CashCalc Specification Sheets (Client Facing)

Pension Drawdown Monte Carlo Simulator

Overview

The Pension Drawdown Monte Carlo Simulator is designed to speculate the percentage chance that a pension pot will drop below a particular threshold and also the percentage chance that it will stay above that threshold for the duration of the forecast. It runs up to ten thousand simulations using a random set of growth rates determined by a preselected risk profile. Inflation values are also randomly generated, both the growth rates and inflation rates used are based on historic values.

Assumptions

Below is a list of all assumptions made in order to perform the calculation:

- Figures are rounded up to the nearest pound
- Calculations are performed on an annual basis
- Growth Rates and Inflation are randomly generated using the Gaussian distribution based on historic values
- Growth Rates generated are assumed to be gross of any charges or fees
- Growth Rates for each Risk Profile are set based on benchmarks provided by an industry leading provider
- Annual Adviser Fee is set by the user and has a range of 0.00% and 3.00% (Default: 0.1%)
- Simulation End Age is set by the user and goes up to 99 years of age
- Values displayed are in today's terms and are adjusted for Inflation unless the user specifies otherwise
- Income is assumed to be drawn from the Pension on the first day of the year
- User specifies any Income drawdown taken from the pot including Start Age, End Age and the rate at which it will match Inflation and if it is Adjusted for Inflation if the Income starts in the future
    - Custom Inflation can range from 0% to 10% (Default: 2%)

For risk profile information see Appendix 1

Calculations Breakdown

The calculations require six parameters in order to calculate the given output, these being:

- Current Pension Pot
- Value Threshold
- Client Risk Profile
- Annual Adviser Fee
- Simulation End Age
- Drawdown Income

The Pension Drawdown Monte Carlo Simulator runs a thousand scenarios to produce the percentages seen when the result is returned, for each of these scenarios the following formulas are used:

Firstly, from our historic data we have an inflation mean and standard deviation which can be used to generate a random value (it is generated using the Gaussian distribution) that will replicate realistic values.

Once the inflation values that are going to be used have been determined the value of income taken can be calculated (if the income is not being adjusted for inflation / growing at a custom rate then those values are used instead):

If the income is adjusted for inflation then the following calculation is used:

```
Value this year = Amount Specified *((1 + (Custom Inflation Rate – Inflation Rate)
                  / 100) ^ (Current Age – Item Start Age))
```

If the income is not adjusted for inflation the following calculation is used:

```
Value this year = Amount Specified * (1 – (Inflation Rate / 100)) ^ (Item Start Age
  – Forecast Start Age) * ((1 + (Custom Inflation Rate – Inflation Rate) / 100) ^
                          (Current Age – Item Start Age))
```

The Growth is calculated using the Gaussian distribution with the mean and standard deviation taken based on the risk profile chosen. The Growth is then adjusted up or down by up to one standard deviation depending on the inflation rate in that year. This gives the Adjusted Growth.

Adjustment Factor:

		Inflation Rate									
		0 - 0.5	0.5 - 1	1 - 1.5	1.5 - 2	2 - 2.5	2.5 - 3	3 - 3.5	3.5 - 4	4 - 4.5	4.5 - 5
Risk Profile	1	-1	-7/9	-5/9	-3/9	-1/9	1/9	3/9	5/9	7/9	1
	2	-7/9	-49/81	-35/81	-21/81	-7/81	7/81	21/81	35/81	49/81	7/9
	3	-5/9	-35/81	-25/81	-15/81	-5/81	5/81	15/81	25/81	35/81	5/9
	4	-3/9	-21/81	-15/81	-9/81	-3/81	3/81	9/81	15/81	21/81	3/9
	5	-1/9	-7/81	-5/81	-3/81	-1/81	1/81	3/81	5/81	7/81	1/9
	6	1/9	7/81	5/81	3/81	1/81	-1/81	-3/81	-5/81	-7/81	-1/9
	7	3/9	21/81	15/81	9/81	3/81	-3/81	-9/81	-15/81	-21/81	-3/9
	8	5/9	35/81	25/81	15/81	5/81	-5/81	-15/81	-25/81	-35/81	-5/9
	9	7/9	49/81	35/81	21/81	7/81	-7/81	-21/81	-35/81	-49/81	-7/9
	10	1	7/9	5/9	3/9	1/9	-1/9	-3/9	-5/9	-7/9	-1

```
Adjusted Growth this year = Growth this year + (Standard Deviation * Adjustment
                            Factor)
```

