

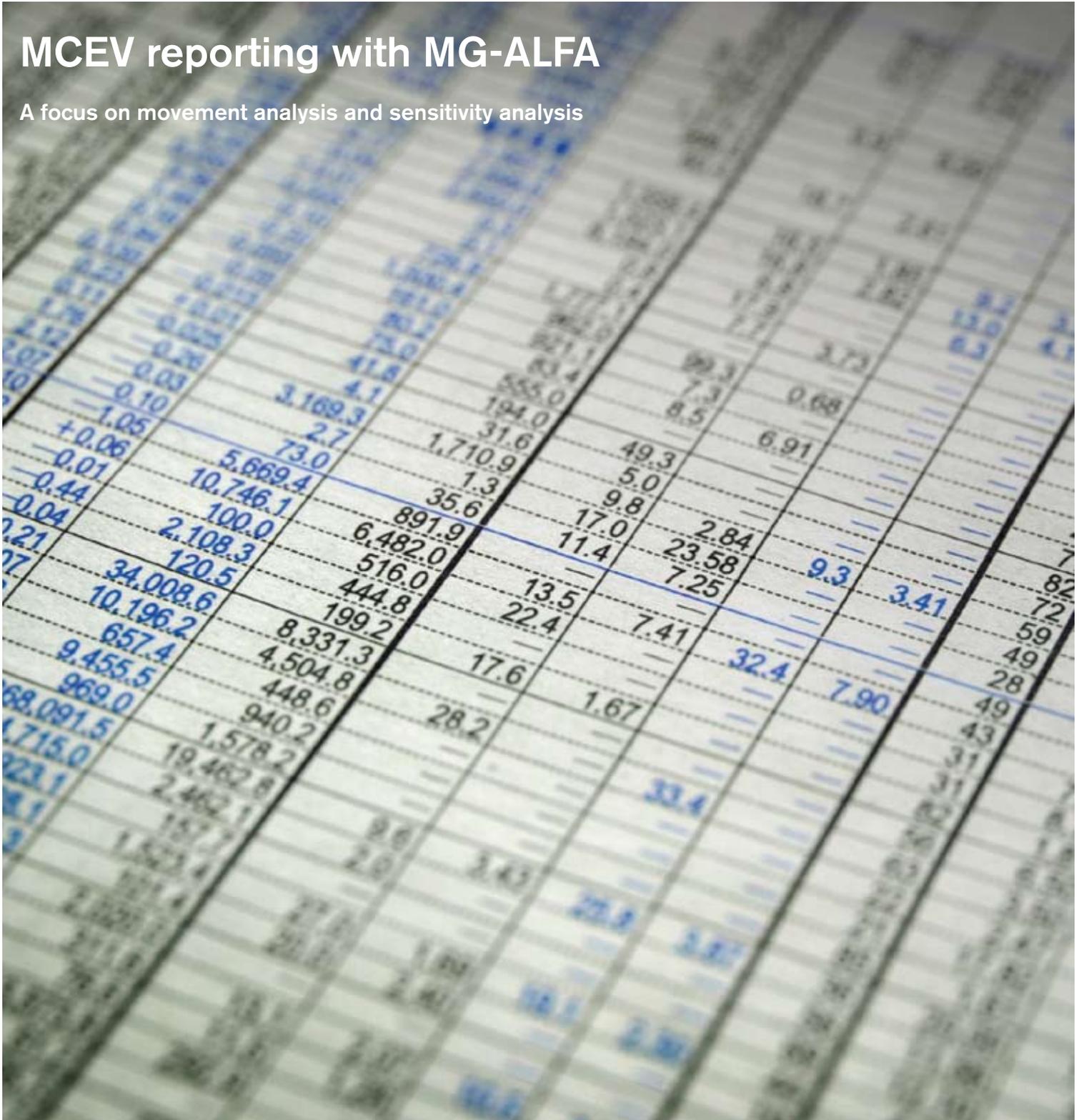
Prepared by:  
David W. Wang, FSA, MAAA

July 2010



# MCEV reporting with MG-ALFA

A focus on movement analysis and sensitivity analysis





## TABLE OF CONTENTS

SECTION I - INTRODUCTION	2
SECTION II - SAMPLE MG-ALFA PROJECT	3
SECTION III - PROJECT SETUP PROCESS	4
SECTION IV - EXCEL TEMPLATE AND ADD-IN TOOL	8
SECTION V - MOVEMENT ANALYSIS	9
SECTION VI - SUMMARY	15

