

Risk analysis

A first step on the road

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Foreword

As a part of my study Business mathematics and Informatics an internship was obligatory. This internship report is documentation of the work I have done in my internship.

I did my internship within GENERALI verzekeringsgroep nv, which is part of the worldwide active GENERALI Group. In Europe GENERALI is the second biggest insurer. In the Netherlands GENERALI has around 435 employees.

GENERALI verzekeringsgroep nv is divided in two divisions, the life division and the non-life division. My internship was in the non-life division, in the department Insurance techniques. The department Insurance techniques is concerned with the creation and maintenance of insurance products. This also includes the management of the product systems and the control of the input of the insured clients.

The department itself has two kinds of people: the mathematicians who work on the technique part and the insurance people, who work on the insurance questions. I belonged to the mathematical crew.

Since GENERALI Netherlands is not a big company itself, not many people within GENERALI occupy themselves with risk management and actuarial questions for the non-life department. The purpose of my internship is to put a first step on the road in the risk analysis. In order to acquire more understanding in the subject, I have been put on two subjects: the Dutch assessment framework: 'het Financieel Toetsingskader' and a model that GENERALI Netherlands received from the German GENERALI: the 'EVA-model'.

I want to thank everybody from the department Insurance techniques, especially Michiel Krol, for the help on this project, Bert Grupstra for his questions that inspired me to think differently on many ideas. I also want to thank Nora Gürtler and Ming Fang, the German colleagues that helped me understand the EVA-model more. Misja Nuyens and Sandjai Bhulai, thank you for the comments on the report and last but not least. I also want to thank my husband for his support and everybody that I forgot to put in here.

Executive summary

This report is about the Dutch assessment framework, the 'Financieel Toetingskader' (=FTK), also known in the Netherlands as the FTK. This framework is the Dutch interpretation of the solvency model that is being created and that is due in 2010. This European solvency model is called Solvency II.

The first chapter describes the problem. In the second chapter the theory and requirements of the FTK that are defined by the Dutch supervisor ('De Nederlandsche bank', in short DNB) are described. In the supplement the input and output with GENERALI figures can be found.

In the third chapter the EVA-model is described. The EVA-model values whether the company will create or destroy value. When for example a company makes profit but has an EVA value below zero, then the company is destroying value. This means that the costs to make the profit were higher than the profit itself and this is of course not good for a company. The third chapter begins with the theory that is used in the EVA-model. After that all the variables that are input and/or output in the EVA-model are described as well. In the supplement the input, output, scenarios are to be found and a conclusion using the GENERALI data.

The third chapter can be used as a reference guide to the EVA-model for filling in the model (the model is described by an Excel-sheet) and the supplement as an example how it can be filled in.

The FTK gives many definitions and requirements. These requirements are not used everywhere and are sometimes not even defined very well, because there is no conformity on those subjects yet. This makes it hard to give a conclusion on the subject or comparing methods. The FTK does give insight in risk management, because it gives an idea of the risks that can be taken along. The FTK also gives an idea of how to interpret risk and how to incorporate it in the company's calculations.

The EVA-model is a model that calculates a lot of variables, which can be interesting for one person and boring for another. There are several interesting variables that are calculated in the model: EVA values for branches and for the total company, the required Combined Ratio and the actual Combined Ratio and much more.

By filling in future values, the model calculates all the variables for the future as well. The effects of these predicted values are calculated in the EVA-model. The EVA-model gives an overview of the past, present and future and gives a sketch of the situation.

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1 Introduction

In the beginning of the internship, the idea was to create a DFA, a dynamic financial analysis model. This is a model that takes along many variables that can be found in the EVA-model as well, but also catastrophes are taken along. The main difference between the EVA-model and a DFA is that several DFA values are calculated statistically, unlike the EVA-model. The link between the FTK and the EVA model is DFA. They both help to understand the contents that a DFA should have and the insight in what still is missing. A DFA is an analysis on several risks, like the FTK. In a DFA some variables are stochastic. This is not the case in the FTK. The EVA-model calculates some values with the help of a normal distribution. Understanding the FTK and the EVA-model will give you an idea of how a DFA should be.

1.1 Problem description

The problem description can best be described as:

Try to get as much usable information and understanding in risk management in such a way that it will be useful for GENERALI.

1.2 Problem approach

To get more understanding in risk management and DFA, I will treat two subjects: the Dutch assessment framework ('Financieel Toetsingskader') and an EVA-model, that GENERALI Netherlands got from the AMB GENERALI colleagues.

If there would be time left, I would also create a framework for a dynamic financial analysis. Unfortunately there was no time, due to some critical agenda problems, so perhaps another person will pick up here.

I started with a literature research on dynamic financial analysis to understand more about the insurance business, the kind of mathematics that is used in the insurance business and of course dynamic financial analysis itself.

After that the data collection followed. During the data collection it became clear to me that it would not be possible to get all the data in time, because sometimes it just was not available. That is why this report contains a description of the requirements of the FTK, that were given by the supervisor ('De Nederlandsche Bank (=DNB)) and only one good advice to take along for the FTK: 'Try it and keep on working on it'. Starting on the EVA-model was even worse in the beginning, because it was totally in German and my first task was to translate the whole sheet into English. I hoped that the terms I used were also the terms that the German colleagues meant and are also used known in the Netherlands.

After the translating, the data had to be acquired, which with a lot of help of 'Planning & Control' and 'Financial Administrations' succeeded.

The workshops from the German colleagues were very helpful to get me more insight in the EVA-model. The EVA-model calculates many variables and gives a lot of overviews. Depending on which variables and overviews are of interest to the reader, these can be lifted out and put in figures. The EVA-model gives a very good idea of which variables are important in risk management. Many variables can be taken along in a DFA. Playing with the EVA-model gives an idea which variables are dependent of each other.

*) The Excel version of GENERALI Netherlands is the Dutch version. Thus ',' is used for decimals and '.' for thousands.

**) Actual figures for GENERALI are not included in the report, but can be found in the confidential supplement.



2 Dutch assessment framework (FTK)

'Financieel Toetingskader' (FTK) is the Dutch assessment framework for insurance companies and pension funds. It was made to supervise the financial position of the company and to improve the short term and long term development of the financial position. With clear insight to the risks a company is exposed to and the possible consequences for its financial position, unwanted developments that are found in the FTK can be anticipated and dealt with before they cause problems.

FTK is the Dutch step working to Solvency II, the upcoming European reporting standard for risk supervision. Because Solvency II is not a fact yet, the Netherlands tries to anticipate on the contents of Solvency II.

For pension funds the FTK will start with claim year 2006. For insurance companies the DNB ('De Nederlandsche Bank', the Dutch supervisor) had the idea to start with claim year 2006 too, but this date has been put off until further notice.

The FTK has three main points: the current value, the solvency test and the continuity analysis. The FTK gives a choice in methods: a simplified method, the standardised method and an intern model.

A template was made for the standardised method.

In the next three paragraphs the current value, the solvency test and the continuity analysis will be explained. In **'Error! Reference source not found.'** I will discuss the input and output of the solvency template and in §0 I will give the conclusion.

The most important note here is that all that is described in the following paragraphs is prescribed by the DNB.

2.1 Current value

The current value ('actuele waarde') is the value of the company based on the presumption that the company will continue to exist. This is because when a company will not continue to exist, the value of the company and its assets will be lower. The current value is a valuation method. As an example, the current value of a building would be the taxation value of today.

When calculating the current value, the next points should be taken into account:

1. The contract conditions of investments and commitments that, when they start to work, bring about a discontinuous change of the worth from the contract regarding the determined current value.
2. The foundation of the balance entry from the annual account.
3. The assessment of assets and liabilities should fit the in the market known standards for the determination of the current value.
4. Abnormalities of the assessment rules should be clarified with a support.

2.1.1 Investments

When calculating the current value of investments, both willing parties should be well informed and independent of each other. There are three categories you can divide the investments in:

1. Relatively easy investments → estimate value of the regular market
2. Market value is not available → price from comparable financial instruments
3. No comparable financial instruments → model assessment technique

An example would be the current value of a stock. In the first case the value of the stock can be found on the exchange market, if this is not the case, find a stock that is comparable with the stock you have. If there is no comparable financial instrument, then try assessing the price of the stock with a model.



Regardless the three situations the following points should be taken into account:

1. The chosen assessment should not lead to systematic benefits.
2. The most realistic current value is the latest price of an identical investment.
3. When determining the current value of the investment you should take the disturbances and the imperfections into account.
4. Every 'embedded option' should be determined.
5. When there is a difference between the market value and the intrinsic value, the intrinsic value can be used when it can be realised in a short time.
6. When you use an external source, there should be some procedure to test the reliability of the value.
7. Used assessment techniques should be calibrated periodically to the, according to the DNB, 'best practice'.

2.1.2 Insurance obligations

An insurance obligation is the amount of money the insurance company owes the client according to the contract they have.

In order to fulfil the insurance obligations, a certain provision should be determined as a sum of the expected value of the provisions coming from the cash flows and a premium in accordance with the market, to cover against inevitable risks in the portfolio. The company should use their own gross obligations before reinsurance and other forms of risk reduction. When you want to calculate the commitments, the next points should be kept in mind:

1. Commitments should at least be valued against the possible guaranteed indemnification per contract.
2. Used valuation methods should be internationally acknowledged.
3. With the valuation of the insurance commitments the factors of influence on the possible cash flows should be taken into account. When determining the insurance commitments, the insurance risks should be divided into groups with similar characteristics.
4. Property insurers should determine cash flows from damage that already happened and the possible payments for future damages in the damage commitments as well as the premium provisions.

Expected value

The expected value of the insurance obligations is the cash value of the expected cash flow from the insurance agreements. The expected value of the insurance company is based on insurance-technical foundations (damage frequencies, buy-out chances, value-transfer frequencies, etc.).

Demographic, juridical, medical, technological, social and financial-economic developments should also be taken into account when calculating the expected value.

Conditional and unconditional cash flows at the insurance company

A result dependent payment is unconditional when the amount of the payment is only linked to an objective financial fact. Because of this fact the amount can be calculated directly.

A result dependent payment is conditional when the amount of the payment is (also) linked to a management decision. (Think about en-bloc clauses, aims, expectations, etc.).

Premium in accordance to the market

The risks and uncertainties of insurance obligations in respect to the most realistic expected value must be taken into account in the valuation of the obligations. This could be done by 'market value margin' above the already calculated expected value of these obligations.

The PVK ('Pensioen- en verzekeringskamer', the former supervisor, now integrated in the DNB) has an approach for the risks and uncertainties that should be used until there are IAS standards (International Accounting Standards) on this subject. The most important points of the PVK on this subject are:



- The required risk premium on the expected value is the difference between the expected value and the value that at a reliability level of 75% belonging to the insurance-technical risks during the contract-term. This way the current value has been determined taking into account the inevitable risks and the uncertainties.
- The risk premium of the expected value should not be less than half the standard deviation of the probability distribution function that describes the current value of the insurance obligations.
- If a company is not able to determine the value according to the prescribed level, another method is necessary. This method should be well founded (robust, reliable, etc.).

Discounting

The insurance obligations of a company should be valued by discounting the related cash flow with a 'rentetermijnstructuur (RTS)', an interest term method. In order to estimate the insurance obligations, when the current value is not directly perceptible in the market, the insurance obligations should be based on the effective return of capital market instruments that lead to the received payments with great certainty.

A rough estimation of the height of the insurance obligations of an insurance company would be the multiplication of the claim frequency with the average claim amount. This would be the expected value of the insurance obligations.

Perhaps the insurance company shares its profit with the personnel when the claim frequency is lower than a certain value. In this case the company would have conditional cash flows.

The DNB wants the current value of these insurance obligations and have split this in two parts: the most realistic expected value of the insurance obligations and a margin, in this case the premium in accordance with the market.

How the most realistic expected value of the insurance obligations should be calculated is left open, each insurance company can calculate this differently, but this method must be conform the market.

For more safety the safety margin is built in.



2.2 Solvency test

In order to get an idea if the financial position of the insurance company is adequate or not, the company has to meet two conditions:

1. In the solvency test an adequate cover of capital of the contracted insurance obligations should be based on the current value. The current value of the free accessible assets must at least be equal to the total of the anticipated obligations that are based on the current value.
2. The free shareholders' equity valued in the current value should, with a certain probability, be sufficient to satisfy the first condition one year after the reference date, with the existing risks.

The FTK keeps in mind the following risks:

1. Market risk
 - a. Interest risk : by alterations in the RTS
 - b. Exchange rate risk : by alterations in the market value of stocks, private equity, commodities, real-estate, etc.
 - c. Currency risk : by alterations in the exchange rate
 - d. Basic risk : because of the effective return on instruments of different credit qualities, liquidity and/of term do not move simultaneously
 - e. Mismatch risk : the risk that a company does not or not correctly tune its investments on its obligations
 - f. Volatility risk : by alterations in the volatility
 - g. Reinvestment risk : the risk that the return on the earnings from investments that are considered for reinvestment are lower than expected

2. Credit risk
 - a. Business related risk : also known as opposition risk, the risk that an opposition can (partly) not fulfil an obligation towards the company
 - b. Debt risk of investments : the risk that a debtor can (partly) not fulfil its contractual obligations or that the credibility of this debtor decreases
 - c. Political risk : changes in the legislation can affect the credibility of financing instruments the company invests in
 - d. Country risk : the risk of running short or the deterioration of the credibility of a government of government related establishment

3. Liquidity risk
 - a. Catastrophe risk : payments related to a catastrophe
 - b. Surrender risk : a higher than expected surrender
 - c. Migration risk : a lower rating of the establishment
 - d. Publicity risk : negative publicity about the company or another company in the same branch
 - e. Economic recession : an economic recession
 - f. Trust in the credit line : the extent in which a company can trust on the existing credit lines
 - g. Access to the financial market : the extent in which a company has access to the financial markets in order to attract money



4. Insurance risk
 - a. Process risk : the company can suffer financial losses that stem from the selection and acceptance of to insure risks
 - b. Premium risk : the premium can be insufficient to fulfil future obligations
 - c. Product risk : the premium can be exposed to risks that were not anticipated when developing the product and determining the premium
 - d. Claim risk : the risk that the number of claims and/or the total claim sum is higher than expected
 - e. Economic risk : the political-social conditions can change that this has a unexpected negative effect on the company
 - f. Own retention risk : the risk that an insurance company achieves a bad insurance technical result because the cover of the reinsurance is insufficient and proves out to be too low with a catastrophe (possibly with a concentration risk)
 - g. Policyholder risk : the risk that a policyholder behaves differently than expected, with a negative effect on the company
 - h. Reserving risk : the risk that the provisions (including a premium according to the market)
5. Concentration risk : concentration risk can appear when the concentration of the portfolios lies in one region, economic sector or opposition
6. Operational risk : the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events

2.2.1 Standardised method

The standardised method does not include all the risks above, but takes the most important ones into account. For market risks and credit risks the method calculates the desired solvency based on the consequences of several scenarios. To calculate the insurance-technical risks the PVK will publish a rate table, based on the risk groups. The concentration risk and the operational risk of a company will also be taken into account, but no standard has been prescribed yet.

The standardised method works with scenarios. The assumption with the scenarios is that a shock in one risk factor happens directly after the reference date and that the resulting revaluation of the balance entries will not change until the end of the year. In each scenario the surplus-change in the current value will be measured. The simulated change in the surplus is equal to the desired solvency for the concerning risk.

