

INSTITUTE AND FACULTY OF ACTUARIES

SUMMARY

April 2018

CA2: Model Documentation, Analysis and Reporting

Paper 2

Hilltop's balance sheet deficit projections

Objective

Our client, Peter, is the chairman of Hilltop, a children's charity. As at 1 January 2018 Hilltop's balance sheet showed a deficit.

Hilltop have launched a campaign from which they expect to receive new charitable donations in 2018 and each subsequent year for as long as the campaign continues. These donations will be used to reduce the charity's deficit. Peter has asked our consultancy, Actuarial Calculations Ltd (AC Ltd), to project Hilltop's balance sheet position forward 15 years allowing for the expected new donations.

Peter does not expect these donations to be sufficient to remove the charity's deficit and has therefore asked AC Ltd to investigate the following:

1. The additional level of donations required for the deficit to be reduced to zero within 15 years.
2. The additional return in excess of the NBI yields required on the assets for the deficit to be reduced to zero within 15 years based on the original level of donations.
3. The additional donations required for the deficit to be reduced to zero within 10 years, based on the original level of investment return.

Data

Peter provided details of Hilltop's balance sheet as at 1 January 2018. He has also provided details of:

- the expected donations from the campaign,
- the charity's current investment strategy,
- the charity's expected annual outgo for each of the next 15 years.

AC Ltd's statistics department provided forward yields for the National Bond Index that Hilltop's assets are assumed to follow.

The data looks reasonable in so far as:

- the count of the outgo data and forward yield data is fifteen which is equal to the projection period we need to cover.
- the minimum, maximum and average of both the outgo figures and forward yields give no reason to doubt the data. However, further validation should be undertaken.
- graphs of the outgo and forward yields show reasonable trends, giving no reason to doubt the data.

Assumptions

- The data provided by Peter and the statistics department are correct.

- The level of annual inflation is appropriate and is assumed to remain constant over the course of the projections.
- Cashflows are assumed to occur, on average, half way through the year.
- Hilltop's assets are assumed to achieve NBI index returns in line with their aim.
- **The level of annual donations anticipated are achievable and can be maintained in real terms for the duration of the projections.**
- **There are no additional annual outgo arising from the new campaign.**
- **No other unexpected outgo will arise in the next 15 years (e.g. unexpected legal or regulatory costs or new causes to support)**
- **The National Bond Index (NBI) is an appropriate indicator of the current asset portfolio's investment return going forward.**
- **The investment strategy is not changed for the duration of the projections, apart from in the 'Additional Return' scenario.**
- **Assets exist which would enable the charity to achieve a return equal to the NBI plus a fixed margin.**
- **The impact on the level of prudence for the change in risk levels can be ignored under the 'Additional Return' scenario**
- **The alternative assets are permissible for the charity to invest in.**
- **It would be possible to increase donations above the level expected from the campaign.**
- **The charity will continue to operate in the same capacity as it is currently run for the duration of the projections.**

Method

Campaign projections

Hilltop's balance sheet is projected forward each year for the next 15 years, allowing for the campaign donations and the annual outgo.

Each year the liabilities are projected forward by taking the liability at the end of the previous year (or the starting value for year 1), deducting the anticipated outgo and adding interest, where:

- The anticipated outgo is in line with the information provided by Peter.
- The interest is equal to:
forward NBI yield x (liability at the start of the year - half of the anticipated outgoing cashflows for the year)

The assets are projected forward by taking:

assets at the end of the previous year (or the starting value for year 1) – anticipated outgo +
anticipated donation + investment return

where:

- The anticipated outgo is consistent with that used for the liabilities.
- The anticipated donation for:
 - Year 1 is equal to the starting level of donation expected
 - For subsequent years, year n is equal to the starting level of donation increased by inflation for n-1 years.
- Investment return is equal to the forward NBI yield for the relevant year multiplied by an amount equal to the assets at the start of the year, minus half of the anticipated outgo, plus half of the anticipated donations.

The deficit at the end of the year is equal to the excess of liabilities over assets.

Donation Target

The liability calculations remain unchanged from the ‘campaign projections’ above.

The assets are projected in the same way as for the ‘campaign projections’ however a new starting level of donations is used. The starting value of these donations is found using goal seek, by setting the deficit at the end of the 15th year to zero.