Once the Adjusted Growth has been calculated the following calculation is used to determine the pot value in the current year:

```
Pot Value this year = (Pot Value previous year – Income Value this year) * (1 +
((Adjusted Growth this year – Annual Adviser Fee – Inflation this year) / 100))
```

After all 10,000 simulations have been run for every year the percentage chance of the Pot ending above the Threshold is calculated using the following formula (This is not calculated if the Threshold is zero):

```
Percentage Chance = (# of Simulations That Ended Above the Threshold / # of
                    simulations ran) * 100
```

After all 10,000 simulations have been run for every year the percentage chance of the Pot staying above the Threshold is calculated using the following formula:

```
Percentage Chance = (# of Simulations That Stayed Above the Threshold / # of
                    simulations ran) * 100
```

The values displayed on the graph as the Optimistic, Average and the Pessimistic are determined by the following steps:

1. For each year that is displayed the values for that year from each of the simulations are sorted according to their size.
2. The Average line uses the median value from this sorted list.
3. The Optimistic takes the value of the upper quartile.
4. The Pessimistic takes the value of the lower quartile.

A PDF report can be created from this calculator which contains detailed information about the relevant client's details and the outputs of the calculations performed. The data plotted in graphical form is created by using the Google Chart API.

Appendix 1:

Historic Performance Data

Figures based upon benchmark returns in 20 year period ended 31st December 2016. The investment mandates available in this solution are detailed below.

Asset Group	Investment Mandates (figures as %)									
Name	1	2	3	4	5	6	7	8	9	10
Managed Liquidity/Cash	80	25	15	15	5	0	0	0	0	0
Fixed Interest	20	55	55	35	30	25	15	0	0	0
Property	0	10	10	10	10	10	15	15	10	0
UK Value and Income Equity	0	5	10	20	20	20	20	20	15	10
UK Growth/Equities	0	5	5	10	15	20	20	15	15	15
Global Equity	0	0	5	10	20	25	25	35	35	40
Emerging Markets	0	0	0	0	0	0	5	15	25	35
Annualised Return	3.41	5.87	6.56	6.97	7.56	7.83	7.94	8.23	8.26	8.26
Volatility	0.92	2.84	3.88	6.05	8.05	9.39	10.26	12.93	14.31	16.51
Maximum 12 Month Rolling Gain	7.48	13.98	18.71	26.21	32.76	37.14	40.45	48.05	52.18	59.45
Maximum 12 Month Rolling Loss	0.04	-5.87	-9.64	-15.61	-20.77	-23.65	-26.46	-30.82	-32.20	-33.83

Asset Group Data

Asset Group	Benchmark
Managed Liquidity/Cash	FE FER Cash Proxy TR in GB
Fixed Interest	20% FTSE Actuaries UK Conventional Gilts All Stocks TR in GB 10% FTSE Actuaries UK Index-Linked All Stocks TR in GB 30% iBoxx Stg CORP. ALL MATS. TR in GB 40% Barclays Global Aggregate GBP H TR in GB
Property	FE UK Property Proxy TR in GB
UK value and Income Equity	FTSE UK Equity Income
UK Growth	FTSE All Share TR in GB
Global Equity	FTSE Developed Ex UK TR in GB
Emerging Markets	FTSE Emerging TR in GB