The following risks are used in the solvency template and by the standardised method:

1. Interest risk
2. Inflation risk
3. Credit risk
4. Stock risk
5. Real-estate risk
6. Raw material risk
7. Currency risk
8. Insurance-technical risk
9. Concentration risk
10. Operational risk



1. Interest risk

Interest risk is present in all investments and obligations where the current value is sensitive for changes of the RTS or of the volatility. In the standardised method the decrease and increase of the interest term structure, which depends on the duration of the asset/liability in question, should be calculated. The scenario with the biggest loss must be taken into account.

Beginning with the start-scenario the effect of an in-/decrease of 25% in the interest volatility (implied volatility) must be calculated for the desired solvency. This applies to interest options and/or interest dependent 'embedded options' in the insurance obligations. The biggest loss will be used.

Aggregation of the interest risk and the volatility risk gives the desired solvency for interest risk.

2. Inflation risk

The inflation has effect on investments and on obligations. The effect of an inflation-increase (inflation risk multiplied by 1,5) and an inflation-decrease (inflation risk divided by 1,5) should be calculated. The biggest effect should be used to calculate the effect on the surplus.

Because there is a positive correlation between inflation and interest, the effect of an inflation increase should be combined with an interest increase and the effect of an inflation decrease with an interest decrease. The biggest loss of both combined scenarios gives the desired solvency for inflation risk. If the desired is higher than the desired solvency value for interest risk (alone), the higher value replaces the interest risk. A lower value has no effect on the solvency.

Suppose that a company assumes a long-term inflation of 2%, then in the solvency test a $2\% \cdot 1,5 = 3\%$ should be considered as an inflation-increase. Also suppose that the interest rate for an obligation is 5% and has a volatility of 0,5%. Then the interest-increase is $0,5\% \cdot 0,25 = 0,125\%$. Calculate this percentage on the value of the obligation together with the 3% inflation risk, then you have the required value.

3. Credit risk

Credit risk is expressed in the credit spread. This can be seen as the difference between the effective return on a collection of cash flows on which the payment is dependent of the creditworthiness of the opposition and the effective return on the same collection cash flows that will be paid with full certainty. A government bond of a very creditworthy government will usually be seen as a credit risk-free obligation. That is why the credit spread of a company's obligation is derived from the effective return on a government bond.

In the standardised method the credit spread on the investment portfolio will be changed with a certain factor.

The company should calculate the effect on the surplus based on an immediate increase of the credit spread of 60% with respect to the actual credit spread on the reference date.

4. Stock risk

The standardised method distinguishes mature markets, emerging markets and private equity. The effect on the surplus should be calculated with a decrease for mature markets of 40%, for emerging markets and private equity a decrease of 45%.

All financial instruments that are influenced by the share price should be taken into account (options, futures, convertibles, equity notes, total return swaps, obligations from investment insurance, etc.).

The stock volatility of an increase and decrease of 25% should be calculated from start position. The biggest loss should be taken into account.

The effects of hedge funds are calculated the same way.

5. Real-estate risk

To calculate the effect on the surplus of the real-estate risk a decrease of 20% has to be calculated. All financial instruments that influence the real-estate should be taken into account as well.

6. Raw material risk (commodity risk)

For the calculation of the commodity risk the starting-point is a global commodity portfolio that is not differentiated in products and categories. A 40% decrease on the starting-point is used for the benchmark. The financial instruments of influence should be taken along.



7. Currency risk

When calculating the total currency position, the company should calculate the effect on the surplus based on a valuation of all the other currencies with respect to the Euro with 25%.

8. Insurance-technical risk

Solvency for these risks is desired for abnormal negative variations in insurance-technical results within a year, given the provisions on the current value. The desired solvency should be calculated per risk group. When aggregating the solvency values of the risk groups to the total desired solvency for insurance-technical risks, a certain measure of diversification should be taken into account.

9. Concentration risk

Concentration risk can appear when there is not enough diversification in assets and liability is. For example a portfolio of loans can strongly be sector-bound. Because of sector-concentration this portfolio has an increased risk. This is called cumulative concentration risk. With the determination of the desired solvency of all risk factors, an indication of how the concentration risk has been taken into account should be given. In the scenarios the company should give its own foundations of the reported concentration risk.

10. Operational risk

Companies should make an inventory, value and report the operation risk. The operational risk should also have its own argumentation why a certain amount is used.

For all risks the following applies when it is not certain if the effect of the risk has a negative effect on the surplus, a sensitivity analysis should be made.

Assessment of all risk factors together

The solvency calculations are classified as follows:

- S_1 the desired solvency for interest risk and (when applicable) inflation risk
- S_2 the desired solvency for business values, thus the sum of the desired solvency of stocks and real-estate
- S_3 the desired solvency for currency risk
- S_4 the desired solvency for commodities
- S_5 the desired solvency for credit risk
- S_6 the desired solvency for insurance-technical risk

Between the scenario of business values and the interest there is a correlation of $\rho = 0,8$. The other risk factors are assumed fully diversified.

The following formula gives the combined desired solvency:

$$S_{Total} = \sqrt{(S_1^2 + S_2^2 + 2 \cdot \rho \cdot S_1 \cdot S_2 + S_3^2 + S_4^2 + S_5^2 + S_6^2)}$$

Risks are standard deviations (= volatility). The solvency total is thus the square root of the sum of the squared risks and the covariance of S_1 and S_2 .

If the shareholders' equity is greater than the outcome of the formula, there is enough shareholders' equity. The company should explain if the specific solvency reflects the risk profile of the company adequately. The company should also indicate if there are risks not taken into account in the solvency test that should be taken into account.



2.3 Continuity analysis

The continuity analysis gives a long-term view of the financial position in different scenarios, the (strategic) policy of the company and the control mechanisms belonging to it. This will show if the company has a view of the mentioned risks and can control them.

The difference between the solvency test and the continuity analysis is that the continuity analysis is done over a longer timeframe. The intended policy, the existing policy-instruments and the effective and possible limitations of the intended policy are taken into account. The in-flow of new participants or new production is fully taken into account in the future financial development of the company.

Interesting questions that will be evaluated are:

1. Whether the safety (financial buffers) and the instruments are in relation with the ambition and the risks involved with it.
2. Whether the management uses realistic assumptions.
3. Whether the company has a 'financial disaster plan' and if it has prepared itself for problems that can take place.

The continuity analysis is a tool to achieve the following targets:

1. The management to get an understanding in the expected developments in relation to the financial set-up and the future financial position of the company, so that the policy definitions keep in mind the possible risks and the question whether the steering mechanisms are effective or not.
2. The supervisor to understand the expectations of the future, threats and possibilities in policy of the company. This insight gives the supervisor the possibility to anticipate better on the future problems by moving the intervention moment forward.
3. To improve the understanding of the degree of applicability of the available steering elements and whether they contribute to the solution of the problems.
4. Recognising a deterioration of the financial position in an early stadium.

A continuity analysis does not have to be performed every year. It should be done when:

- The financial position of the company has worsened significantly in relation to the previous book year or in relation to the last continuity analysis.
- The policy of the company has changed.
- Circumstances have changed resulting in increased risks.

2.3.1 Content of the continuity analysis

The most important point of the continuity analysis is the development of the financial position of the company of the coming years (C). In order to judge these developments, the policy-objectives and the policy-instruments of the company should be explained (A), with assumptions and all (B).

Understanding the sensitivity of the assumptions is of great importance. The biggest risks are traced in the sensitivity analysis (D). For the three biggest risks a stress test should be done (E).

The quality of the forecast is tested in an analysis afterwards (F).

Objectives and policy-instruments (A)

The expected development of the financial position of the company can only be judged if it is linked to the objectives of the company. The choice, which policy-instrument to use, is a direct consequence of the objectives. That is why the next questions are of importance:



1. What are the general objectives (long-term) objectives of the company and which preconditions apply on it?
2. Which objectives apply on a short-term (next three years)?
3. Which policy-instruments does the company have, to realise these objectives?
4. Which limitations and/or dependencies are present concerning the availability of the mentioned policy mechanisms?
5. Which strategy does the company use in its investment policy? What is the policy on the matching of the obligations? (Does the company use a proportion in the asset-mix?)
6. Which policy-instruments does the company have, to overcome an immediate shortage in the solvency test?
7. Steering mechanisms: Does the company use prefix numbers to understand the steering force of the policy-instruments. If so, which ones?

Environment (B)

The expected development of the financial position of the company depends on the environment such as the external, non-compliant circumstances, like the economic and demographic development. With no understanding of the external expectations, the results of the continuity analysis can not be judged. That is why the continuity analysis explicitly wants the expectations that are of importance to the company. Requested information is for example the policy founded assumptions about market interest (short and long), stock return and inflation.

	Reality T-2	Reality T-1	Estimate T	Estimate T+1	Estimate T+2	Estimate T+3
Effective return government bonds 1 year	*)	*)				
Effective return government bonds 30 year	*)	*)				
Return on stocks	*)	*)				
Return on real-estate	*)	*)				
Wage inflation	*)	*)				
Etc.	*)	*)				

Table 2.1 : template requested information

Expected results (C)

The future forecast of the company has a set of most realistic assumptions. This set of assumptions forms the basic scenario and shows the expected results. The PVK can ask for a prognosis of a different scenario. The number of years the report should include must be long enough to take along all the long-term risks and the influence of the policy reactions must be expressed fully.

For property insurance companies the number of prognosis years has been set on three years. Specific information over these three years should be available. The company should also have an idea about the expectations, risks and policy beyond the time horizon.

*) To be filled in by the DNB according to yet to be defined definitions



Results basic scenario	Reality T-2	Reality T-1	Estimate T	Estimate T+1	Estimate T+2	Estimate T+3
Premiums						
Investment profit						
Payments						
Costs						
Result						
Other capital mutations						
Shareholders' equity						
Required solvency (from solvency test)						
Solvency ratio						
Provision insurance obligations						

Table 2.2 : template expected results

Sensitivity analysis (D)

A company is expected to perform a sensitivity analysis on her financial position on the quantities that are of importance. The biggest risks should be identified.

The assumptions that determine the financial position of the company are:

- Foundations to determine the provisions
- Risk factors from the solvency test
- Assumptions on the in- and outflow of the participants or new production.

The company should determine which specific assumptions are being analysed. The sensitivity analysis should show where the biggest threats lie for the continuity of the company.

Stress testing (E)

Knowing the most important risks, stress testing will show how the company acts on the unfavourable effects of such risks. Can the company cope with such an effect? The policy instruments are thus centre of stress testing.

For at least the three biggest identified risks the unfavourable effects should be examined. The realistic influences of a stress factor should be taken into account also. These effects of the three biggest identified risks should be filled in table 2.3.

Other scenarios	Reality T-2	Reality T-1	Estimate T	Estimate T+1	Estimate T+2	Estimate T+3
Premiums						
Investment profit						
Payments						
Costs						
Result						
Other capital mutations						
Shareholders' equity						
Required solvency (from solvency test)						
Solvency ratio						
Provision insurance obligations						

Table 2.3 : template stress scenario

Confidential

Risk analysis

A first step on the road





Afterward analysis of the dissimilarities (F)

The afterward analysis is a comparison of the expectations of the continuity analysis and the realisation. The differences are analysed to the cause of the differences, like:

- Different external circumstances
- Other policy than was indicated
- Other outcomes of the policy then expected

When making a new continuity analysis, the differences should be taken into account. The company must note how this has been done.



2.4 Solvency template

The solvency template is based on the standardised method. In the previous paragraphs the important parts of this method have been discussed. The solvency template is the implementation of the standardised method, given by the DNB.

Data from the sheets are often used in other sheets in the same workbook. This means that if the sheet is not filled in correctly or is empty, this has effect in other places.

The template often asks for the currently used value of an entry and for the current value of the entry. The factors that should be kept in mind when calculating the current value of an entry can be found in §2.1.

The main pointer of the template is the solvency of the company.

The FTK workbook has eight sheets:

- | | |
|------------------------------------|-----------------------------------|
| 1. 'Invoerformulier' | : input form |
| 2. 'Beleggingen' | : investments |
| 3. 'Voorzieningen' | : provisions |
| 4. 'Vorderingen op herverzekeraar' | : claims on reinsurance companies |
| 5. 'Andere passivaposten' | : other liability entries |
| 6. 'Discontinuïteit' | : discontinuity |
| 7. 'Scenario's' | : scenarios |
| 8. 'Balans' | : balance sheet |

Each sheet will be discussed in the following subparagraphs. My input can be found in '**Error! Reference source not found.**'

2.4.1 Input form

The basic information about the company should be put into this sheet, namely:

- | | |
|---|--|
| 1. 'Instelling' | : the name of the company |
| 2. 'Peildatum' | : the reference date |
| 3. 'Toegepaste methode' | : the applied method |
| a. 'Gest. methode, discontering tegen RTS' | : the sheet will calculate with the standard method (prescribed by the PVK), discounting with the interest term structure model |
| b. 'Gest. methode, alternatieve discontering' | : the sheet will calculate with the standard method and using an alternative discounting model, one sheets will ask for more information |
| c. 'Interne modellen methode' | : the sheet will calculate with an intern model, but in the sheets there is no change. |
| 4. 'Soort instelling' | : kind of (insurance) company. |

When choosing the kind of (insurance) company, you can choose between 'Pensioenfondsen' (Pension fund), 'Levens/natura- en uitvaartverzekering' (Life- and in kind insurance) and 'Schade/zorgverzekeraar' (Property- and care insurance).



2.4.2 Investments

This sheet has been created in order to get an overview of the assets. If the company does not value the investments according to the current value method, the difference between the currently used value method and the current value method can be seen.

This sheet asks for the value of all investments, categorised in the next groups:

- | | |
|--|------------------------------|
| 1. 'Liquide middelen (looptijd < 1 mnd)' | : liquid assets |
| 2. 'Vastrentende waarden' | : fixed interest values |
| a. 'Staatsobligaties' | : government bonds |
| b. 'Index-linked bonds' | : index-linked bonds |
| c. 'Hypotheken' | : mortgages |
| d. 'Bedrijfsleningen' | : business loans |
| e. 'Kortlopende vorderingen op banken' | : short-term claims on banks |
| 3. 'Aandelen' | : stocks |
| a. 'Mature markets' | : mature markets |
| b. 'Private equity' | : private equity |
| c. 'Emerging market aandelen' | : emerging market stocks |
| d. 'Hedge funds' | : hedge funds |
| 4. 'Onroerend goed' | : real-estate |
| 5. 'Grondstoffen' | : raw materials |
| 6. 'Overig' | : others |

For each group the currently used valuation method and the current value are asked. For the fixed interest values the duration and the credit spread is asked.

In §2.1.1 more information can be found about calculating the current value of investments.

2.4.3 Provisions

In this sheet the technical provisions are asked. This means all the obligations the company has towards the client for a contract they have. The obligations can be split in the most realistic value of the obligations and a safety margin, the extra reserve for unforeseen circumstances.