Additional Returns

The liability calculations remain unchanged from the ‘campaign projections’ above.

The asset calculations are in line with the ‘campaign projections’, other than the investment returns i.e. the donations are the same as for the campaign. The investment return on the assets is revised to include a fixed additional yield to the NBI forward yield. The fixed additional yield is found using goal seek, by setting the deficit at the end of the 15th year to be zero.

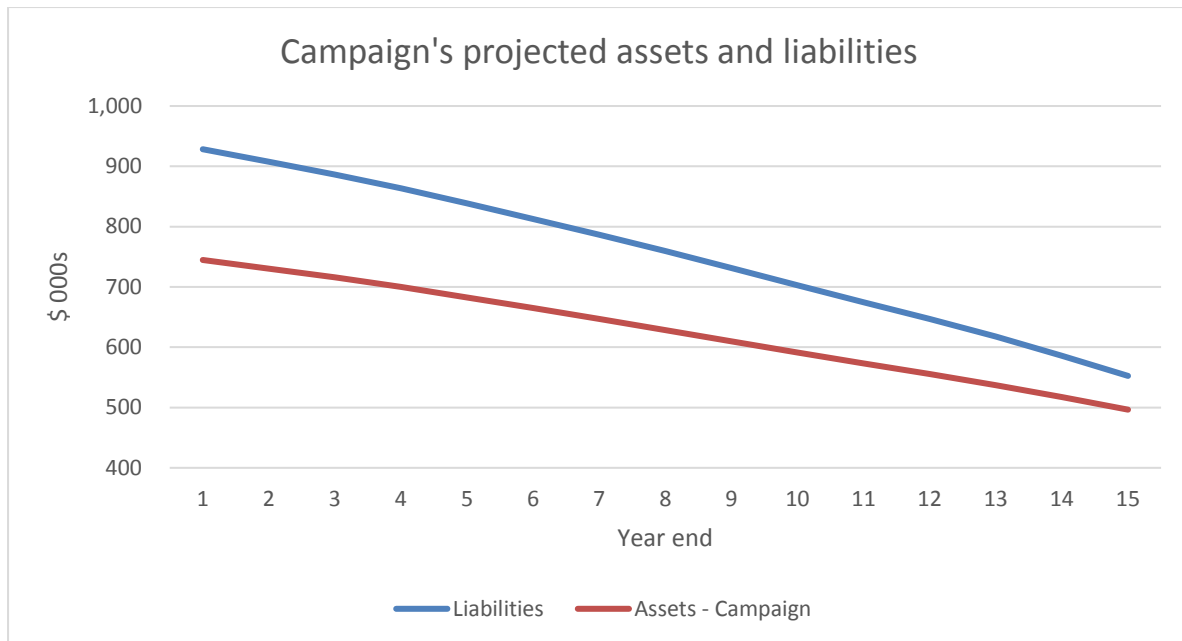
10 Year Target

Up to year 10, the 10 year target calculations are consistent with those undertaken for the ‘Donation Target’ scenario. However, in this scenario the starting donation is found by goal seek by setting the deficit at the end of the 10th year is set to zero. After year 10 we assume no further donations are accepted, therefore donations after year 10 are set to zero.

Results

Campaign projections

The following graph shows the projection of Hilltop’s assets and liabilities under the ‘Campaign’ scenario:



At the end of 15 years the charity is projected to have liabilities of \$552k and assets of \$496k, hence the deficit is \$56k. This is lower than the \$190k deficit as at 1 January 2018.

We can see from the graph that:

- The liabilities are greater than assets at all times, hence Hilltop is in deficit at all points over the next 15 years.
- The gap between the liabilities and assets reduces as time progresses. This is because the campaign's assets reduce more slowly than the liabilities, mainly due to the existence of the donations. Additional investment return earned on the donations increases this effect.