---

## SECTION I – INTRODUCTION

---

**In this report we will present the results of a recent research project that was initiated to automate the process involved in MCEV reporting using MG-ALFA.**

A significant number of companies in Europe and Asia either have switched to or are considering switching to the market-consistent embedded value (MCEV) reporting framework. MG-ALFA® can currently handle MCEV calculations, but it involves a significant amount of manual work, from model setup to report generation. In this report we will present the results of a recent research project that was initiated to automate the process involved in MCEV reporting using MG-ALFA. In addition to this report, the results of our research include a zip file that contains the backup of a sample MG-ALFA project, and an Excel template that uses the MG-ALFA results. These files are available upon request.

Both the sample MG-ALFA project and the Excel template focus on producing two important tables as part of the MCEV reporting, the Movement Analysis Table and the Sensitivity Analysis Table. The completion of these two tables requires the most number of different (nested) stochastic projections and the largest quantity of financial data compared with other tables required in MCEV reporting. This report will not discuss the preparation of other parts of the MCEV reporting.

It should be emphasized that the purpose of the research project is to recommend a streamlined process and template for preparing the two tables. Both the sample MG-ALFA project and the Excel templates are for illustration only and are not intended to represent any meaningful MCEV results.

The remainder of the report is structured as follows. Section II describes the sample MG-ALFA project in detail. Section III summarizes the step-by-step process involved in setting up all the MG-ALFA runs. Section IV describes the Excel template and the MG-ALFA Excel add-in tool. Section V summarizes the roll-forward logic behind the Movement Analysis Table in our template. Section VI serves as a conclusion together with recommendations on how our work may be customized in real MCEV work.

---

## SECTION II – SAMPLE MG-ALFA PROJECT

The sample MG-ALFA project contains 16 AIN files, 1 ADB file, 4 AIL files, 16 ASD files mapping to each of the AIN files, and 16 AFD files each produced from the corresponding AIN file.

The AIN and ADB files will be described in more detail in Section III. The ASD files are results of loading different risk-neutral scenarios and will also be discussed in Section III. The AFD files are to be accessed by the Excel template and will be discussed in Section IV.

The single ADB file is shared by all AIN files. It is the standard U.S. variable annuity database with only a slight modification to the `srDiscRate` where it was changed from an input to a formula reading 90-day rates from the yield curve. A new total temp, `Total003`, is also introduced that stores the result variables useful to MCEV reporting. The variable annuity database was chosen as the model platform simply because the database is ready to run with stochastic economic scenarios and has built-in logic for simple embedded guarantees. The latter is relevant to produce the time value of options and guarantees (TVOG) in MCEV reporting.

The MG-ALFA models were built purely to illustrate the process. The user will benefit remarkably from the streamlined process and user-friendly interface presented in this report, but is still responsible for product-related and MCEV-related database coding. While some attempt was made to ensure reasonableness of results, greater efforts were made to make sure the roll-forward logic in the Movement Analysis Table is sound. The roll-forward logic will be discussed in detail in Section V.

Nonetheless, the following simplifications and assumptions should still be noted.

- The post-tax profits and distributable earnings were assumed to be correct from MG-ALFA calculations. But different companies may have different approaches in calculating certain MCEV items, and it is difficult, if meaningful at all, to generalize these calculations.
- The required capital (RC) was assumed to be a simple percentage of account value. This value must be compliant with both statutory capital requirement and the economic capital requirement, which might involve complicated modeling techniques possibly including nested stochastic projections.
- The cost of non-hedgeable risk (CNHR) was assumed to be a simple percentage of required capital. In reality, this may involve complicated calculations.
- A simple return of premium (ROP) guaranteed minimum death benefit (GMDB) product was illustrated in the sample project. It was assumed to have only one separate account linked to the S&P 500. Assets in the general account were simply cash. If other forms of assets are modeled in reality, then consideration should be given to whether assets are modeled on a book value or market value basis. If the former, some adjustments will be necessary to bring the surplus to a market-consistent basis.