The sheet asks for provisions on insurance obligations in the following categories:

- | | |
|--|---|
| 1. 'Ongevallen en ziekte' | : accidents and illnesses |
| 2. 'Aansprakelijkheid motorrijtuigen' | : liability motor vehicle |
| 3. 'Motorrijtuig overig' | : remaining motor vehicle |
| 4. 'Brand en andere schade aan zaken' | : fire and other damage on goods |
| 5. 'Zee-, transport- en luchtvaartverzekering' | : sea-, transport- and aviation insurance (thus marine) |

Some data on motor vehicles were not available in the requested category and that is why I joined the two categories together in one category. For each category the following is required:

- | | |
|---|--|
| a. 'Rekenrente' | : basic interest rate |
| b. 'Voorziening pensioen- en verzekeringsverplichtingen (huidig)' | : provisions pension- and insurance obligations (currently used) |
| c. 'Verwachtingswaarde onvoorwaardelijke verplichtingen' | : expected value unconditional obligations |
| d. 'Verwachtingswaarde voorwaardelijke verplichtingen' | : expected value conditional obligations |
| e. 'Marktconforme opslag volgens tabellenboek' | : premium according to the market from a rating table |
| f. 'Marktconforme opslag o.b.v. 75% percentiel' | : premium according to the market based on a 75% percentile |
| g. 'Duration' | : duration |



The template then calculates the 'Voorziening pensioen- en verzekeringsverplichtingen (actuele waarde)' (provisions pension- and insurance obligations according to the current value) by using the other values.

2.4.4 Claims on reinsurance companies

This sheet asks for the overview of the claims on reinsurance companies. For all reinsurance companies the next numbers are required:

- | | |
|---|--|
| 1. 'Contractnr.' | : contract number |
| 2. 'Herverzekerde verplichtingen op huidige voorzieningsgrondslagen' | : reinsurance obligations based on the currently used provisions |
| 3. 'Actuele waarde herverzekerde verplichtingen op voorzieningsgrondslagen' | : current value of the reinsurance obligations on the provisions |
| 4. 'Duration herverzekeringscontract' | : duration of the reinsurance contract |
| 5. 'Credit spread voor herverzekerder' | : credit spread of the reinsurance company |
| 6. 'Actuele waarde herverzekeringscontract' | : current value of the reinsurance contract |

2.4.5 Other liability entries

The liabilities that have to be considered are technical reserves, the loan capital and the remaining liabilities. The technical reserves have been filled in another sheet, thus the loan capital and the remaining liabilities have to be filled in.

For both entries the currently used value, the current value, the duration and the credit spread should be entered.

2.4.6 Discontinuity

The sheet asks if there are any aspects that would decrease the current value of the assets and which asset provider has the highest priority.

2.4.7 Scenarios

The effects of risks should be valued. This sheet asks for several risks a value of the effect that they have on the current value. The sheet then calculates the total difference in solvency for each risk.

The following risks are taken into account:

- | | |
|-----------------------------------|---|
| 1. 'Renterisico' | : interest risk |
| a. 'Renterisico' | : interest risk, interest shock dependent of the duration |
| b. 'Volatiliteit' | : volatility (increase of 25%) |
| c. 'Inflatierisico' | : inflation (shock effect 50%) |
| 2. 'Kredietrisico' | : credit risk (spread * 1,6) |
| 3. 'Aandelenrisico' | : stock risk |
| a. 'aandelen' | : stocks (mutation 40%) |
| b. 'private equity' | : private equity (mutation 45%) |
| c. 'emerging markets' | : emerging markets (mutation 45%) |
| d. 'volatiliteit' | : volatility (increase of 25%) |
| 4. 'Vastgoedrisico' | : real-estate risk |
| 5. 'Grondstoffen risico' | : raw material risk |
| 6. 'Valutarisico' | : currency risk |
| 7. 'Verzekeringstechnisch risico' | : insurance-technical risk |
| 8. 'Concentratie risico' | : concentration risk |
| 9. 'Operationeel risico' | : operational risk |



1a. Interest risk

As a approach method, the interest term structure can be used. When using the interest terms structure, the interest risk can be calculated with the following formula:

$$\text{Interest risk} = CW * \left\{ \left(\frac{1 + r_{\text{current}}}{1 + r_{\text{RTS}}(k)} \right)^k - 1 \right\}$$

CW	= current value
r_{current}	= current interest rate
$r_{\text{RTS}}(k)$	= current interest rate * RTS (based on the duration) for increase and decrease, the one that has the most effect should be chosen
k	= duration ((Macaulay) modified duration)

1b. Volatility

Effects on assets

effect of a 25% increase in volatility should be taken into account (government bonds, bonds and loans).

Effects on liabilities

effect of a 25% increase in volatility should be taken into account (all interest-bearing entries).

1c. Inflation

Effects on assets

for all interest-bearing assets with a duration longer than a year the inflation risk should be calculated. The effect of a decreasing inflation (interest percentage divided by 1,5) and an increasing inflation (multiplied by 1,5) should be calculated. The biggest effect should be taken into account.

Effects on liabilities

for all interest-bearing liabilities with a duration longer than a year the inflation risk should be calculated in the same manner as the assets.

2. Credit risk

Effects on assets

the sheet calculates this entry itself by multiplying the fixed interest values with 0,0091.

3a. Stocks

Effect on assets

the 40% mutation can be calculated by: $0,40 \bullet \text{Stock}$, the PVK is only interested in the decrease value.

3b. Private equity

Effect on assets

the 45% mutation can be calculated by: $0,45 \bullet \text{Stock}$, because the PVK is only interested in the decrease value.

3c. Emerging markets

Effect on assets

the 45% mutation can be calculated by: $0,45 \bullet \text{Stock}$, because the PVK is only interested in the decrease value.

3d. Volatility

Effects on assets

effect of a 25% increase in volatility should be taken into account

4. Real-estate risk

A decrease of 20% of the worth of the real-estate should be calculated.

5. Raw material risk

A mutation of 40% of the worth of the raw materials should be calculated.



6. Currency risk

The effect of a decrease of 25% on all the currencies in respect to the euro should be calculated.

7. Insurance-technical risk

The insurance-technical risk should be calculated with the help of a premium table, which has not been published yet.

8. Concentration risk

In order to value the (cumulative) concentration risk, research should be done to find out if the spread between asset and liabilities is big enough. Think about portfolios in the same region, economic sectors and the risk that they have effect on more than one factor.

The chosen input should be well founded, but there is no standard to value this risk.

9. Operational risk

A standard for valuing operational risk has not been made yet; therefore every company should try to make a method itself. Of course the used method should be well founded.

2.4.8 Balance sheet

The balance sheet calculates all but one value on its own by using the other sheets. The next values are shown on the balance sheet:

Assets

1. Liquid assets
2. Fixed interest values
3. Stocks
4. Real-estate
5. Raw materials
6. Claims on reinsurance companies
7. Other assets

Liabilities

1. Provisions pension- and insurance obligations
2. Loan capital
3. Other liabilities
4. Shareholders' equity

Clarification

1. FTK RC
2. Required solvency (WTV)

Free shareholders' equity

3. FTK
4. Present issuing

For each asset and liability value the currently used value and the current value have been displayed. The user should fill in the required solvency.



2.5 Conclusion

Starting with the financial assessment framework was not easy. Full understanding in the subject costs more time than a month.

When filling in the sheet, there were several interpretations for different values. After the closing of the project, more understanding in the model came and answers from questions that were asked about and inquired after with the DNB were answered.

If you understand the insurance terminology and the information given by the DNB, then the solvency template can be filled in with ease, if all data is available. But only having filled in the solvency template does not give a complete view of the risk. It is therefore important to also make the continuity analysis. It is important to know what steering tools are available and what the limits are.

How the output should be interpreted would be an interesting question. The FTK is a new document and several things can still go wrong. There is nothing to compare with.

The FTK gives GENERALI an idea what to expect in 2010, when Solvency II will probably be a fact and has to be delivered each year. It is very difficult to understand/know everything about the FTK when not fully understanding the insurance-business yet. Learning more about insurance-techniques and ideas, gave me more insight in the project.

Interpreting the FTK is difficult, because normal posts are filled in in a different way. There are new calculations and of course there is a difference between the currently used method and the FTK method.

I think the most important thing I learned from the FTK is that it gives you new insights on things that have only been done one way.

Even though the FTK was already written, understanding the document 'Financieel Toetsingskader' was not that easy. By filling in the solvency template and clearing the questions within GENERALI, GENERALI has now understanding in the model.

The FTK model that exists and has to be filled in and has to be filled in for the supervisor. A real conclusion can not be made, it is something that is.

The FTK asks for much and it is not always clear what is meant with a definition. After spending more time with the insurance-technical people from the department and talking to them, more things became clear that were unclear before.

Things that were unclear:

1. The interpretation of the duration
2. Current value of the reinsurance contract.

In the time after the closing of the project, more became clear and more answers came. For these two unclear points the solution was found. The explanation is written below.

Interpretation of the duration

Normally the interest rates over a bond are different for every year. But instead of calculating with these different interest-rates, it is possible to calculate one rate, the yield to maturity, which gives the same present value of the bond.



Period	Interest rate	C_t	PV at r_t	C_t	PV at r_t	Formula PV at r_t
i=1	$r_1=0.05$	€ 50	€ 47,62	€ 100	€ 95,24	$\frac{C_1}{1+r_1}$
i=2	$r_2=0.06$	€ 50	€ 44,50	€ 100	€ 89,00	$\frac{C_2}{(1+r_2)^2}$
i=3	$r_3=0.07$	€ 50	€ 40,81	€ 100	€ 81,63	$\frac{C_3}{(1+r_3)^3}$
i=4	$r_4=0.08$	€ 50	€ 36,75	€ 100	€ 73,50	$\frac{C_4}{(1+r_4)^4}$
i=5	$r_5=0.09$	€ 1050	€ 682,43	€ 1100	€ 714,92	$\frac{C_5}{(1+r_5)^5}$
Totals			€ 852,11		€ 1054,30	$\frac{C_1}{1+r_1} + \frac{C_2}{(1+r_2)^2} + \frac{C_3}{(1+r_3)^3} + \frac{C_4}{(1+r_4)^4} + \frac{C_5}{(1+r_5)^5}$

Table 2.4 : calculating present value of a bond

The formula for the present value is given by:

$$PV = \sum_{i=1}^n \frac{C_i}{(1+r_i)^i},$$

with PV the present value and r_i the yearly interest rate. What is searched is where

$$\sum_{i=1}^n \frac{C_i}{(1+y)^i} = \sum_{i=1}^n \frac{C_i}{(1+r_i)^i},$$

thus one rate instead one rate per year. The yield to maturity can now be calculated with, for example with excel (goal-seek). The yield to maturity for the example in table 2.4 is 8,78% and 8,62%.

The idea of the present value is to know what an bond is worth now. This can be calculated with the yield to maturity as well.

Period	C_t	PV(C_t) at 8,78%	Proportion of total value (PV(C_t)/V)	Proportion of total value * time	C_t	PV(C_t) at 8,62%	Proportion of total value (PV(C_t)/V)	Proportion of total value * time
t=1	€ 50	€ 45,96	0,054	0,054	€ 100	€ 92,07	0,087	0,054
t=2	€ 50	€ 42,25	0,050	0,099	€ 100	€ 84,76	0,080	0,161
t=3	€ 50	€ 38,84	0,046	0,137	€ 100	€ 78,04	0,0074	0,222
t=4	€ 50	€ 35,71	0,042	0,168	€ 100	€ 71,84	0,0068	0,273
t=5	€ 1050	€ 689,34	0,809	4,045	€ 1100	€ 727,59	0,690	3,451
		V=€ 852,11	1,000	4,502		V=€ 1054,30	1,000	4,193

Table 2.5 : calculating the duration of a bond

Table 2.5 shows the calculation of the duration of a bond, the average time to each payment, by using the total value of the bond V. The formula for the duration is:

$$duration = \sum_{t=1}^n \frac{(t \cdot PV(C_t))}{V}$$



With t the period, V the total value of the bond and $PV(C_t)$ the present value of the cash flow of period t . Consider now what happens to the prices when the yield changes:

	€ 50 bond		€ 100 bond	
	New price	Change	New price	Change
Yield falls 0,5%	€ 870,00	+ 2,10%	€ 1074,95	+ 1,96%
Yield rises 0,5%	€ 834,73	- 2,04%	€ 1034,21	- 1,91%
Difference		4,14%		

Table 2.6 : calculating the volatility of the duration

Table 2.6 shows the calculations of the volatility of the duration. This means that with a 1-percentage-point variation in yield, the price of the € 50 bond will change with 4,14% and the price of the € 100 bond will change with 3,87%.

The formula of the volatility is:

$$volatility(\text{percent}) = \frac{duration}{1 + y}$$

The duration is also known as the Macauley duration. The volatility of the Macauley duration is also known as the modified (Macauley) duration. The modified duration is the duration that is used in the FTK. The change in bond price for the € 50 bond is:

$$\text{change in bond price} = 4,14 \bullet \text{change in interest rates}$$

The credit spread is used for the change in interest rate. Thus multiplying the two would give the change in bond price and thus the extra risk.

In Excel there is a function to calculate the duration and the modified duration.

Current value of the reinsurance contract

How to calculate the current value of the reinsurance-company contract can best be shown with an example.

Suppose an insurance company has a reinsurance-program of € 100 million, based on the risk free interest term structure. The term of this program is two years and the reinsurer has a credit spread of 50 basis points (0,5%). Assume that the risk free rate is 3% for the two years. The current value of the reinsurance contract is now:

$$\left(\frac{1,03}{1,035} \right)^2 \bullet 100 \text{ million} = 99 \text{ million.}$$

Thus in formula the current value of the reinsurance contract is:

$$\left(\frac{1 + \text{risk free rate}}{1 + \text{risk free rate} + \text{credit spread}} \right)^{\text{years}} \bullet \text{value reinsurance contract}$$



3 EVA model

EVA stands for Economic Value Added. GENERALI obtained an Excel-sheet containing a worked-out EVA model from their German colleagues. My task was to get the data, make assumptions where needed, document everything and try to understand what the EVA model can do for GENERALI and if it can be used in a risk management model.

In short, the EVA-model contains the following things:

Input

- The EVA-model uses claim-triangles as input
- The EVA-model takes along the assets and the liabilities.
- Global economic assumptions:
 - risk discount rate
 - risk free rate
 - rating level (BBB-rating, 1 in 400 year a catastrophe with probability 0,26%)
- Cost of capital
 - Risk based capital (RBC) for assets: EVA estimates this roughly
 - RBC for liabilities (by lines of business (LOB's):
 - premium risk: simple normal distribution approach, inserted in the sheet "Input"
 - reserving risk: normal distribution approach, inserted in the sheet "Input"
 (more complex)
- Correlation matrix between the chosen LOB's, and correlations between the investments.

Output

- RBC on business unit level, the required and the actual value that the company has.
- Economic capital, the required and the value that the company has.
- Excess Capital, the required and the value that the company has.
- Risk –adjusted return on capital (RAROC).
- Economic value added per line of business and for the total company.
- Economic result by lines of business, this can be approximated by (premiums-claims-costs-discounting reserves-cost of capital).
- Gross permissible Combined Ratio (should be ≥ 0).

To get more understanding of what exactly happens, the first paragraph I will describe the theory of the EVA model, the second paragraph and third paragraph will discuss the input and output of the EVA-sheet, the fourth paragraph will contain the conclusion.

3.1 Theory

The main idea behind the EVA-model is to know the height of the "Shareholders' value". The shareholders value is the value a company has in the eyes of the shareholder. Calculating the value of the company can be done in several ways, especially because there are a lot of factors that have to be dealt with. These factors have different effects on the shareholders' value. When accounting for the need of several reserves, the dividend that can be paid out, can be put up or down, in accordance with the wishes of the management (how much dividend has to be paid each year?).