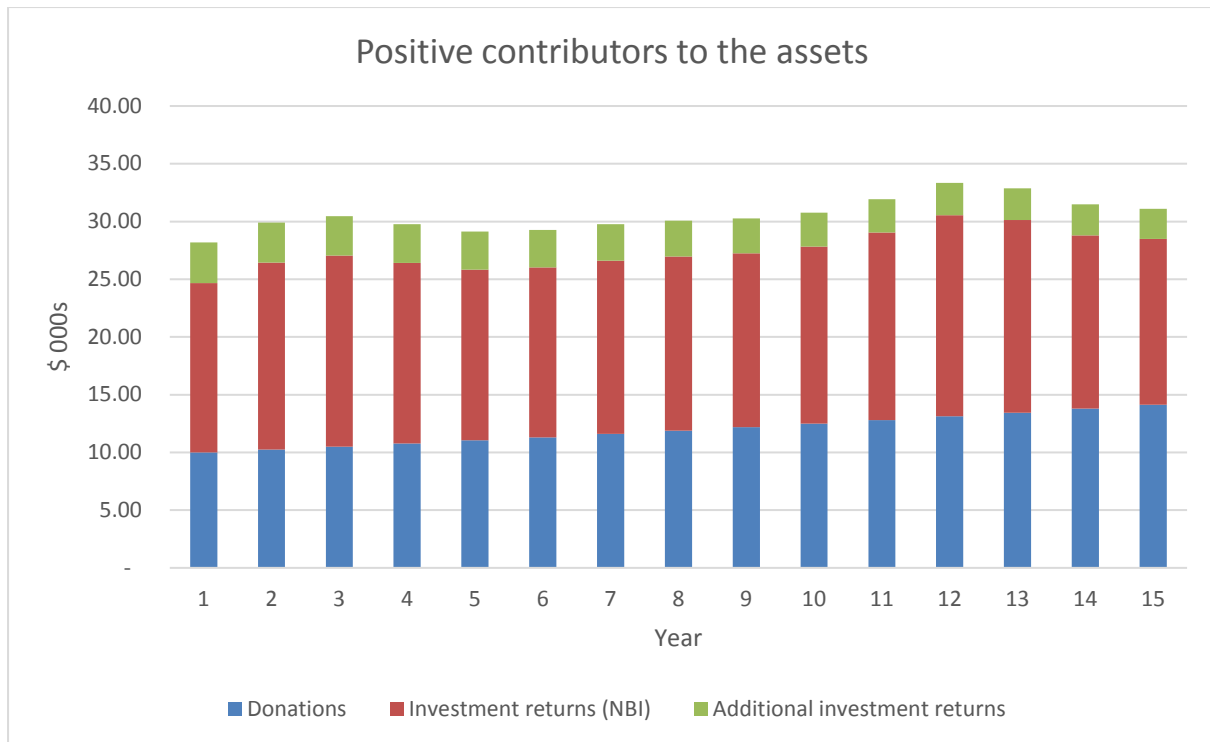
Donation target

For the deficit to be zero by the end of 15 years, donations need to start at \$12.6k in year 1, all else being equal to the campaign scenario. It follows that the donations need to be higher than the \$10k anticipated by the campaign which resulted in a deficit of \$56k after 15 years. Yields are roughly 2.5% per annum and inflation is 2.5% per annum. The average donation is received in 7.5 years' time. There are 15 donations so in 15 years' time the additional \$2.6k annual donation roughly has a total value of $2.6 \times 1.05^{7.5} \times 15 = \$56k$.

Additional return

For the deficit to be zero at the end of 15 years, with assumed donations at the campaign level, then the assets need to return 0.47% per annum in excess of the NBI forward yields.

The following graph shows how the investment returns and donations contribute towards reducing Hilltop's deficit:



We can see from the graph that:

- The investment return from NBI yields is the main cause of the increase. This return varies slightly over the term of the projections, which is expected as the NBI forward yields vary by year. The shape of this element of the graph reflects the shape of the forward NBI yield curve. When the yields are higher, more interest is received. For example, the forward yield curve has a peak in year 3, where we can see the investment returns are higher than those in the years either side of it, and it dips in year 5, where we can see the investment returns are lower than the years around it.
- The additional investment return is only a small contributing factor. The additional investment return rate is constant over the term of the projections and we therefore do not see a significant variation in the shape of this element of the graph from year to year.
- The element of the graph in respect of donations increases each year – this is expected as the donations increase by inflation each year.
- Roughly 60% of the increase in the assets consists of investment return. This indicates a large reliance on the investment strategy when considering whether the deficit can be met in the specified timeframe.