---

**The user will benefit remarkably from the streamlined process and user-friendly interface presented in this report, but is still responsible for product-related and MCEV-related database coding.**

---

## SECTION III – PROJECT SETUP PROCESS

The sample MG-ALFA project was set up to support MCEV calculations as described below. The step-by-step process enables the completion of both the Movement Analysis Table and the Sensitivity Analysis Table. The process was carried out manually in our research project, but it is expected to be automated in future MG-ALFA development. The automation will be part of a new feature of MG-ALFA currently under development. The feature will allow the user to set up, update, and run the MG-ALFA models through the Excel file. This feature, combined with the Excel add-in tool discussed in Section IV, essentially will allow the user to start and finish the reporting process without having to open and close the MG-ALFA interface.

---

**The automation will be part of a new feature of MG-ALFA currently under development. The feature will allow the user to set up, update, and run the MG-ALFA models through the Excel file.**

Until the feature is ready, the user will manually execute the following steps. The generation of ALL files and the scenario files is assumed to be completed before these steps. It should be noted that these steps describe a recommended process but not necessarily the only process. The user may vary the order or the way each step is carried out based on the specific requirement. For example, Step 2 calculated the value of new business (VNB) with issue point and assumptions all as of the beginning of the reporting period. However, the middle or end of the period also may be used. Also, we varied expense, lapse, and mortality assumptions in our exercise. In reality, the assumption changes might be different. In addition, Step 3 below describes the setup for experience variance calculation. Some companies may execute this as the last step.

**STEPS INVOLVED TO COMPLETE THE MOVEMENT ANALYSIS TABLE:**

<b>STEPS</b>	<b>ACTION</b>
<b>STEP 1: PRIOR PERIOD MODEL (ASSUMED TO BE 12/31/2008)</b>	<ul style="list-style-type: none"> <li>(1) Open the prior period model "Mcev_Demo_Bop.Ain".</li> <li>(2) Link to the in-force AIL as of the beginning of the reporting period.</li> <li>(3) Run the model with Certainty Equivalent ("CE") and stochastic scenarios as of the beginning of the period.</li> </ul>
<b>STEP 2: NEW BUSINESS MODEL</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Bop.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Nb.Ain".</li> <li>(3) Link to the new business AIL.</li> <li>(4) Run the model with CE and stochastic scenarios as of the beginning of the period.</li> </ul>
<b>STEP 3: EXPERIENCE VARIANCES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Bop.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step1.Ain".</li> <li>(3) Change the valuation date to the current period (ie, 12/2009).</li> <li>(4) Link the current period's in-force file to the model (refresh the model and fill in the data holes if needed).</li> <li>(5) Change FreeSurplus to that as of the current period.</li> <li>(6) Run the model with CE and stochastic scenarios as of the prior period.</li> </ul>
<b>STEP 4: MAINTENANCE EXPENSE CHANGES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step1.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step2.Ain".</li> <li>(3) Change the maintenance expense assumptions to match what is in the current period model.</li> <li>(4) Run the model with CE and stochastic scenarios as of the prior period.</li> </ul>
<b>STEP 5: LAPSES CHANGES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step2.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step3.Ain".</li> <li>(3) Change lapse assumptions to match what's in the current period model.</li> <li>(4) Run the model with CE and stochastic scenarios as of the prior period.</li> </ul>
<b>STEP 6: MORTALITY CHANGES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step3.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step4.Ain".</li> <li>(3) Change the mortality assumptions to match what's in the current period model.</li> <li>(4) Run the model with CE and stochastic scenarios as of the prior period.</li> </ul>
<b>STEP 7: ECONOMIC CHANGES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step4.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step5.Ain".</li> <li>(3) Change the CE and stochastic scenarios to match what's in the current period model.</li> <li>(4) Run the model with CE and stochastic scenarios as of the current period.</li> </ul>