German tax has to be paid over the dividend payout. This means the dividend is smaller. In the Netherlands this is not the case, when GENERALI property insurance pays out dividend; no tax has to be paid according to the Dutch law. The German law also does not want an insurance company to discount their provisions.

Of course the EVA-model would not be named EVA-model if it would not calculate the Economic Value Added, thus calculating whether the company is creating or destroying value. The economic value added method is best to explain with an example and can be found in the next paragraph.



3.1.1 Economic Value Added

Symbol	Meaning
β	sensitivity of the market fluctuation
r_m	market return
r_f	risk free rate return
k_e	cost of equity
k_d	cost of debt
w_d	weight of debt of total capital employed ($=D/V$)
w_e	weight of net worth in total capital employed ($=E/V$)
capital employed	debt + net worth (equity + reserve and surplus) ($=V$)

Table 3.1 : symbols for EVA formula and their meaning

The weighted average cost of capital (WACC) is an average representing the expected return on all of a company's securities. Each source of capital, such as stocks, bonds, and other debt, is assigned as a required rate of return, and then these required rates of return are weighted in proportion to the share each source of capital contributes to the company's capital structure. The resulting rate is what the firm would use as a minimum for evaluating a capital project or investment.

WACC can be calculated with the next formula:

$$WACC = k_e \cdot w_e + k_d \cdot w_d \quad (1)$$

To calculate the cost of equity the following formula can be used:

$$k_e = r_f + \beta(r_m - r_f) \quad (2)$$

Example

Suppose a mobile telephone producer makes 20.000 telephones in the year 2004 and sells everything. Each telephone is worth € 300. The production costs for 2004 were € 2.000.000 and the operating costs were € 800.000. The capital employed (see table 3.1) is € 10.000.000. Tax is 31,5%, β is 0,9, $r_m = 19\%$, $r_f = 11\%$, $w_d = 11\%$, $w_e = 89\%$ and $k_d = 3\%$.

$$k_e = 0,11 + 0,9(0,19 - 0,11) = 0,18$$

$$WACC = 0,18 \cdot 0,89 + 0,03 \cdot 0,11 = 0,16$$

Sales	20.000 • € 300 =	€ 6.000.000
Production costs		€ 2.000.000 –
Operating costs		€ 800.000 –
<hr/>		
Operating profit before interest and tax (OPBIT)		€ 3.200.000
Tax	€ 3.200.000 • 0,315 =	€ 1.008.000 –
<hr/>		
		€ 2.192.000
WACC	€ 10.000.000 • 0,16 =	€ 1.600.000 –
<hr/>		
EVA		€ 592.000

The theory behind EVA is that when a company has made profit but does not have a positive EVA, the company has destroyed value, which is not good for the company, because it means that the cost of capital was higher than the operating profit after interest and tax.



When the company has a positive EVA value, then the company is creating value, which is of course good for the company.

3.1.2 Market risk

In order to calculate the market risk, first some extra information is needed to understand the situation. When having shares, diversification reduces the risk. The following formula shows how the expected rate of return for the coming year of a stock influences the expected portfolio return.

$$\text{Expected portfolio return} = \sum_i (\text{percentage portfolio})_i \cdot (\text{expected return rate of stock})_i \quad (3)$$

The portfolio risk (standard deviation) can be calculated with the help of the past standard deviations. Because the standard deviation is the square root of the variance, the variance of the portfolio has to be calculated.

$$\text{Portfolio variance} = \sum_{i=1}^N \sum_{j=1}^N x_i x_j \sigma_{ij} \quad (4)$$

The covariance between stocks i and stock j is given by the following formula:

$$\text{Covariance between stocks } i \text{ and stock } j = \sigma_{ij} = \rho_{ij} \sigma_i \sigma_j, \quad (5)$$

where ρ_{ij} is the correlation coefficient between stock i and stock j .

β is the sensitivity of the market fluctuation. If stocks have a $\beta > 1$, they tend to amplify the overall movements of the market. Stocks where $0 < \beta < 1$ move in the same direction as the market. In a formula β can be calculated as:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2}, \quad (6)$$

here σ_{im} is the covariance between stock i 's return and the market return. σ_m^2 is the variance of the market return.

3.1.3 Opportunity cost of equity

The Capital Asset Pricing Model (CAPM) gives the following equation for the cost of capital (before investors' tax):

$$\text{Cost of capital} = r_f + r_m \cdot \beta \quad (7)$$

3.1.4 Combined Ratio

A formula for the Combined Ratio is:

$$\text{Combined Ratio} = \frac{\text{Loss} + \text{Loss adjustment expenses}}{\text{Earned premium}} + \frac{\text{Underwriting expenses}}{\text{Written premium}} + \frac{\text{Dividend to Policyholder}}{\text{Earned premium}} \quad (8)$$

The Combined Ratio is a ratio that shows whether the branch is making profit on the premiums and can cover its costs. When the Combined Ratio is above the 100%, then the company is not making profit, if the Combined Ratio is lower, then the company does make profit.



3.1.5 Claims-triangle

Year of origin	Development year						
	1	2	...	j	...	t - 1	t
1	$Y_{1,1}$	$Y_{1,2}$	...	$Y_{1,j}$	...	$Y_{1,t-1}$	$Y_{1,t}$
2	$Y_{2,1}$	$Y_{2,2}$	...	$Y_{2,j}$	...	$Y_{2,t-1}$	
...		
i	$Y_{i,1}$	$Y_{i,2}$	...	$Y_{i,j}$			
...				
t - 1	$Y_{t-1,1}$	$Y_{t-1,2}$					
t	$Y_{t,1}$						

Table 3.2 : claims-triangle (incremental)

$Y_{i,j}$ = claimed amount in year of origin $1 \leq i \leq t$ and development year $1 \leq j \leq t$.

In the first year of origin there are t amounts available and the origin year has totally been developed. In the second year of origin there are $t - 1$ amounts available and has not been totally developed, etc.

There are two claim-triangles, the incremental and the cumulative claim-triangle. Let $C_{i,j}$ be the cumulative claims for origin year i and development year j . $C_{i,j}$ is defined by:

$$C_{i,j} = \sum_{k=1}^j Y_{i,k} \tag{9}$$

When using the cumulative claim-triangle, the total paid amount converges to a certain amount. For each origin year you would like to know to which total amount the claims will go, so you can reserve it. GENERALI uses ResQ Loss Reserve Software to calculate and analyse this, but the theory behind the software uses the mean of the available factors between the first and second development year, the second and third development year, the third and fourth development year, etc., for all available origin years. This means you have a mean factor based on $t - 1$ values for the factor between the first and second development year, $t - 2$ for the factor between the second and third development year, etc..

The formula for the development factors $\hat{\lambda}_j$ is the following:

$$\hat{\lambda}_j = \frac{\sum_{i=1}^{t-j+1} C_{i,j}}{\sum_{i=1}^{t-j+1} C_{i,j-1}}, \quad j=2, \dots, n \tag{10}$$

Note that the factor between the $(t - 1)$ -st and the t -th development year is based on far less origin years than the factor between the first and second development year. Because the development years that are closer to the ultimate paid amount have factors that are close to 1, the fact that these factors are based on less origin years does not affect the reliability of estimated ultimate values.

To forecast future values of the cumulative claims $C_{i,t-i+1}$, the following formula can be used:

$$\begin{aligned} \hat{C}_{i,t-i+2} &= C_{i,t-i+1} \hat{\lambda}_{t-i+2} \\ \hat{C}_{i,k} &= \hat{C}_{i,k-1} \hat{\lambda}_k, \quad k = t - i + 3, t - i + 4, \dots, t \end{aligned} \tag{11}$$



This method is called the Chain Ladder technique and ResQ uses this method.

Often the number of development years that are recorded are cut down to ten years and a tail-factor is written down to get from the tenth development year to the ultimate (the t -th) development year.

3.1.6 Reserves

Year of origin	Development year					
	1	2	...	j	...	t
1	100%	$\frac{C_{1,2}}{C_{1,1}} - 1$	...	$\frac{C_{1,j}}{C_{1,j-1}} - 1$	...	$\frac{C_{1,t}}{C_{1,t-1}} - 1$
2	100%	$\frac{C_{1,2} + C_{2,2}}{C_{1,1} + C_{2,1}} - 1$	...	$\frac{C_{1,j-1} + C_{2,j}}{C_{1,j-1} + C_{2,j-1}} - 1$	...	$\frac{C_{1,t-1} + C_{2,t}}{C_{1,t-1} + C_{2,t-1}} - 1$
3	100%	$\frac{C_{1,2} + C_{2,2} + C_{3,2}}{C_{1,1} + C_{2,1} + C_{3,1}} - 1$	...	$\frac{C_{1,j} + C_{2,j} + C_{3,j}}{C_{1,j-1} + C_{2,j-1} + C_{3,j-1}} - 1$	...	$\frac{C_{1,t} + C_{2,t} + C_{3,t}}{C_{1,t-1} + C_{2,t-1} + C_{3,t-1}} - 1$
4	100%	$\frac{C_{2,2} + C_{3,2} + C_{4,2}}{C_{2,1} + C_{3,1} + C_{4,1}} - 1$	...	$\frac{C_{2,j} + C_{3,j} + C_{4,j}}{C_{2,j-1} + C_{3,j-1} + C_{4,j-1}} - 1$	...	$\frac{C_{4,t}}{C_{4,t-1}} - 1$
...
i	100%	$\frac{C_{i-2,2} + C_{i-1,2} + C_{i,2}}{C_{i-2,1} + C_{i-1,1} + C_{i,1}} - 1$	...	$\frac{C_{i-2,j} + C_{i-1,j} + C_{i,j}}{C_{i-2,j-1} + C_{i-1,j-1} + C_{i,j-1}} - 1$	...	$\frac{C_{i,t}}{C_{i,t-1}} - 1$
...
t-1	100%	$\frac{C_{t-3,2} + C_{t-2,2} + C_{t-1,2}}{C_{t-3,1} + C_{t-2,1} + C_{t-1,1}} - 1$	...	$\frac{C_{t-1,j}}{C_{t-1,j-1}} - 1$	...	$\frac{C_{t-1,t-1}}{C_{t-1,t-2}} - 1$
t	100%	$\frac{C_{t,2}}{C_{t,1}} - 1$	...	$\frac{C_{t,j}}{C_{t,j-1}} - 1$	...	$\frac{C_{t,t}}{C_{t,t-1}} - 1$

Table 3.3 : triangle of payment percentages

Table 3.3 shows the triangle of payment percentages. The calculations are done based on a vertical moving average of three cumulative values. To calculate a percentage of a development year of a year of origin that has already occurred ($P_{i,j}$), the following formula is used:

$$P_{i,j} = \begin{cases} \frac{C_{i-2,j} + C_{i-1,j} + C_{i,j}}{C_{i-2,j-1} + C_{i-1,j-1} + C_{i,j-1}} - 1 & , \text{if } i > 2, j > 1 \\ 1 & , \text{if } j = 1 \\ \frac{C_{i,j}}{C_{i,j-1}} & , \text{if the development year of an origin year has not occurred yet} \end{cases} \quad (12)$$

$P_{i,j}$ is used to calculate the mean and the volatility of development years over origin years that have already occurred.

To calculate the volatility on the reserves (reserves on the origin years that have not fully developed), the predicted $C_{i,j}$ is multiplied with σ_{P_j} for each development year of each not fully developed origin year. Table 3.4 shows the triangle of risk on the reserves.



Year of origin	Development year					
	1	2	...	j	...	t
1						
2						
3						
4						$C_{4,t} \cdot \sigma_{P_t}$
...						...
i						$C_{i,t} \cdot \sigma_{P_t}$
...						...
t - 1				$C_{t-1,j} \cdot \sigma_{P_j}$		$C_{t-1,t} \cdot \sigma_{P_t}$
t		$C_{t,2} \cdot \sigma_{P_2}$		$C_{t,j} \cdot \sigma_{P_j}$		$C_{t,t} \cdot \sigma_{P_t}$

Table 3.4 : triangle of risk on reserves

It would be interesting to know what the volatility on the total reserve (thus until it is out-developed) is for origin-year t . In normal cases the sum of the entries of the development years for origin-year t would give that answer, but because the volatility on the reserves is the square root of the variance on the reserves, all values have to be raised to the square. Let $R_{i,j} = (C_{i,j} \cdot \sigma_{P_j})^2$.

The volatility on the reserves for each origin can now be calculated with the following formula:

$$K_i = \sqrt{\sum_{j \in \zeta} R_{i,j}}, \text{ with } \zeta = \text{not yet occurred development year } j \text{ on origin year } i. \tag{13}$$



3.2 Input sheets

The EVA-sheet has nineteen sheets: one explanation sheet, nine input-sheets and nine output sheets. The input-sheets are: In, KA_EVA, Abw, Kosten, GuV, Bilanz, Korrr, SVgl, SQ and Ztri. The output-sheets are: Plmp, Netto, ExCap, BerJÜ, CR, DB, RBC_DFA, KA_EVA, and RBC_VT_EVA. First I will discuss the technical specifications of the input-sheets; afterwards I will discuss the specifications of the output-sheets.

3.2.1 In

The sheet In is the general sheet that asks for the basic information, the branch-classification, rates, volatility and RBC in accordance with DFA. With the switches a choice can be made whether to let the EVA-sheet calculate the RBC for asset and liabilities (choose EVA), or let another program calculate the RBC for assets and liabilities (choose DFA).

Basic information

The first part of the sheets asks for the basics: the name of the company, the book year/current year and the date the sheet has been filled in.

Branch headers

The second part of the sheet asks for a branch-classification. This classification does not have to contain the total portfolio, because the template includes a classification 'other branches'. In 'other branches' the not included classifications are calculated. The choice of classification is based on the availability of the data and the standard that is used within the company.

Switches

1. 'Bereinigter JÜ mit normalisierten KA' / 'Bereinigter JÜ mit tatsächlichen KA', this is the choice for normalised values of investments or actual values of investments. This switch has been made to show that some things are an effect of management and some are because of the bad market. When normalised, the values can be compared better.
2. 'Keine Anrechnung KA-Erträge auf RST bei Soll-CR' / 'Anrechnung KA-Erträge auf RST bei Soll-CR', this is the choice for taking along or not taking along the investment profit on claim reserves in the calculations of the required Combined Ratio.
3. 'Berücksichtigung Total Return verbundene Unternehmen' / 'Keine Berücksichtigung Total Return verbundene Unternehmen', this is the choice whether or not taking along the total return of associated companies.
4. 'Berücksichtigung Stille Reserven verbundene Unternehmen' / 'Keine Berücksichtigung Stille Reserven verbundene Unternehmen', this is the choice whether or not taking along the hidden reserve from associated companies.
5. 'RBC VT gemäß EVA' / 'RBC VT gemäß DFA', here a choice can be made whether to calculate the RBC of the insurance-techniques in the EVA-sheet or calculating the RBC somewhere else and just filling in the values. EVA are the calculation done by the sheet, DFA is filling in the values from another program.
6. 'RBC KA gemäß EVA' / 'RBC KA gemäß DFA', here a choice can be made whether to calculate the RBC of the investments in the EVA-sheet or calculating the RBC somewhere else and just filling in the values.
7. 'RBC VT EVA korreliert / RBC VT EVA unkorreliert', here the choice is whether to correlate the RBC of insurance-techniques with EVA or not.

