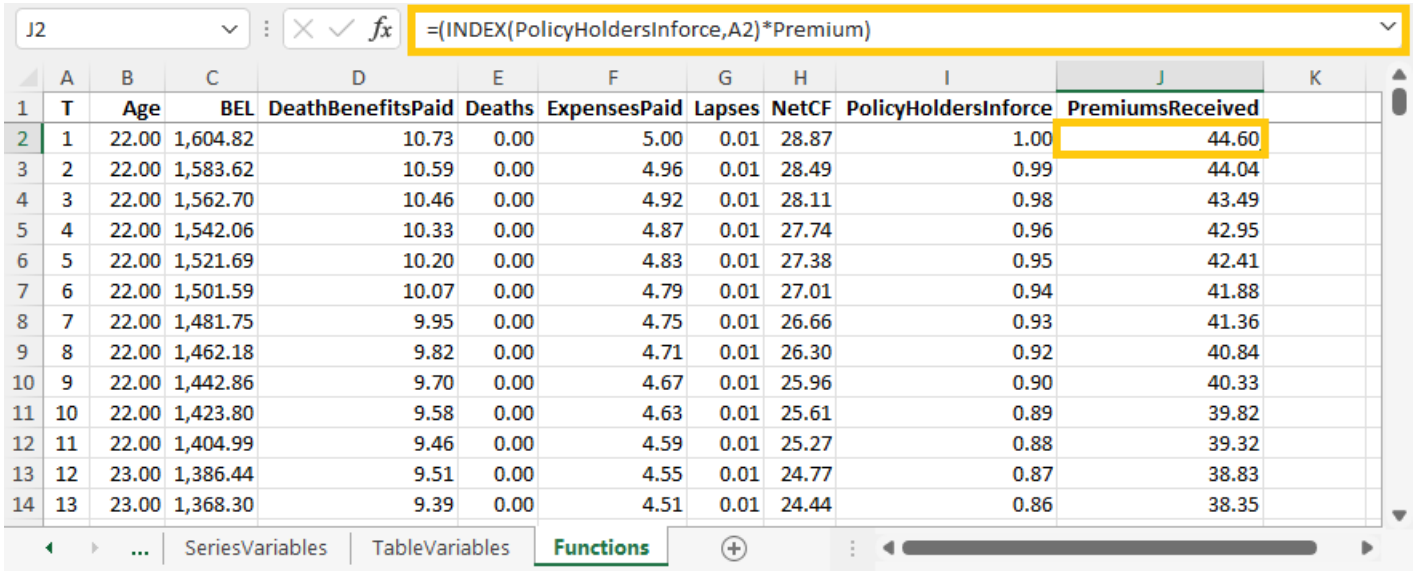
Deterministic Audit

Inputs required:

Input	Description
Product Number	Which product in the data set to use in the calculation.
Scenario	Which scenario to use in the calculation

Given a particular data item (e.g. policy) in a data set the **Audit Result Set** creates an Excel spreadsheet that contains all the calculations for the given data item for all **Time Periods** from **1** to **MaxT** for all the **Functions** of the chosen **Product Type**. The spreadsheet contains **formulae** (not mere values) so that you can inspect how the calculations are actually done. This is extremely useful for auditing models.

Below is an example showing a formula contained in the Audit spreadsheet:



	A	B	C	D	E	F	G	H	I	J	K
1	T	Age	BEL	DeathBenefitsPaid	Deaths	ExpensesPaid	Lapses	NetCF	PolicyHoldersInforce	PremiumsReceived	
2	1	22.00	1,604.82	10.73	0.00	5.00	0.01	28.87	1.00	44.60	
3	2	22.00	1,583.62	10.59	0.00	4.96	0.01	28.49	0.99	44.04	
4	3	22.00	1,562.70	10.46	0.00	4.92	0.01	28.11	0.98	43.49	
5	4	22.00	1,542.06	10.33	0.00	4.87	0.01	27.74	0.96	42.95	
6	5	22.00	1,521.69	10.20	0.00	4.83	0.01	27.38	0.95	42.41	
7	6	22.00	1,501.59	10.07	0.00	4.79	0.01	27.01	0.94	41.88	
8	7	22.00	1,481.75	9.95	0.00	4.75	0.01	26.66	0.93	41.36	
9	8	22.00	1,462.18	9.82	0.00	4.71	0.01	26.30	0.92	40.84	
10	9	22.00	1,442.86	9.70	0.00	4.67	0.01	25.96	0.90	40.33	
11	10	22.00	1,423.80	9.58	0.00	4.63	0.01	25.61	0.89	39.82	
12	11	22.00	1,404.99	9.46	0.00	4.59	0.01	25.27	0.88	39.32	
13	12	23.00	1,386.44	9.51	0.00	4.55	0.01	24.77	0.87	38.83	
14	13	23.00	1,368.30	9.39	0.00	4.51	0.01	24.44	0.86	38.35	

Stochastic Aggregate

Inputs required:

Input	Description
T	Which time periods values must be stored in the result set.
Scenarios	The number of scenarios in the stochastic defined input data variables

Performs an **aggregate** calculation for each **scenario** in the stochastic data set, with each scenario's values for the selected time period **t** being stored. Results can be extracted as the **average** of all the scenarios as well as for selected **percentiles**.

In the example below we have selected to show the **average** as well as the 0, 25, 50 75, and 100 **percentiles** (Note that the **average** and the **50th percentile** are close but not exactly the same!)

Run Id 31 Run Name Individual (600.03) Calculation Type StochasticAggregate

	EndValue	GuaranteePayout
Average	127,667,382.37	424.18
0.000 Percentile	105,972,107.74	0.00
25.000 Percentile	123,514,472.52	0.00
50.000 Percentile	127,543,497.02	0.00
75.000 Percentile	131,660,364.24	0.00
100.000 Percentile	154,979,641.86	807,778.46