**STEPS INVOLVED TO COMPLETE THE SENSITIVITY ANALYSIS TABLE:**

<b>STEPS</b>	<b>ACTION</b>
<b>STEP 1: SHIFT 100BP UP IN SWAP CURVE</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step6.Ain".</li> <li>(3) Replace the CE and stochastic scenarios with the new ones.</li> <li>(4) Run the model with the new CE and stochastic scenarios.</li> </ul>
<b>STEP 2: SHIFT 100BP DOWN IN SWAP CURVE</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step7.Ain".</li> <li>(3) Replace the CE and stochastic scenarios with the new ones.</li> <li>(4) Run the model with the new CE and stochastic scenarios.</li> </ul>
<b>STEP 3: 10% DECREASE IN EQUITY/PROPERTY VALUES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step8.Ain".</li> <li>(3) Replace the in-force file with the new where account values are reduced by 10%.</li> <li>(4) Run the model with CE and stochastic scenarios as of current period.</li> </ul>
<b>STEP 4: 25% INCREASE IN EQUITY/PROPERTY IMPLIED VOLATILITIES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step9.Ain".</li> <li>(3) Replace the CE and stochastic scenarios with the new ones.</li> <li>(4) Run the model with the new CE and stochastic scenarios.</li> </ul>
<b>STEP 5: 25% INCREASE IN SWAPTION IMPLIED VOLATILITIES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step10.Ain".</li> <li>(3) Replace the CE and stochastic scenarios with the new ones.</li> <li>(4) Run the model with the new CE and stochastic scenarios.</li> </ul>
<b>STEP 6: 10% DECREASE IN MAINTENANCE EXPENSES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step11.Ain".</li> <li>(3) Change AIN input to reduce maintenance expenses by 10%.</li> <li>(4) Run the model with CE and stochastic scenarios as of current period.</li> </ul>
<b>STEP 7: 10% PROPORTIONATE DECREASE IN LAPSE RATES</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step12.Ain".</li> <li>(3) Change AIN input to reduce lapse by 10%.</li> <li>(4) Run the model with CE and stochastic scenarios as of current period.</li> </ul>

**STEPS INVOLVED TO COMPLETE THE SENSITIVITY ANALYSIS TABLE (CONTINUED):**

STEPS	ACTION
<b>STEP 8: 5% PROPORTIONATE DECREASE IN BASE MORTALITY</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step13.Ain".</li> <li>(3) Change AIN input to reduce mortality by 5%.</li> <li>(4) Run the model with CE and stochastic scenarios as of current period.</li> </ul>
<b>STEP 9: REQUIRED CAPITAL EQUAL TO LEVEL OF SOLVENCY CAPITAL</b>	<ul style="list-style-type: none"> <li>(1) Open "Mcev_Demo_Eop_Step5.Ain".</li> <li>(2) Rename the model as "Mcev_Demo_Eop_Step14.Ain".</li> <li>(3) Change AIN input to make target surplus to the level of solvency capital.</li> <li>(4) Run the model with CE and stochastic scenarios as of end of period.</li> </ul>

## SECTION IV – EXCEL TEMPLATE AND ADD-IN TOOL

---

**The MG-ALFA Excel add-in tool does not require the user to open any MG-ALFA model or outputs and thus eliminates the work of manually exporting results.**

The Excel template uses the MG-ALFA Excel add-in tool to extract the results from the AFD files after runs finish. This tool is available as part of the version 7.0 release. The MG-ALFA Excel add-in tool proved to be a very efficient tool in this exercise. It does not require the user to open any MG-ALFA model or outputs and thus eliminates the work of manually exporting results. The add-in also automatically calculates the average present values of any specified cash flows across multiple scenarios. A user manual for the add-in tool is available from the MG-ALFA team.

The template file has many tabs. The Control tab specifies the different AIN and AFD files from which results are to be retrieved. The Non-MGALFA Inputs tab contains some inputs that are typically not from MG-ALFA. A good example is the CNHR assumption. However, this tab is expected to vary significantly among different users depending on their extent of MG-ALFA modeling. The MCEV Movement Calc tab shows the results of the Movement Analysis Table in the format prescribed by the CFO Forum. The MCEV Sensitivity Calc tab shows the results of the Sensitivity Analysis Table with sensitivities consistent with MCEV requirements. All the other tabs store results from the different MG-ALFA runs. We split the CE and stochastic results in different tabs, but it is possible to have them shown in a single tab.