Several rates are used in the model. They are stated below. Explanations can be found in the stated paragraphs.



Variable	Link
<i>Economic assumptions</i>	
Risk-free rate	§3.2.1.1
Risk premium	§3.2.1.2
Cost of capital rate after tax (from committed risk capital)	§3.2.1.3
Cost of capital for required-Combined Ratio (before tax)	§3.2.1.4
Profit-tax-rate	§3.2.1.5
<i>Risk-technical assumptions</i>	
Fall-out probability (BBB-rating)	§3.2.1.6
Normal Distribution-Quantile	§3.2.1.7
<i>For making the cost of capital plausible</i>	
Guaranteed return	§3.2.1.8
Fall-out probability AA-rating	§3.2.1.9
Normal Distribution-Quantile (corresponding to the midst of the DAX-Portfolio)	§3.2.1.10

Table 3.5 : rates

For the chosen branches, motor total, sum of all the included branches and the not included branches the variables of tables 3.6, 3.7 and 3.8 are asked for the actual year. The RBC of the invested capital has only one value (the total investments of the year).

Variable	Link
Gross written premiums direct business in:	Sum per year of §3.2.9.4
Moving average claim costs	§3.2.1.11
Volatility previous years-reserves	§3.2.1.12
Volatility actual year-reserves	§3.2.1.13
RBC previous years-Reserves	§3.2.1.14
RBC actual year-Reserves	§3.2.1.15

Table 3.6 : volatility actual year- and previous years-reserve for (committed) RBC in accordance with the EVA-Model

Variable	Link
RBC rate before the expected value of return	§3.2.1.16
Risk based capital claim reserves	§3.2.1.17
RBC branches together	§3.2.1.18
RBC invested capital (in % premiums)	§3.2.1.19

Table 3.7 : committed gross-RBC in accordance with DFA in % of the gross earned premiums

Variable	Link
Net written premiums direct business in:	Sum per year of §3.2.9.8
RBC rate before the expected value of return	§3.2.1.20
Risk based capital claim reserves	§3.2.1.21
Risk based capital branches together	§3.2.1.22
Risk based capital invested capital (in & premiums)	§3.2.1.23

Table 3.8 : committed net-RBC in accordance with DFA in % of the net contribution

3.2.1.1 Risk-free rate

The risk-free rate is the rate to which you can lend or borrow your money risk-free. The rate of a government bond is often taken as the risk-free rate, when the government is reliable.

3.2.1.2 Risk premium

This is the market risk premium.



3.2.1.3 Cost of capital rate after tax (from committed risk capital)

In §3.1.3 formula (7) has been presented. With this formula the cost of capital rate before tax can be calculated. The sheet assumes $\beta = 1$.

This value is given by management and depends on what the management wants.

3.2.1.4 Cost of capital for required-Combined Ratio (before tax)

This value is not really different than the cost of capital rate after tax, but is used in the sheet on other places than the cost of capital rate after tax.

3.2.1.5 Profit-tax-rate

Tax rate for profit.

3.2.1.6 Fall-out probability BBB-rating

This is the probability given once in the four hundred years a catastrophe will happen and the company can pay out with 99,75% certainty and will not go bankrupt.

3.2.1.7 Normal Distribution-Quantile

This is the standard normal distribution-quantile belonging to the fall-out probability from §3.2.1.6.

3.2.1.8 Guaranteed return

The guaranteed return is the rate that is used to make the cost plausible and should be the same as the risk-free rate.

3.2.1.9 Fall-out probability AA-rating

See 3.2.1.6.

3.2.1.10 Normal Distribution-Quantile

This is the standard normal distribution-quantile belonging to the fall-out probability from §3.2.1.9

3.2.1.11 Moving average claim cost

From the sheet SQ the variable 'gross written premiums' and 'moving average claim ratio after Chain Ladder'. The following formula is used to calculate the moving average claims costs:

$$\text{moving average claims costs} = \text{gross written premiums} \bullet \text{discounted moving} \quad (14)$$

3.2.1.12 Volatility previous years-reserve

In §3.1.6 formula (13) shows how the volatility of the reserves can be calculated. If origin-year t is the actual year, then the following formula gives the previous-years reserve:

$$\text{Volatility previous years - reserve} = \sum_{i=1}^{t-1} K_i \quad (15)$$

3.2.1.13 Volatility actual year-reserve

The volatility of the actual year-reserve can be given with the following formula, if origin-year t is the actual year.

$$\text{Volatility actual year - reserve} = K_t \quad (16)$$

3.2.1.14 RBC previous years-reserve

The risk based capital on previous years-reserve is based on the normal distribution-quantile (BBB-rating). The following formula is used to calculate the RBC previous years-reserve:

$$\text{RBC previous years - reserve} = \text{Volatility previous years - reserve} \bullet \text{normal distribution - quantile} \quad (17)$$

3.2.1.15 RBC actual year-reserves

This calculation is the same as the risk based capital on previous years-reserve.

$$\text{RBC actual year - reserve} = \text{Volatility actual year - reserve} \bullet \text{normal distribution - quantile} \quad (18)$$

3.2.1.16 RBC rate before the expected value of return (gross)

This is the risk based capital before the expected value of return divided by the gross written premiums. A reinsurance calculation or a dynamic financial analysis program will give this value. This value is also known as the gross risk adjusted capital.

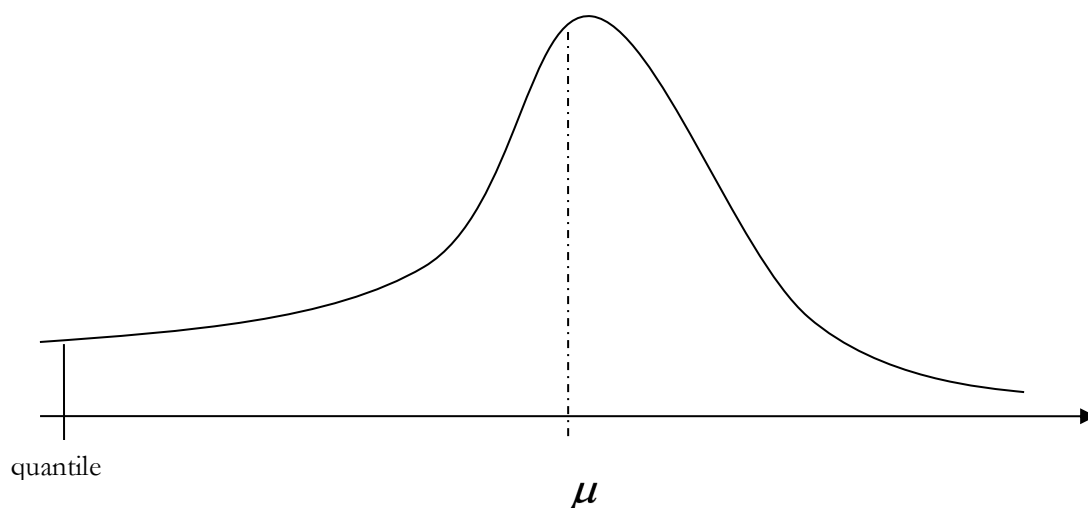


Figure 2.1: distribution for the risk based capital

The RBC before the expected value of return is assumed to be:

$$\text{RBC before the expected value of return} = q - \mu, \quad (19)$$

with μ the expected value of return and q the quantile.



3.2.1.17 Risk based capital claim reserves (gross)

This is the risk on the claim reserves. This can be calculated in different ways. One way is taking the sum of the RBC actual year-reserve and the RBC previous year-reserve divided by the gross written premium. A second way is calculating this value with a DFA.

Diversification should be taken into account.

3.2.1.18 RBC branches together (gross)

The RBC branches together actually means the risk based capital of the expected value of return and the claim reserves. When the expected value of return and the claim reserves are correlated, the following formula can be used to calculate the RBC branches together.

Assume RBC before the expected value of return is a , RBC claim reserves is b and the correlation between the two is $\rho \in [0,1]$. A negative ρ means that when bad things happens in one branch a good thing will happen in another branch. This would not be realistic. See it as a worst scenario. The RBC branches together can be calculated with the following formula.

$$\text{RBC branches together} = \sqrt{a^2 + b^2 + 2 \cdot \rho \cdot a \cdot b} \quad (20)$$

Logically, when the expected value of return and the claim reserve are not correlated then $\rho = 0$ and RBC branches together $= \sqrt{a^2 + b^2}$.

3.2.1.19 RBC invested capital (in % premium) (net)

In the sheet 'Korr' the volatility of the invested capital can be found and in the sheet 'Bilanz' the balance sheet. Multiplying the four groupes (shares, associated companies, fixed income and real-estate) with their volatility gives the risk based capital per group. Since the sum of the four groups is needed, the following formula is needed to calculate the risk based capital for the invested capital.

$$\text{RBC invested capital} = \sqrt{(\text{shares} \cdot \sigma_{\text{shares}})^2 + (\text{assoc.} \cdot \sigma_{\text{assoc.}})^2 + (\text{fix.} \cdot \sigma_{\text{fix}})^2 + (\text{real-estate} \cdot \sigma_{\text{real-estate}})^2} \quad (21)$$

The RBC invested capital has to be divided by the gross written premiums to get the requested rate.

3.2.1.20 RBC rate before the expected value of return (net)

This is the risk based capital before the expected value of return divided by the net earned premiums. This value is known as the net risk adjusted capital.

3.2.1.21 Risk based capital claim reserves (net)

Same as in §3.2.1.17, only net instead of gross.

3.2.1.22 Risk based capital branches together (net)

Same as in §3.2.1.18, but now for net.

3.2.1.23 Risk based capital invested capital (in % premium) (net)

Same as in §3.2.1.19, now for net.

3.2.2 KA_EVA

This sheet asks and calculates the risk capital numbers for investments and the hidden reserves of the investments. Even though this sheet requires some input, a good overview of the investments is given in this sheet.

The following tables show the variables that are to be filled in for several years.

Variable	Link
Hidden reserves investments per 31.12. of the year	§3.2.2.1
Securities with fixed interest rate	
Shares	
Profit-sharing from associated companies	
Other profit-sharing	
Real-estate	
Total hidden reserves investments	
Total market value investments	§3.2.2.2
Shares (including other profit-sharing)	
Associated companies	
Fixed income (including other investments)	
Real-estate	
Total market value investments	
In terms of percentages grouped market value of investments (per 31.12. of the year)	§3.2.2.3
Shares (including other profit-sharing)	
Associated companies	
Fixed income (including other investments)	
Real-estate	
Total	
Announcing: Shares without other profit-sharing	§3.2.2.4
Market value of the shares without other profit-sharing	
Share ratio without other profit-sharing	

Table 3.9 : overview market value investments

Variable	Link
Fixed Income	
Total return on investments on market value per 31.12. of the year	§3.2.2.5
Shares	
Associated companies	
Fixed Income	
Real-estate	
Total of total return	
Investment result (without delta SoPo)	§3.2.2.6
Current average interest (without expenses)	§3.2.2.7
Net return (without expenses)	§3.2.2.8
Total Return	§3.2.2.9

Table 3.10: overview investment result

Variable	Link
Total return investments in percent market value investments	§3.2.2.10
Volatility investments in percent market value investments	§3.2.2.11
Risk capital investments for the expected value of return	§3.2.2.12
Risk capital investments in % market value investments	§3.2.2.13
Risk capital investments after the expected value of return	§3.2.2.14
Risk capital investments in % market value investments	§3.2.2.15

Table 3.11: overview risk capital from investments in accordance with EVA



Variable	Link
Risk capital after the expected value of return with AA-rating	§3.2.2.16
Total return absolute after deducing certain return	§3.2.2.17
ROE	§3.2.2.18

Table 3.12: overview to make the cost of capital plausible

3.2.2.1 Hidden reserves investments

The hidden reserves can be calculated by the difference of the market value of an investment and the balance sheet value of that investment. For each investment type (securities with fixed interest, shares, profit-sharing from associated companies and real-estate) this can be calculated. The sum of all the investment types gives the total hidden reserve on investments.

In the balance sheet there are more investment entries. Table 3.13 shows which category the investment entry is put in.

Balance sheet entry	Category
Real-estate	Real-estate
Shares in undertaking companies	Associated companies
Other participations	Shares (including other profit sharing)
Stocks, fraction funds	Shares (including other profit sharing)
Bearer bonds	Fixed income (including other investments)
Mortgages	Fixed income (including other investments)
Other loans	Fixed income (including other investments)
Fixed and instalment money	Fixed income (including other investments)
Deposit claims	Fixed income (including other investments)

Table 3.13: investment categories

3.2.2.2 Total market value investments

The total market value of an investment is the sum of the balance sheet value and the hidden reserve on this investment. KA_EVA calculates these values.

$$\text{market value investment} = \text{hidden reserve on investment} + \text{balance sheet value investment} \quad (22)$$

3.2.2.3 In terms of percentages grouped market value of investments

Same as in §3.2.2.2, but now in percentages of the total market value of all investments.

3.2.2.4 Announcing: shares without other profit sharing

The total market value of the shares is for some managers more interesting than the sum of the market value of shares and profit-sharing. That is why a calculation is done for the market value and the ratio on the total market value of investments.



3.2.2.5 Total return on investments on market value

The total return on investment is the expected value of contribution coverage on investments and is given by the following formula. For each investment category this is calculated and the total return is the sum of the individual expected value.

$$\text{Expected value of the contribution coverage} = \text{market value investment} \cdot \rho_{\text{investment}}, \quad (23)$$

with $\rho_{\text{investment}}$ the correlation between the total return and the investment.

3.2.2.6 Investment result (without delta SoPo)

The sheet calculates this value by adding up the profit on investments (these can be found in the profit and loss account) and the difference of the year you are calculating and the year before SoPo (SoPo is short for 'Sondern Posten', see vocabulary for more information)

3.2.2.7 Current average interest (without expenses)

The sheet calculates this value by dividing the current investment profit by the mean of this year's and last year's investments total.

3.2.2.8 Net return (without expenses)

The net return on investments is the capital profit plus the realised capital gains/losses and the sum of the two values must be divided by the mean of total investments of the calculated year and the year before. In formula this means:

$$\text{Net interest (without expenses)} = \frac{\text{capital profit} + \text{capital gains/losses}}{\frac{1}{2} \cdot I_t + \frac{1}{2} \cdot I_{t-1}} \quad (24)$$

I_t = total investments of the calculated year t.

3.2.2.9 Total return

The total return is calculated with the following formula:

$$\text{Total return} = \frac{\text{capital profit from investments} + SoPo_t - SoPo_{t-1} + (\text{total hidden reserve})_t - (\text{total hidden reserve})_{t-1}}{\frac{1}{2} \cdot (\text{total market value})_t + \frac{1}{2} \cdot (\text{total market value})_{t-1}} \quad (25)$$

$SoPo$ = 'Sondern Posten'

t = year you are calculating

3.2.2.10 Risk capital from investments in accordance with EVA

The total return on investments in percentage of the market value of the investments can logically be calculated by dividing the market value of the investments on the total return. In formula:



$$\text{Total return investments in percent market value investments} = \frac{\text{Total return}}{\text{Market value investments}} . \quad (26)$$

3.2.2.11 Volatility investments in percent market value investments

The calculations of the volatility investments in percent market value investments:

$$\text{volatility investments in percent market value investments} = \sqrt{x^T A x} . \quad (27)$$

With x the percentual market value vector and A the covariance matrix of the four investment categories.

