**Pension Projection Model**

**Objective**

This model has been produced for Jeremy Owens, client of HH Wealth Management Ltd. The purpose of the model is to project the future value of Jeremy’s pension fund and determine what annual contribution he needs to make to achieve his target of £15,000 annual income in retirement.

During accumulation (i.e. from age 45 exact to his 65th birthday) Jeremy’s fund is invested in ‘Pension Accumulation I’ (PAI) and ‘Pension Accumulation II’ (PAII). On retirement on his 65th birthday his fund moves into ‘Drawdown I’ (DDI). An actuarial student has provided projected monthly and annual returns for each fund.

The model performs the following calculations:

* The value of the fund during retirement (ages 65 to 90) is projected to determine what size the fund needs to be at retirement to meet Jeremy’s income target (i.e. what are the minimum contributions required so that he has sufficient funds to provide an annual income of £15,000 from age 65 exact up to age 89, with the fund being exhausted on his 90th birthday).
* The value of the fund during accumulation is projected to determine the annual contribution Jeremy needs to make to meet his target.
* To illustrate the uncertainty in the projections, an additional calculation is performed. This calculation shows what income Jeremy could take if his fund at retirement was only £200,000.
* The annual return calculations provided by the student actuary are checked by calculating annual returns from the monthly returns.

**Data**

An actuarial student has provided 240 monthly returns for funds PAI and PAII, covering the 20 year period when Jeremy is aged 45 to 65, and 300 monthly returns for fund DDI, covering the 25 year period when Jeremy is aged 65 to 90. She has told us that the returns are net of charges, and the distributions are as follows:

* Pension Accumulation I: Normal with a mean of 0.4% and standard deviation of 0.05%
* Pension Accumulation II: Normal with a mean of 0.95% and standard deviation of 0.2%
* Drawdown I: Normal with a mean of 0.3% and standard deviation of 0.04%

The following validation checks have been performed on the data:

* The mean and standard deviation of the monthly returns for each of the three funds have been compared to the expected values based on the normal distributions. The values are within 0.1% of those expected.
* The maximum and minimum return for each fund has been calculated. These fall within a reasonable range (they have been compared to the mean +/- three standard deviations and are within 0.5%).
* The number of data points is as expected.
* There are no blanks or zero values.

The student also calculated annual returns for each fund using the monthly returns. These are used in the funds projections and have been checked by calculating annual returns from monthly returns on the sheet ‘Annual Return Checks’.

No changes have been made to the data.

**Assumptions**

The following assumptions have been made in the model:

* Jeremy withdraws his annual income in retirement at the start of the year, making 25 withdrawals in total.
* Jeremy makes contributions to the fund during accumulation at the start of the year, making 20 contributions in total. Each contribution is split equally between PAI and PAII.
* No allowance has been made for mortality, lapses or further charges. I have also assumed Jeremy does not miss any payments, and his retirement plans don’t change.
* The info on fund performance is a reasonable representation of what is likely to happen.
* Assume that you don’t rebalance the fund split to 50/50 post age 45.

**Parameters**

This sheet sets out the parameters used in the model:

* Annual withdrawal in retirement. Jeremy has told us his target is £15,000.
* Fund value at age 45 exact. We know the current fund value is £10,000.
* Proportion invested in fund PAI and PAII. We know that the fund is currently split equally between the two, and each annual contribution will be split equally.

This sheet also shows the colour coding used in the model.

**Drawdown Fund Values**

This sheet projects the value of the fund in retirement. Initially the fund at age 65 is assumed to be £300,000. This is input in cell C4. The fund at the end of each year is calculated as follows:

$$Fund at end=(Fund at start-Annual withdrawal)×(1+i)$$

Where i is the annual return for that year.

There is an automated check that the total investment returns in this sheet matches the total returns in the previous sheet.

Goalseek was then used to calculate the minimum fund required at age 65. The goalseek setup was as follows:

* Set cell: G33
* To value: 0
* By changing cell: C4

The minimum fund at age 65 has been calculated as £250,476.

**Accumulation Fund Values**

This sheet projects the value of the fund during accumulation. Initially the annual contribution is assumed to be £2,500. This is input in cell C5. The fund at the end of each year is calculated separately for PAI and PAII as follows:

$$Fund at end=(Fund at start+Annual contribution)×(1+i)$$

Where i is the annual return for that fund for that year. The total fund value is simply equal to the sum of the value of the two funds.

There is an automated check that the total investment returns for each fund in this sheet matches the total returns in the annual return checks sheet. There is also a check that the total contributions are equal to 20 times the annual contribution.

Goalseek was then used to calculate the minimum annual contribution required so that the fund at age 65 was equal to the target fund calculated previously (£250,476). The goalseek setup was as follows:

* Set cell: L33
* To value: 0
* By changing cell: C5

The minimum annual contribution required has been calculated as £3,278.

**Poor Performance Calculations**

This sheet shows what annual contribution Jeremy could take if his fund value at retirement was only £200,000. The fund value has been input in cell C4. The calculations are the same as in the sheet ‘Drawdown Fund Values’. Initially we assume an annual withdrawal of £15,000. This is input in cell C3.

There is an automated check that the total investment returns in this sheet matches the total returns in the annual return checks sheet. There is an automated check to check that the calculated annual withdrawal is less than the initial target of £15,000.

Goalseek was then used to calculate the maximum annual withdrawal Jeremy could take. The goalseek setup was as follows:

* Set cell: G33
* To value: 0
* By changing cell: C3

The maximum annual contribution has been calculated as £11,977.

**Charts**

This sheet is used to create two charts. The first shows the projected fund values during accumulation for PAI, PAII and the total fund. The fund values at each age have been taken from the sheet ‘Accumulation Fund Values’. The fund value at age 65 is the fund value at the end of the year for age 64.

There is an automated check that the total on this sheet matches the total on the sheet ‘Accumulation Fund Values’.

The second chart shows the fund during drawdown based on our initial assumptions, and under the poor performance scenario.

**Annual Return Checks**

In this sheet the monthly returns are used to calculate annual returns for each fund, to check that the annual returns calculated by the student actuary are correct. 20 annual returns are calculated for PAI and PAII and 25 annual returns are calculated for DDI. Each set of 12 monthly returns is combined to give the annual return using the following formula:

$$i\_{annual}=\left[\prod\_{x=1}^{12}(1+i\_{x})\right]-1$$

The following automated checks are performed:

* 240 monthly returns are being brought through to this sheet for PAI and PAII.
* 300 monthly returns are being brought through to this sheet for DDI.
* 20 annual returns are calculated for PAI and PAII.
* 25 annual returns are calculated for DDI.

The following reasonableness checks are performed:

* The average annual return for each fund is compared to (1+i)12-1, where i is the average monthly return for the fund. These checks show that the values appear reasonable.
* Checked that the calculated results match those provided by the actuarial student. All match exactly.