---

**The Excel format makes it relatively straightforward to modify links and calculations in the file. However, it requires careful considerations and good MCEV knowledge to make the Movement Analysis Table sound and reasonable.**

The template file is expected to be customized by the user. The Excel format makes it relatively straightforward to modify links and calculations in the file. However, it requires careful considerations and good MCEV knowledge to make the Movement Analysis Table sound and reasonable. In the next section, we will provide an explanation of the roll-forward logic underlying our calculation.

## SECTION V – MOVEMENT ANALYSIS

In the Movement Analysis Table, there are six columns in total, each rolling from the beginning of the reporting period to the end of the reporting period, with sources of changes prescribed by the MCEV Principles:

- Free surplus (FS)
- Required capital (RC)
- Present value of future profits (PVFP)
- Time value of options and guarantees (TVOG)
- Frictional cost (FC)
- Cost of non-hedgeable risk (CNHR)

In the following paragraphs, explanation is provided behind the roll-forward logic in the Movement Analysis Table, but it might still be helpful to reference the formulas in the Excel template.

### 1. Roll-forward of free surplus

Opening free surplus

+ {- first year RC from NB CE run + first year after-tax profit from the NB CE run}  
*New business value*

+ Opening free surplus \* i (expected risk-neutral)  
*Expected existing business contribution (reference rate)*

+ Opening free surplus \* [i (expected real-world) – i (expected risk-neutral)]  
*Expected existing business contribution (in excess of reference rate)*

+ {- expected change in required capital - expected profits in projection year 1}  
*Transfers from VIF and required capital to free surplus*

+ {actual profits in the current year + actual release in capital in current year – expected profits in year 1 – expected release in capital in year 1} \*  
*Experience variances*

\*the investment gains/losses are excluded here and grouped in economic variances

+ {Required capital/CNHR/FC under old assumption – required capital/CNHR/FC under new assumption}  
*Assumption changes*

+ {Actual investment gains/losses – expected investment gains/losses}  
*Economic variances*

= Closing free surplus

## 2. Roll-forward of required capital

Opening required capital

+ {first year RC from NB CE run }  
*New business value*

+ Opening required capital \* i (expected risk-neutral)  
*Expected existing business contribution (reference rate)*

+ Opening required capital \* [i (expected real-world) – i (expected risk-neutral)]  
*Expected existing business contribution (in excess of reference rate)*

+ {expected required capital at end of year 1- opening required capital accumulated with interest }  
*Transfers from VIF and required capital to free surplus*

+ {Time 0 required capital from experience variance run –  
time 1 required capital from opening run – NB value}  
*Experience Variances*

+ {beg required capital from assumption change run –  
beg required capital from experience variance run}  
*Assumption changes*

+ {beg required capital from economic variance run –  
beg required capital from experience variance run}  
*Economic variances*

= Closing required capital

---

### 3. Roll-forward of PVFP

Opening PVFP (PV of post-tax profit from CE run)

+ { PV of post-tax profit from NB CE run }

*New business value*

+ Opening PVFP \* i (expected risk-neutral)

*Expected existing business contribution (reference rate)*

+ expected investment income (net of expenses and tax) in year 1

*Expected existing business contribution (in excess of reference rate)*

+ { - after tax profit in projection year 1 of the opening run - expected investment income (net of expenses and tax) in year 1 }

*Transfers from VIF and required capital to free surplus*

+ { PVFP from experience run – PVFP from year 2 on from opening run – (actual interest on opening PVFP – expected interest on opening PVFP) }

*Experience variances*

+ { PVFP from assumption change run – PVFP from experience variance run }

*Assumption changes*

+ { PVFP from economic variance run – PVFP from assumption change run }

*Economic variances*

= Closing PVFP

#### 4. Roll-forward of TVOG

Opening TVOG (PV of average stochastic post-tax profit - PVFP)

+ { PV of post-tax profit from NB stochastic run– PVFP from NB CE run }  
*New business value*

+ {Time 2 TVOG from opening run - Time 1 TVOG in opening run}  
*Expected existing business contribution (reference rate)*

+ 0  
*Expected existing business contribution (in excess of reference rate)*

+ 0  
*Transfers from VIF and required capital to free surplus*

+ {Time 1 TVOG from experience run – Time 2 TVOG from opening run}  
*Experience variances*