3.2.2.12 Calculations of risk capital investments for the expected value of return

Calculations of risk capital investments for the expected value of return:

$$\text{risk capital expected value of return} = \frac{\text{volatility investments in \% market value}}{\text{total market value of investments}} \cdot \text{normal distribution quantile} . \quad (28)$$

3.2.2.13 Risk capital investments in percent market value investment

Calculations risk capital investments in % market value investments:

$$\text{risk capital investments in \% market value} = \frac{\text{risk capital expected value of return}}{\text{total market value}} . \quad (29)$$

3.2.2.14 Calculations risk capital investments after the expected value of return

Calculations risk capital investments after the expected value of return:

$$\text{risk capital investments after expected value of return} = \text{risk capital investments in \% market value} - \text{risk capital expected value of return} . \quad (30)$$

3.2.2.15 Risk capital investments in percent market value

Calculations risk capital investments in % market value:

$$\text{risk capital investments in \% market value} = \frac{\text{risk capital investments after expected value}}{\text{total market value of investments}} . \quad (31)$$

3.2.2.16 Risk capital after the expected value of return with AA rating

Risk capital after the expected value of return with AA-rating:

$$\begin{aligned} \text{risk capital after expected value of return with AA rating} = & (\text{volatility of the investments in \% market value} \\ & \text{of investments} \cdot \text{Normal distribution quantile according to the DAX - portfolio} \\ & - \text{total return investments in percent market value of investments}) \cdot \text{total market value of investments} . \end{aligned} \quad (32)$$

3.2.2.17 Total return absolute after guaranteed return

Total return absolute after guaranteed return:



$$\text{total return abs. after guaranteed return} = (\text{total return inv. \% market value inv.} - \text{risk - free rate}). \quad (33)$$

3.2.2.18 Return on equity

Formula for the return on equity:

$$\text{return on equity} = \frac{\text{total return absolute after guaranteed return}}{\text{risk capital after the expected value of return with AA - rating}}. \quad (34)$$

3.2.3 Abw

This sheet gives an impression of which ratio's of the gross written premium is needed for several reserves. These numbers are total numbers, not branch categorised. The following tables show which variables are included in this sheet:

Variable	Link
Gross written premiums direct business	Copy of value from GuV
% previous years	§3.2.3.1
Actual year claim ratio after HGB	§3.2.3.2
Actual year claim ratio	
Gross claim provisions (direct, without claim handling costs)	§3.2.3.3
Settlement profit	§3.2.3.4
Higher paid claim provisions in accordance with HGB (accident year without older years, in % premium)	§3.2.3.5
Higher paid claim provisions in accordance with HGB (accident year without older years, absolute)	§3.2.3.6
Higher paid claims provisions in accordance with HGB (actual year and older years)	§3.2.3.7

Table 3.14: Overview on the gross higher paid claim reserves (HGB versus Chain Ladder)

Variable	Link
Net claim provisions (direct, without claim handling costs)	Copy of value from Bilanz
Net settlement profit (direct, without claim handling costs)	§3.2.3.8
Net higher paid claims provision in accordance with HGB (accident year without older years)	§3.2.3.9
Net higher paid claims provision in accordance with HGB (actual year and older years)	§3.2.3.10

Table 3.15: Overview on net higher paid claim reserves (HGB versus Chain Ladder)

3.2.3.1 % previous year

This value shows the growth of the portfolio in respect to the previous year. The calculation is as follows:

$$\%(\text{previous year}) = \frac{(\text{gross written premium})_t}{(\text{gross written premium})_{t-1}} \quad (35)$$

t = year you are calculating

3.2.3.2 Claims (in % of the gross written premiums)

The total of the gross written premiums can be found in the profit and loss account, the gross claims of the actual year can be found in the profit and loss account as well. The actual year claim ratio can be calculated with the following formula:

$$\text{actual year - claim part after} = \frac{\text{gross claims of the actual year}}{\text{gross written premiums}} \quad (36)$$

Actual year claim ratio (Chain Ladder ultimate) is extracted from the sheet SQ. The actual year-claim ratio (Chain Ladder ultimate) is calculated with formula (37).



$$\text{actual year - claim ratio (CL ultimate)} = \frac{\text{Chain ladder ultimate}}{\text{gross written premiums}} \quad (37)$$

3.2.3.3 Gross claim provisions

The balance value of the gross technical claim provisions should be filled in for each year.

3.2.3.4 Settlement profit

When paying a claim, the provision for this claim is taken from the technical claim provision. When the provision was more than the claim amount, the profit is put in the settlement profit post.

3.2.3.5 Higher paid claim provisions (accident year without older years, in % premium)

This is the difference between the actual year claim ratio and the actual year claim ratio. In formula:

$$\text{higher paid claim provisions (accident year without older years, in \% premium)} = \text{actual year claim ratio} - \text{actual year claim ratio (CL ultimate)} \quad (38)$$

3.2.3.6 Higher paid claim provisions (accident year without older years, absolute)

The higher paid claim provisions (accident year without older years, absolute) can be calculated by multiplying the higher paid claim provisions (accident year without older years, in % premium) with the gross written premium. Formula (39) shows this:

$$\text{higher paid claim provisions (accident year without older years, absolute)} = \text{higher paid claim provisions (accident year without older years, in \% premium)} \bullet \text{gross written premium} \quad (39)$$

3.2.3.7 Higher paid claims (actual year and older years)

This is the reserves adequacy of total actual reserved. This is the extra part in the reserve that is not really needed.

3.2.3.8 Net settlement profit

The net settlement profit, the profit after taking out and putting in amounts in the provisions. This has to be filled in, for direct businesses, without claim handling costs.

3.2.3.9 Net higher paid claim provisions (accident year without older years)

The net higher paid claim provisions can be calculated with the following formula:

$$\text{net higher - paid claim provisions (accident year without older years)} = \frac{\text{higher - paid claim provisions (accident year without older years)} \bullet \text{net claim provisions}}{\text{gross claim provisions}} \quad (40)$$



3.2.3.10 Net higher paid claim provisions (accident year and older years)

Net higher paid claims provision in accordance with HGB Net (actual year and older years) is calculated with formula (41):

$$\text{net higher paid claims provisions} = \frac{\text{higher paid claims (act. yr and older yrs)} \bullet \text{net claim provisions}}{\text{gross claim provision}}. \quad (41)$$



3.2.4 Kosten

This sheet shows an overview of the commission costs per branch, the insurance-technical costs per branch and the total costs made within the company. Table 3.16 shows the variables that have to be filled in or are calculated.

Variable	Link
Commission ratio (direct business, in % written premium)	§3.2.4.1
Other insurance-technical costs (direct business, in % written premium)	§3.2.4.2
Total costs ratio (direct business, in % written premiums)	§3.2.4.3
Total costs, gross	§3.2.4.4
Commissions including mediation-commission	§3.2.4.5
Service profit (profit from service and mediation)	§3.2.4.6
Total costs without commissions and service profit/mediation profit ("net")	§3.2.4.7
Total cost ratio, gross	§3.2.4.8
of that: commission ratio	
of that: service profit ratio	
Total costs ratio without commissions and service profit ("net")	§3.2.4.9
Claim settlements and other expenses	§3.2.4.10
Cost ratio according to the profit and loss account	§3.2.4.11
Claim handling costs ratio according to the profit and loss account	§3.2.4.12
Gross company expenses ratio according to the profit and loss account	§3.2.4.13
Gross written premiums (direct business)	Copy of §3.2.9.4

Table 3.16: variables in the Kosten-sheet

3.2.4.1 Commission ratio

The commission costs are per branch and per year and a ratio of the gross written premium of the branch of the year. This is an input field.

3.2.4.2 Other insurance-technical ratio

The other insurance-technical costs contain the acquisition costs and the direct- and indirect and allocated general operating expenses (including personnel profit-sharing). These costs should be filled in as a ratio of the gross written premium of the branch of the year. This is an input field.

3.2.4.3 Total costs ratio

The total costs ratio is the sum of the commission ratio and the other insurance-technical ratio. This ratio shows the percentage of the gross written premium that is needed to cover the costs.

3.2.4.4 Total costs, gross

The total costs are again the total costs made for the insurance, thus again the commission cost, the acquisition costs, the allocated general operating expenses, etc. The total costs are the costs for all the branches, these costs can also be found in the profit and loss account, although there the allocated costs are not included in the insurance company expenses. These values have to be filled in.

3.2.4.5 Commissions including mediation-commission

The commissions including mediation-commission are the total commission costs of all the branches together and the mediation costs. This value has to be filled in.



3.2.4.6 Service profit

When mediating with other companies a certain profit can be gained from service, this is the service profit and this value should be filled in here.

3.2.4.7 Total costs without commissions and service profit/mediation profit

This value gives an idea how much of the costs go to commissions. The sheet calculates this.

3.2.4.8 Total costs ratio, gross

This is the ratio of total gross costs from §3.2.4.4 as a ratio on the gross written premium and is calculated by the sheet.

A ratio of the commission costs including mediation costs is also calculated, as well as a ratio on the service profit. These ratios are also based on the gross written premium.

3.2.4.9 Total costs without commissions and service profit

The sheet calculates this value of the costs without commission costs and service profit, as a ratio of the gross written premium.

3.2.4.10 Claim settlements and other expenses

This value is the difference between the total gross costs ratio from §3.2.4.8 and the ratio of the gross expenses of the insurance company according to the profit and loss account.

3.2.4.11 Costs ratio according to the profit and loss account

The sheet calculates the claim handling costs from the profit and loss account as a ratio of the gross written premium.

3.2.4.12 Claim handling costs ratio according to the profit and loss account

The sheet calculates the gross expenses of the insurance company from the profit and loss account as a ratio of the gross written premium.

3.2.4.13 Gross company expenses ratio according to the profit and loss account

This is the sum of the cost ratio according to the profit and loss account and the claim handling costs ratio according to the profit and loss account. This is actually a double calculation of the model to check if the values of this sheet are correct and are in agreement with the numbers in the profit and loss account.



3.2.5 GuV

This is the profit and loss account. Table 3.17 shows the variables that have to be filled in.

Variable
Gross written premium
Changes in contribution transfers
Gross earned premiums direct business
Gross claims actual year, without claim handling costs
Settlement results
Allocated claim handling costs
Other insurance-technical results (direct)
Insurance-technical gross result direct business
Results reinsurance
Insurance-technical net result direct business
Results other businesses (direct business + indirect net)
Insurance-technical joint net result
Provisions for impending losses
Equalisation fund
Insurance-technical net result after equalisation funds & provisions for impending losses
Current capital profit
Realised capital gains / -losses
Other profits + invested capital
Invested capital profit
Profit provisions of services + company mediation
Cost services + mediation
Other profit + costs
Year-surplus before taxes
Tax costs
Year-surplus before taxes for companies

Table 3.17: profit and loss account variables

3.2.6 Bilanz

Table 3.18 shows the variables that have to be filled in the balance sheet.

Assets	Liabilities
Intangible funds	Shareholders' equity
Investments	Authorised capital
Real estate	Reserved funds
Shares in undertaking companies	Profit reserves
Other participations	Balance profit
Stocks, fraction funds	Reserves
Bearer bonds	Joint provisions for outstanding claims
Mortgages	Provisions for impending losses
Other loans	Other reserve
Fixed and instalment money	Fluctuation provisions and other provisions
Deposit claims	Retirement reserves
Cheque, cash, giro balance	Sondern Posten
Company equipment	Other liabilities
Other assets	

Table 3.18: balance sheet variables



3.2.7 Korr

The sheet 'Korr' asks for different kind of correlations that are used on different places in the model. Table 3.19 shows which variables are asked.

Variable	Link
Correlation between insurance-techniques and investments	§3.2.7.1
Correlation in the insurance-techniques	§3.2.7.2
Total return and correlations in the investments	§3.2.7.3
Correlation	
Covariance	
Input of the total return on investments per enterprise	§3.2.7.4

Table 3.19: correlation variables

3.2.7.1 Correlation between insurance-techniques and investments

This is the correlation between the insurance-techniques (thus the branches) and the investments. This is a correlation that has large effect on the results.

3.2.7.2 Correlation in the insurance-techniques

The correlation in the insurance-techniques is the correlation within the branches. The correlations can best be calculated with the Spearman Rank method, because this correlation is used within the GENERALI group. Within the Spearman Rank method each number gets a rank (from low to high). Then difference δ_i between the two values of the vector you want to compare should be calculated. The correlation ρ between the two vectors can be calculated by the following formula:

$$\rho = 1 - \frac{6 * \sum \delta_i^2}{n^3 - n}. \quad (42)$$

Where n is the length of the vector (number of data-points of each branch) and i the value. The negative correlation values have been left out, because it is better not to presume that if one branch goes one way, another will go exactly the other way around.

3.2.7.3 Total return and correlations in the investments

The sheet has a drop bar for the total return on investments, which gives the choice to choose the values of the total return on investments of one of five enterprises.

The correlation between the investment categories is the correlation between 'shares', 'associated companies', 'fixed income' and 'real-estate'. These correlations are also Spearman Rank correlations. With the help of the correlations the sheet also calculates the covariances.

3.2.7.4 Input of the total return on investments per enterprise

Here the total return on the investment categories and the volatility on the investment categories have to be filled in.



3.2.8 SVgl

This sheet asks for the claim frequency and the average claim amount for each branch. When the two values are multiplied you get the claim costs per contract. The sheet asks this for several years; it asks these values for 1996 – 2004, but there is place for more years.

Over the claim costs per contract you can calculate the mean (expected value) over the years and the volatility (standard deviation).

The volatility for RBC in accordance with EVA (rate) is also needed as input. This is the volatility of the claim costs per contract as a percentage of the expected value of the claim costs per contract. Normally for each year at least twenty data points are needed (thus for 1996 the years 1977 – 1996). Then the sheet can calculate the volatility that is used to calculate the RBC in accordance with this model. But because not every insurance company has that many information of those years, the volatility percentage that is calculated by the sheet is used as a volatility for all the years.

3.2.9 SQ

This sheet asks for several branch categorised inputs. SQ stands for ‘Schadenquoten’, freely translated it stands for claim ratio. Table 3.20 shows all the values that are or asked to filled in or are calculated.

Variable	Link
Actual year claim ratio	§3.2.9.1
Chain Ladder ultimate divided by written premiums	§3.2.9.2
Difference Chain Ladder / Actual year claim ratio (=ratio higher paid)	§3.2.9.3
Gross written premiums	§3.2.9.4
Actual year claim expenses	§3.2.9.5
Claim expenses after Chain Ladder	§3.2.9.6
Difference actual year claim expenses/ Claim expenses Chain Ladder	§3.2.9.7
Net written premiums	§3.2.9.8
Actual year payment ratio	§3.2.9.9
Claim ratio with present value claim payments	§3.2.9.10
Difference Chain Ladder / Chain Ladder present value (in % premiums)	§3.2.9.11
Moving average claim ratio after Chain Ladder	§3.2.9.12
Actual payments	§3.2.9.13
Claim expenses after Chain Ladder with present value claim payments	§3.2.9.14
Difference Chain Ladder / Chain Ladder present value	§3.2.9.15

Table 3.20: Overview claim ratios

3.2.9.1 Actual year claim ratio

The claim ratio of the actual year is the ratio of the paid claims of the actual year and the reserve that has been put aside for the actual year. This sum is known as the incurred ratio. The incurred value is a ratio of the gross written premium. This needs to be filled in for all the chosen branches. There is place for fourteen past years, the actual year and five future years that can be filled in. In the ideal situation all ratios are to be filled in, but this is not necessary.