10 year target

For the deficit to be zero at the end of 10 years, annual donations need to start at \$18.9k. This is the highest starting annual donation of all the scenarios. It follows that donations need to start above the level of the 'donation target' scenario as there is the same deficit to meet however less time in which to do that.

The following graph shows the projection of Hilltop's assets and liabilities under the scenario which investigate how the deficit can be met:



We can see from the graph that:

- All scenarios show a zero deficit at the end of 15 years.
- The '10 year target' scenario shows a zero deficit at the end of 10 years. After that point the assets and liabilities are equal. This is because it is assumed no further donations are received and the interest applied to both the assets and liabilities is assumed to be equal.
- The assets under the '10 year target' scenario diminish more slowly than under the other scenarios as the donations assumed to be received are greater.
- The assets under the 'additional returns' and 'donation target' scenarios are similar. This is because the additional investment returns required (in \$ terms) are roughly equal to the additional donations required. The same level of deficit needed to be eliminated under both scenarios, the time period was the same and both methods increase the asset side only so a similar effect on the assets is expected.
- All the lines are downward sloping as the assumed outgo is larger than both the interest on liabilities and the combination of donations and investment returns. Consequently both the assets and liabilities are reducing over time. The assets are reducing less quickly than the liabilities as donations (and additional investment returns for the additional investment returns asset line) are acting to increase the assets, whereas they do not affect the level of the liabilities.
- The liabilities over time are the same in all three scenarios.

Conclusions

- The donations anticipated from the campaign scenario are insufficient to reduce the deficit to zero by the end of 15 years.
- Either a further \$2.6k donations per annum increasing with inflation or an additional 0.47% per annum investment return would be required to project a zero deficit at the end of 15 years.
- An additional \$8.9k per annum would be required to project a zero deficit at the end of 10 years.
- Whether the deficit is removed will depend on the actual investment returns earned, as well as the actual donations received.

Next steps

- Validate the data provided.
 - Confirm with the asset managers whether achieving returns in line with the NBI is reasonable.
 - Verify the starting balance sheet position of the charity
 - Verify the NBI forward rates against an external source
- Confirm that the trustees would accept the additional risk required under the ‘Additional Return’ scenario.
- Confirm whether any material changes have taken place between 1 January 2018 and the time of the projections being undertaken e.g. are the NBI yields being used still appropriate or have markets moved substantially?
- Independently verify whether targeting higher investment returns is achievable and allowable.
- Make an allowance for additional credit risk as a result of investing in higher risk assets to achieve the additional yield.
- Model future investment returns stochastically so that a range of deficit values can be provided, giving Peter an idea of the likelihood of a deficit at the end of 15 years.
- Allow for the assumed inflation to vary over time i.e. reflect an inflation curve rather than a single assumption.
- Find out about the anticipated timings of donations and outgo so that investment returns can be more accurately calculated e.g. are donations more likely to be received over the Christmas period.

- Find out more detail about the anticipated amount of the donations and how these are likely to increase e.g. are they more likely to increase in line with earnings rather than price inflation.
- If appropriate, enhance the model to allow for monthly cashflows.
- Sensitivity test the result to changes in outgoing cashflows.
- Consider the change to investment returns and/or donations for the deficit to be met one year earlier or one year later.
- Show the effect on the deficit if the charity was to grow or take on additional projects over the course of the projections, resulting in different income (be it from donations or other sources) and higher levels of outgo.
- Determine the additional margin required over the NBI yield for the deficit to be removed by the end of 10 years, rather than varying the assumed donations.
- Undertake a “shock” scenario test – for example:
 - what would happen were the charity to require more substantial outgo in any one particular year
 - what would happen if the market values of the assets were to drop substantially and how would this affect the value placed on the liabilities if these are linked to the same index as the assets
- Update the projections monthly as time passes, including new liability values based on new NBI forward rates and updated asset market values. This will enable Peter to determine whether Hilltop needs to try and obtain higher levels of donations in future years or whether there is less pressure to campaign for donations.
- Consider tax implications, e.g. gift aid, on donations or reclaims of tax allowed on outgo for charities if not already allowed for in Peter’s figures.
- Confirm that any costs of the campaign are included in the outgoing cashflow figures, or if not obtain and include them if they are to be met from charity funds.
- Check that new donations can be used to remove the deficit and are not ring-fenced.
- Obtain a peer review of the work performed.

END OF SUMMARY