+ {Time 1 TVOG from assumption change run – Time 1 TVOG from experience variance run}  
*Assumption changes*

+ {Time 1 TVOG from economic variance run – Time 1 TVOG from assumption change run }  
*Economic Variances*

= Closing TVOG

---

## 5. Roll-forward of FC

Opening FC (PV of CE DE – PVFP - RC)

+ {PV of CE DE from NB run – PVFP from NB run – Time 1 RC from NB run}  
*New business value*

+ Opening FC \* i (expected risk-neutral)  
*Expected existing business contribution (reference rate)*

+ {- expected tax on RC in year 1}  
*Expected existing business contribution (in excess of reference rate)*

+ {+ expected tax and investment expenses on RC in projection year}  
*Transfers from VIF and required capital to free surplus*

+ {Time 1 FC from experience run – Time 2 FC from opening run - NBV}  
*Experience variances*

+ {Time 1 FC from assumption change run – Time 1FC from experience variance run}  
*Assumption changes*

+ {Time 1 FC from economic variance run – Time 1FC from assumption change run}  
*Economic variances*

= Closing FC

## 6. Roll-forward of CNHR

Opening CNHR (PV of CE required capital \* -1%)

+ {PV of CE RC from NB run \* -1%}  
*New business value*

+ {PV of CE RC starting from year 2 \* -1% - opening CNHR}  
*Expected existing business contribution (reference rate)*

+ 0  
*Expected existing business contribution (in excess of reference rate)*

+ 0  
*Transfers from VIF and required capital to free surplus*

+ {PV of CE RC \* -1% from experience run –  
PV of CE RC \* -1% from year 2 on from opening run – NBV}  
*Experience variances*

+ {PV of CE RC \* -1% from assumption change run - PV of CE RC \* -1% from experience run}  
*Assumption changes*

+ {PV of CE RC \* -1% from economic variance run - PV of CE RC \* -1% from assumption change run}  
*Economic variances*

= Closing CNHR

---

## SECTION VI – SUMMARY

This report documents the research project on preparing the MCEV reporting with MG-ALFA. Through a sample MG-ALFA project and the Excel reporting template, a streamlined process is illustrated to prepare the Movement Analysis Table and the Sensitivity Analysis Table. In addition, this report documents the assumptions and simplifications in the modeling, provides a brief description of the Excel add-in tool, and explains the roll-forward logic underlying the Movement Analysis Table.

The process described in the report is likely to be customized in real-life projects. Some customizations may relate to the specific product designs, some may be necessary because of the existing practices of the company, and others may be due to a different interpretation of the MCEV Principles. To best utilize the tools and the process presented in the report, the user may wish to consider the following in the customization process:

- Try to have as much calculation done in MG-ALFA as possible. This will maximize the benefits of the Excel add-in tool and minimize the non MG-ALFA inputs in the template.
- Try to avoid having too many projections in one AIN. This may get confusing over time and creates a very large result file.
- If unsure of result variables eventually needed, capture the entire income statement and balance sheet variables in the total temp.
- In cases where the Movement Analysis Table needs to be changed, keep a check line similar to row 33 in the template.
- Read the user manual for the Excel add-in tool to learn more about it. This can help greatly if the user wishes to build custom reports

---

**The process described in the report is likely to be customized in real-life projects. Some customizations may relate to the specific product designs, some may be necessary because of the existing practices of the company, and others may be due to a different interpretation of the MCEV Principles.**







Milliman is among the world's largest independent actuarial and consulting firms. Founded in Seattle in 1947 as Milliman & Robertson, the company currently has 52 offices in key locations worldwide. Milliman employs over 2,400 people, with a professional staff of more than 1,100 qualified consultants and actuaries, including specialists ranging from clinicians to economists. The firm has consulting practices in healthcare, employee benefits, property & casualty insurance, life insurance and financial services. Milliman serves the full spectrum of business, financial, government, union, education and nonprofit organizations. For further information, visit [milliman.com](http://milliman.com).

1301 Fifth Avenue  
Suite 3800  
Seattle, WA 98101

+1 206 624 7940

[milliman.com](http://milliman.com)