3.2.9.2 Chain Ladder ultimate divided by written premiums

This is the Chain Ladder ultimate as a ratio of the gross written. This means that the predicted ultimates should also be known. This can be done with the multiplications of the development factors with a certain assumption. An example would be taking the development factors that were used to calculate the ultimate of the actual year.



3.2.9.3 Difference Chain Ladder / Actual year claim ratio (=ratio higher paid)

These values are calculated by the sheet. This value shows the difference between the Chain Ladder ultimate ratio and the actual year claim ratio. This ratio says whether the company is underreserving (<0) or overreserving (>0).

3.2.9.4 Gross written premiums (in millions €)

In this part all the gross written premiums (past and future) have to be filled in.

3.2.9.5 Actual year claim ratio

With the actual year claim ratio and the gross written premium known, the sheet calculates the actual year claim amounts in millions for the chosen branches for the years that are filled in for both actual year claim ratio and gross written premium.

3.2.9.6 Claim expenses after Chain Ladder

With the Chain Ladder ultimate ratios and the gross written premiums known, the expected total claim expenses for the chosen branches for the filled in years are calculated in millions by the sheet.

3.2.9.7 Difference actual year claim expenses / Chain Ladder claim expenses

This is an overview of the difference of the actual year claim expenses and the Chain Ladder ultimate claim expenses. These values show if the reserves put on in the actual year and the claim already paid in the actual year are higher or lower than the claim expenses calculated with the Chain Ladder method.

3.2.9.8 Net written premiums (in million €)

The net figures are interesting for some managers and thus there are some net calculations done in the workbook. For those calculations the net written premiums are needed for the chosen branches for several years.

3.2.9.9 Actual year payment ratio

These values are the first development year payments as a ratio of the gross written premium.

3.2.9.10 Claim ratio with present value claim payments

Here the present value of the ultimate payment is calculated as a ratio of the gross written premium. This is calculated with the risk free rate.

3.2.9.11 Difference Chain Ladder / Chain Ladder present value

This is an overview of the difference of the Chain Ladder ultimate and the Chain Ladder present value as a ratio of the gross written premium. This is thus the capital profit from the interest rate.

3.2.9.12 Moving average claim ratio after Chain Ladder

To get more stable claim ratios, the moving average of the actual year claim ratio is calculated (=average of three values).



3.2.9.13 Actual year payments

Here the actual year payments are given in millions.

3.2.9.14 Claim expenses after Chain Ladder with present value claim payments

The present value of the claim expenses after Chain Ladder is given here in millions.

3.2.9.15 Difference Chain Ladder / Chain Ladder present value

To have an idea of the difference of the present value of the Chain Ladder claim payments and the Chain Ladder payments, an overview is given of it in millions.

3.2.10 ZTri

In this sheet for each branch the cumulative payment triangle has to be filled in. With this payment triangle, the sheet calculates the incremental payment triangle and with the help of the incremental payment triangle, the present value of the ultimates of the payments can be calculated. Table 3.21 shows the variables of the sheet. The paragraphs will give more information about the variable.

Variable	Link
Cumulative payment triangle per branch	§3.2.10.1
Incremental payment triangle per branch	§3.2.10.2
Present value of the Chain Ladder ultimate	§3.2.10.3

Table 3.21: Overview claim ratios

3.2.10.1 Cumulative payment triangle per branch

The cumulative payment triangle is actually not a triangle, because not only the known values are asked, but also the unknown values are asked. These values can be calculated as written in §3.1.5. With the mean development factors of each development year to the next development year, future payments can be calculated.

For future years, only the first payment has to be known. With the mean development factors an estimation of the ultimate can be calculated.

3.2.10.2 Incremental payment triangle per branch

This triangle is deduced from the cumulated payment triangle, to give an overview of what amount is paid out for a certain origin year. The incremental payment triangle is also used to calculate the present value of the Chain Ladder ultimate.

3.2.10.3 Present value of the Chain Ladder ultimate

With the use of the incremental payment triangle the value Chain Ladder ultimate can be calculated to the present value. The risk free rate from the sheet 'In' is used to calculate this value to the present value.



3.3 Output sheets

3.3.1 Netto

The sheet 'Netto' gives overviews of the year-surplus net with normalised capital profit, the year-surplus with actual capital profit, the net available shareholders' equity, the net committed risk capital, the net Excess Capital, EVA and net ROE regarding the shareholders' equity and EVA and net ROE regarding the risk capital. The normalised net year-surplus is based on values of the calculated year and the year before. This gives an impression whether numbers are better/worse than the year before. The normalised numbers also give an indication whether the economy is bad or that the manager does not function well.

Variable	Link
Year-surplus after HGB (after tax on profit)	Copy of value from GuV
Changes in hidden reserve in investments	§3.3.1.1
Net feed on equalisation funds	Copy of value from GuV
Net feed provisions for impending losses	Copy of value from GuV
Higher paid claims (actual year without older years)	Copy of §3.2.3.9
Net settlement profit	Copy of §3.2.3.8
Total return associated companies	Copy of §3.2.2.5
Put in and take out SoPo	§3.3.1.2
Net year-surplus before tax	§3.3.1.3
More tax (tax rate ...%)	§3.3.1.4
Net year-surplus after tax	§3.3.1.5

Table 3.22: overview year-surplus net with normalised capital and actual capital profit

Variable	Link
Perceptible shareholders' equity	§3.3.1.6
Sondern Posten with financial reserve ratio	Copy of value from Bilanz
Hidden reserves	§3.3.1.7
Invested hidden reserve	§3.3.1.8
Securities with fixed interest rate	From §3.2.2.1
Shares	
Profit-sharing from associated companies	
Other profit-sharing	
Real-estate	
Equalisation fund	Copy of value from Bilanz
Provisions for impending losses	Copy of value from Bilanz
Higher paid claims provisions in accordance with HGB (actual year and older years)	From §3.2.3.10
Total available shareholders' equity (per 31.12)	§3.3.1.9
Hidden reserves associated companies	§3.3.1.10
Available shareholders' equity after hidden reserves associated companies (31.12)	§3.3.1.11

Table 3.23: overview net available shareholders' equity

Variable	Link
Net committed insurance-technical RBC, before the expected value of return	§3.3.1.12
Net committed invested RBC, before the expected value of return	§3.3.1.13
Sum	§3.3.1.14
Total net committed RBC, before the expected value of return	§3.3.1.15
Diversification	§3.3.1.16

Table 3.24: overview net committed risk capital (31.12; only in accordance with DFA)

Variable	Link
Excess Capital before tax and profit-loss (with RBC before the expected value of return)	§3.3.1.17
Tax load when realising the hidden reserve (tax ...%)	§3.3.1.18
Excess Capital after tax, before profit-loss (per 31.12)	§3.3.1.19
Profit-loss when paying the Excess Capital (cash value of the everlasting interest)	§3.3.1.20
Excess Capital after tax and profit-loss (per 31.12)	§3.3.1.21

Table 3.25: overview net Excess Capital (per 31.12. of the year)

Variable	Link
Available shareholders' equity on 01.01. before tax on hidden reserve	§3.3.1.22
Tax on hidden reserve (without associated companies)	§3.3.1.23
Available shareholders' equity on 01.01. after tax on hidden reserve	§3.3.1.24
Year-surplus after tax, before risk capital	§3.3.1.25
Cost of capital (...% on available shareholders' equity)	§3.3.1.26
EVA regarding available shareholders' equity	§3.3.1.27
ROE (return on available shareholders' equity)	§3.3.1.28

Table 3.26: overview EVA and net ROE, regarding the available shareholders' equity

Variable	Link
Committed risk capital on 01.01.	§3.3.1.29
Year-surplus after tax, before risk capital	§3.3.1.30
Interest-profit on Excess Capital (after tax)	§3.3.1.31
Return on risk capital	§3.3.1.32
Cost of capital (...% on risk capital)	§3.3.1.33
EVA regarding risk capital	§3.3.1.34
ROE (Return on committed risk capital)	§3.3.1.35

Table 3.27: overview EVA and net ROE, regarding risk capital

3.3.1.1 Changes in hidden reserve in investments

The changes in the hidden reserve in investments of the net year-surplus with normalised capital profit is the change in hidden reserve is the difference of the previous year's total of the total return on investments and the actual year's investment result, which are both calculated in KA_EVA.

The changes in the hidden reserve in investments of the net year-surplus with actual capital profit are calculated by the difference of the actual year's total hidden reserve and the previous year's total hidden reserve.

3.3.1.2 Put in and take out SoPo

When calculating the put in and take out of the 'Sondern Posten' the difference of the actual year's and the previous year's balance sheet value of the 'Sondern Posten' is calculated. This is true for calculating the normalised year-surplus and the actual year-surplus.



3.3.1.3 Net year-surplus before tax

The net year-surplus (normalised and actual year-surplus) is the sum of the year-surplus after tax on profit, the changes in the hidden reserve in investments, the net feed on equalisation funds, the net freed on provisions for impending losses, the higher paid claims (actual year without older years), the net settlement profit, the total return on associated companies and the difference in SoPo.

3.3.1.4 More tax (tax rate ...%)

This is the tax calculated over the net year-surplus before tax and the year-surplus from the profit and loss account.

3.3.1.5 Net year-surplus after tax

The tax profit that is made because of the difference in value of the year-surplus (after tax on profit), from the profit and loss account, and the net year-surplus before tax is tax that now can be added as profit. This is because no tax is paid over all the values that are included in the net year-surplus before tax, except the tax that is already paid in the year-surplus from the profit and loss account. The net year-surplus after tax is thus the sum of the net year-surplus before tax and the 'more tax'.

3.3.1.6 Perceptible shareholders' equity

Perceptible shareholders' equity is the difference between the balance sheet value of the shareholders' equity and the balance profit.

3.3.1.7 Hidden reserves

The total of the hidden reserves is the sum of the hidden reserves on investments, the equalisation funds and other reserves, the provisions for impending losses and the provisions for higher paid claims.

3.3.1.8 Invested hidden reserve

The hidden reserves on investments is the sum of the hidden reserves on securities with a fixed rate, shares, profit-sharing from associated companies, other profit-sharing and real-estate.

3.3.1.9 Total available shareholders' equity (per 31.12)

The total available shareholders' equity is the sum of the perceptible shareholders' equity, Sondern Posten with financial reserve ratio and the total hidden reserve.

3.3.1.10 Hidden reserves associated companies

In the sheet 'In' a switch has been made to include or exclude the hidden reserves from associated companies. Depending on the choice made by the user, the hidden reserves from associated companies have a value or not.

3.3.1.11 Available shareholders' equity after hidden reserves associated companies (31.12)

The available shareholders' equity after hidden reserve associated companies is total available shareholders' equity minus the hidden reserves from associated companies.



3.3.1.12 Net committed insurance-technical RBC, before the expected value of return

The calculation of the net committed insurance-technical RBC, before the expected value of return depends on the choice of the switch 'RBC VT gemäß EVA / RBC VT gemäß DFA' in the sheet 'In'. When the calculations are according to the EVA calculations, the sheet is blank. When using the DFA manner, the sheet copies the value from RBC_DFA.

3.3.1.13 Net committed invested RBC, before the expected value of return

The calculations of the net committed investments RBC, before the expected value of return are also dependent of the switch 'RBC VT gemäß EVA / RBC VT gemäß DFA'. When using the DFA manner, the sheet copies the value from RBC_DFA.

3.3.1.14 Sum

Sum of the net committed risk capital is the sum of the net committed insurance-technical RBC before the expected value of return and the net committed invested RBC before the expected value of return.

3.3.1.15 Total net committed RBC, before the expected value of return

The total net committed RBC, before the expected value of return is calculated with the following formula:

$$\text{Total net committed RBC} = \sqrt{yBy^T} \quad (43)$$

With y the vector of net committed insurance-technical RBC and B the matrix of the correlation between the investments and the insurance-technique.

3.3.1.16 Diversification

The difference between the sum of the net committed risk capital and the total net committed RBC is the diversification profit/loss.

3.3.1.17 Excess Capital before tax and profit-loss (with RBC before the expected value of return)

The Excess Capital before tax and profit loss is the difference between the available shareholders' equity after hidden reserves associated companies and the total net committed RBC.

3.3.1.18 Tax load when realising the hidden reserve (tax ...%)

The tax load when realising the hidden reserves is the Excess Capital before tax and profit-loss multiplied with the tax rate (from sheet 'In').

3.3.1.19 Excess Capital after tax, before profit-loss (per 31.12)

Excess Capital after tax and before profit-loss is the Excess Capital before tax and profit-loss minus the tax load when realising the hidden reserve.



3.3.1.20 Profit-loss when paying the Excess Capital (cash value of the everlasting interest)

The profit-loss when paying the Excess Capital is calculated with the following formula:

$$\text{Profit - loss when paying the excess capital} = \frac{\text{Excess capital before tax and profit - loss} \cdot \text{risk free rate} \cdot (1 - \text{tax - rate})}{\text{Cost of capital after tax}} \quad (44)$$

3.3.1.21 Excess Capital after tax and profit-loss (per 31.12)

The Excess Capital after tax and profit-loss is the difference between the Excess Capital after tax, before profit-loss minus the profit-loss when paying the Excess Capital.

3.3.1.22 Available shareholders' equity on 01.01. before tax on hidden reserve

This is the available shareholders' equity without hidden reserves associated companies from 31.12 of the year before.

3.3.1.23 Tax on hidden reserve (without associated companies)

This is the tax on the difference of the total hidden reserves minus the hidden reserves on associated companies. Since the EVA and ROE on available shareholders' equity is calculated for 01.01, it means that data from 31.12 of the year before should be used to calculate values.

3.3.1.24 Available shareholders' equity on 01.01. after tax on hidden reserve

This is the available shareholders' equity on 01.01 before tax on hidden reserves minus the tax on the hidden reserves.

3.3.1.25 Year-surplus after tax, before risk capital

The year-surplus after tax and before risk capital can be calculated with actual capital profit or with normalised capital profit. It thus depends on whether the switch in the sheet 'In' is on actual or normalised capital profit.

The net year-surplus after tax from the normalised calculations or actual values calculations will then be filled in here, depending on the state of the switch.

3.3.1.26 Cost of capital (...% on available shareholders' equity)

The cost of capital (...% on available shareholders' equity) is the available shareholders' equity on 01.01. after tax on hidden reserve times the cost of capital rate after tax.

3.3.1.27 EVA regarding available shareholders' equity

EVA regarding available shareholders' equity is the difference of the year-surplus after tax, before risk capital minus the cost of capital.

3.3.1.28 ROE (return on available shareholders' equity)

The return on equity is the year-surplus after tax, before risk capital as a ratio of the available shareholders' equity on 01.01. after tax on hidden reserve.



3.3.1.29 Committed risk capital on 01.01.

This is the total net committed RBC from 31.12 of the previous year.

3.3.1.30 Year-surplus after tax, before risk capital

Depending on the switch in the sheet 'In', the year-surplus after tax is this year's net year surplus after tax with actual capital profit or normalised capital profit.

3.3.1.31 Interest-profit on Excess Capital (after tax)

The interest-profit on Excess Capital after tax is the risk free rate times the Excess Capital after tax, before profit-loss.

3.3.1.32 Return on risk capital

The return on risk capital is the difference of the year-surplus after tax, before risk capital and the interest-profit on Excess Capital.

3.3.1.33 Cost of capital (...% on risk capital)

The cost of capital on the risk capital is the cost of capital rate after tax times the committed risk capital.

3.3.1.34 EVA regarding risk capital

EVA regarding risk capital is the difference between the return on risk capital and the cost of capital on risk capital.

3.3.1.35 ROE (Return on committed risk capital)

The ROE of the return on committed risk capital is the return on committed risk capital as a ratio of the committed risk capital on 01.01.

3.3.2 ExCap

This sheet calculates the Excess Capital and the values of the EVA and ROE on shareholders' equity and risk capital. Unlike the numbers in 'Netto', the values calculated here are gross figures.

Variable	Link
Perceptible shareholders' equity	Same as §3.3.1.6
Sondern Posten with financial reserve ratio	Copy of value from Bilanz
Hidden reserves	Same as §3.3.1.7
Invested hidden reserve	Same as §3.3.1.8
Securities with fixed interest rate	From §3.2.2.1
Shares	
Profit-sharing from associated companies	
Other profit-sharing	
Real-estate	
Equalisation fund	Copy of value from Bilanz
Provisions for impending losses	Copy of value from Bilanz
Higher paid claims provisions in accordance with HGB (actual year and older years)	From §3.2.3.7
Total available shareholders' equity (per 31.12)	Same as §3.3.1.9
Hidden reserve associated companies	Same as §3.3.1.10
Available shareholders' equity after hidden reserves associated companies (per 31.12)	Same as §3.3.1.11

Table 3.28: overview available shareholders' equity

Variable	Link
Committed insurance-technical RBC, before the expected value of return	§3.3.2.1
Committed invested RBC, before the expected value of return	§3.3.2.2
Sum	§3.3.2.3
Total committed RBC, before the expected value of return	Same as in §3.3.1.15
Diversification	Same as in 3.3.1.16
Expected value of the insurance-technical coverage contributions	Copy of value from RBC_VT_EVA
Expected value of the invested coverage contributions	Same way as §3.2.2.5
Total expected value coverage contributions	§3.3.2.4
Total committed RBC after the expected value of return	§3.3.2.5

Table 3.29: overview committed risk capital (per 31.12 of the year)

Variable	Link
Excess Capital before tax and profit-loss (with RBC before the expected value of return; per 31.12)	§3.3.2.6
Excess Capital with RBC after the expected value of return	§3.3.2.7
Tax load when paying the Excess Capital to the shareholders (tax ...%)	§3.3.2.8
Excess Capital after tax, before profit-loss (per 31.12.)	§3.3.2.9
Profit-loss after paying the Excess Capital	§3.3.2.10
Excess Capital after tax and profit-loss	§3.3.2.11

Table 3.30: overview Excess Capital (per 31.12. of the year)

Variable	Link
Available shareholders' equity on 01.01. before tax on hidden reserves	§3.3.2.12
...% tax on hidden reserves (without associated companies)	§3.3.2.13
Available shareholders' equity on 01.01. after tax on hidden reserves	§3.3.2.14
Year-surplus after tax, before risk capital	§3.3.2.15
Cost of capital (...% on available shareholders' equity)	§3.3.2.16
EVA regarding available shareholders' equity	§3.3.2.17
ROE (Return on available shareholders' equity)	§3.3.2.18

Table 3.31: overview EVA and ROE regarding available shareholders' equity

Variable	Link
Committed risk capital on 01.01.	
Year-surplus after tax, before risk capital	Same as §3.3.2.15
...% interest-profit on Excess Capital (after tax)	
Return on the risk capital	
Cost of capital (...% on risk capital)	
EVA regarding risk capital	
ROE (Return on committed risk capital)	

Table 3.32: overview EVA and ROE regarding risk capital

3.3.2.1 Committed insurance-technical RBC, before the expected value of return

Depending on the switch 'RBC VT gemäß EVA / RBC VT gemäß DFA', this value is calculated in 'RBC_VT_EVA' or 'RBC_DFA'.

3.3.2.2 Committed invested RBC, before the expected value of return

Depending on the switch 'RBC VT gemäß EVA / RBC VT gemäß DFA', this value is calculated in 'KA_EVA' or 'RBC_DFA'.

3.3.2.3 Sum

The sum of the committed RBC is of course the sum of the committed insurance-technical RBC and the committed invested RBC.

3.3.2.4 Total expected value coverage contributions

The total expected value of coverage contributions is the sum of the expected value of insurance-technical coverage contributions and the expected value of the investments coverage contribution.

3.3.2.5 Total committed RBC after the expected value of return

The total committed RBC after the expected value of return is the difference of the total committed RBC before the expected value of return and the total expected value of coverage contributions.



3.3.2.6 Excess Capital before tax and profit-loss (with RBC before the expected value of return; per 31.12)

The Excess Capital before tax and profit-loss is the difference between the available shareholders' equity after hidden reserves associated companies and the total committed RBC before the expected value of return.

3.3.2.7 Excess Capital with RBC after the expected value of return

The Excess Capital with RBC after the expected value of return is the difference between the available shareholders' equity after hidden reserves associated companies and the total committed RBC after the expected value of return.

3.3.2.8 Tax load when paying the Excess Capital to the shareholders (tax ...%)

This is the tax load on the Excess Capital with RBC before tax and profit-loss.

3.3.2.9 Excess Capital after tax, before profit-loss (per 31.12.)

The Excess Capital after tax and before profit loss is the Excess Capital before tax and profit-loss minus the tax load on the Excess Capital.

3.3.2.10 Profit-loss after paying the Excess Capital

The profit-loss after paying the Excess Capital is given by the following formula:

$$\text{Profit - loss after paying the excess capital} = \frac{\text{Excess capital before tax and profit - loss} \bullet \text{risk free rate}}{\text{Cost of capital after tax}} \quad (45)$$

3.3.2.11 Excess Capital after tax and profit-loss

The Excess Capital after tax and profit-loss is the difference between the Excess Capital after tax and before profit-loss and the profit-loss after paying the Excess Capital.

3.3.2.12 Available shareholders' equity on 01.01. before tax on hidden reserves

On 01.01. the available shareholders' equity before tax on hidden reserves is the same as the available shareholders' equity after hidden reserves associated companies on 31.12. the previous year.

3.3.2.13 ...% tax on hidden reserves (without associated companies)

This is the tax on the total hidden reserves minus the hidden reserves on associated companies.

3.3.2.14 Available shareholders' equity on 01.01. after tax on hidden reserves

The available shareholders' equity on 01.01. after tax on hidden reserves is the difference between the available shareholders' equity on 01.01. before tax on hidden reserves and the tax on hidden reserves (without associated companies).



3.3.2.15 Year-surplus after tax, before risk capital

The calculation of the year-surplus after tax, before risk capital depends on the choice whether the actual figures or the normalised figures have to be used. The year-surplus for both cases is calculated in BerJÜ.

3.3.2.16 Cost of capital (...% on available shareholders' equity)

The cost of capital is calculated on the available shareholders' equity on 01.01. after tax on hidden reserves, with the percentage of the cost of capital after tax from the sheet 'In'.

3.3.2.17 EVA regarding available shareholders' equity

The economic value added is calculated by the difference between the year-surplus after tax, before risk capital and the cost of capital on the available shareholders' equity.

3.3.2.18 ROE (Return on available shareholders' equity)

The return on available shareholders' equity is the ratio of the year-surplus divided by the available shareholders' equity on 01.01. after tax on hidden reserves.

3.3.2.19 Committed risk capital on 01.01.

The committed risk capital on 01.01. is the same as the total committed RBC before the expected value of return on 31.12. of the previous year.

3.3.2.20 ...% interest-profit on Excess Capital (after tax)

This is the interest-profit of the risk free rate on the Excess Capital after tax, before profit-loss (per 31.12.).

3.3.2.21 Return on the risk capital

The return on the risk capital is the difference of the year-surplus after tax, before risk capital and the interest-profit on Excess Capital.

3.3.2.22 Cost of capital (...% on risk capital)

This is the cost of capital on the committed risk capital on 01.01. (cost of capital rate after tax).

3.3.2.23 EVA regarding risk capital

EVA regarding risk capital is the difference of the return on the risk capital and the cost of capital on the risk capital.

3.3.2.24 ROE (Return on committed risk capital)

The return on the committed risk capital is the return on risk capital as a ratio of the committed risk capital.

3.3.3 BerJÜ

In the sheet 'BerJÜ' the year-surplus is calculated with normalised and actual figures. The following tables show which variables are calculated for both the normalised and actual figures. This sheet also calculates the gross year-surplus with an analysis of values from the profit and loss account. The variable will be discussed in a paragraph.

Variable	Link
Year-surplus (after tax on profit)	§3.3.3.1
Changes in hidden reserves	§3.3.3.2
Net feed for equalisation funds	§3.3.3.3
Net feed provisions on impending losses	§3.3.3.4
Higher paid claims provisions in accordance with HGB (actual year without older years)	§3.3.3.5
Reinsurance result	§3.3.3.6
Settlement profit	§3.3.3.7
Total return associated companies	§3.3.3.8
Put in and take out SoPo	§3.3.3.9
Gross year-surplus before tax	§3.3.3.10
More tax (tax rate ...%)	§3.3.3.11
Gross year-surplus after tax	§3.3.3.12
Additional risk capital (if needed to be save)	§3.3.3.13
Free cash flow after subtraction of the risk capital	§3.3.3.14

Table 3.33: overview gross year-surplus with normalised / actual capital profit

Variable	Link
Gross earned contributions direct business	§3.3.3.15
Claims (gross, direct business, without registration costs and higher paid claims provisions)	§3.3.3.16
Costs (gross, insurance-technical)	§3.3.3.17
Other insurance-technical results (including results other businesses, without higher paid other businesses)	§3.3.3.18
Insurance-technical results before equalisation funds, provisions for impending losses, higher paid claims provisions	§3.3.3.19
Investment results	§3.3.3.20
Result service-/mediation businesses	§3.3.3.21
Other results / expenses (particularly tax)	§3.3.3.22
Taxes	§3.3.3.23
Checksum year-surplus after tax	§3.3.3.24

Table 3.34: analysis gross year-surplus (with normalised / actual capital profit) by result source

3.3.3.1 Year-surplus (after tax on profit)

The year-surplus is taken from the profit and loss account (GuV). For the normalised and actual calculation this is year-surplus before taxes for companies.

3.3.3.2 Changes in hidden reserves

The changes in hidden reserves in the normalised calculations is given by the following formula:

$$\text{Changes in hidden reserves (normalised)} = (\text{total return on investments})_{t-1} - (\text{investments result (without delta SoPo)}), \quad (46)$$



The calculation of the total return on investments can be found in §3.2.2.5 and the investments results (without delta SoPo) can be found in §3.2.2.6. In formula 233 and 123 t is the year that is calculated and t is the year before.

The calculations of the hidden reserves when using the actual capital profit is as follows:

$$\text{Changes in hidden reserves (actual)} = (\text{Total hidden reserves investments})_t - (\text{Total hidden reserves investments})_{t-1} \quad (47)$$

The calculations of the hidden reserves on investments can be found in §3.2.2.1.

3.3.3.3 Net feed for equalisation funds

The net feed for equalisation funds is copied from the profit and loss account (the sign is reversed). This is for the normalised- and actual capital profit calculation.

3.3.3.4 Net feed provisions on impending losses

The net feed on provisions on impending losses for the normalised- and actual capital profit calculation is copied from the profit and loss account (the sign is reversed).

3.3.3.5 Higher paid claims provisions in accordance with HGB (actual year without older years)

The higher paid claims provisions (actual year without older years) is copied from the sheet 'Abw', see §3.2.3.6 for both profit calculations.

3.3.3.6 Reinsurance result

For both profit calculations the reinsurance result is copied from the profit and loss account (sign is reversed).

3.3.3.7 Settlement profit

The settlement profit is copied from the profit and loss account (sign reversed). This is true for the calculation with actual capital profit and normalised capital profit.

3.3.3.8 Total return associated companies

The value of the total return on associated companies depends on the choice whether or not taking into account associated companies, which can be chosen in the sheet 'In'. The calculation for both normalised and actual capital profit is the same, which is a copy of the value for associated companies in the investments results and is discussed in §3.2.2.5.

3.3.3.9 Put in and take out SoPo

For both the calculations the same as in §3.3.1.2.



3.3.3.10 Gross year-surplus before tax

For both calculations this is the sum of year-surplus, the changes in hidden reserves, the net feed for equalisation funds, the net feed on provisions for impending losses, the higher paid claim provisions, the reinsurance result, the settlement profit, the total return on associated companies and the difference in 'Sondern Posten'.

3.3.3.11 More tax (tax rate ...%)

For both calculations the following formula gives the tax:

$$\text{More tax} = -(\text{year - surplus} - \text{gross year - surplus before tax}) \bullet \text{tax - rate} \quad (48)$$

3.3.3.12 Gross year-surplus after tax

The gross year-surplus after tax is the sum of the gross year-surplus before tax and more tax, the extra tax on the reserves and results, discussed in the previous paragraphs. This is true for both calculations.

3.3.3.13 Additional risk capital (if needed to be save)

The additional risk capital is the difference of the total committed RBC before the expected value of return (from ExCap) from the year that is calculated and the year before. This is for both calculations true.

3.3.3.14 Free cash flow after subtraction of the risk capital

The free cash flow after subtraction of the risk capital is the sum of the gross year-surplus after tax and the additional risk capital. This is in the normalised capital profit calculation and the calculation with the actual capital profit.

3.3.3.15 Gross earned contributions direct business

For both calculations this value is copied from the profit and loss account.

3.3.3.16 Claims (gross, direct business, without registration costs and higher paid claims provisions)

For both calculations this is the gross claims of the actual year from the profit and loss account minus the higher paid claims provisions from 'Abw' (§3.2.3.6).

3.3.3.17 Costs (gross, insurance-technical)

For the normalised capital profit calculations and the actual capital profit calculations the costs (gross, insurance-technical) is the sum of the allocated claim handling costs and the gross insurance-technical costs, which are both from the profit and loss account.

3.3.3.18 Other insurance-technical results (including results other businesses, without higher paid other businesses)

For both calculations this is the same: the sum of the other insurance-technical results the results of other businesses, which can be found in the profit and loss account.



3.3.3.19 Insurance-technical results before equalisation funds, provisions for impending losses, higher paid claims provisions

For both calculations the insurance-technical results before equalisation funds, provisions for impending losses and higher paid claims provisions is:

$$\text{insurance - technical results} = \text{gross earned contributions} - \text{claims} - \text{costs} - \text{other insurance - technical results} \quad (49)$$

3.3.3.20 Investment results

For both calculations this is the sum of invested capital profit (from the profit and loss account), the changes in hidden reserve (§3.3.3.2), total return associated companies (§3.3.3.8) and put in and take out SoPo (§3.3.3.9).

3.3.3.21 Result service-/mediation businesses

This is for both calculations the difference of the profit on provision of services and company mediation minus the costs of service and mediation (both from the profit and loss account).

3.3.3.22 Other results / expenses (particularly tax)

In both calculations this is the other profit and costs from the profit and loss account.

3.3.3.23 Taxes

For both calculations this is the sum of the tax costs (sign reversed; from profit and loss account), the tax on profit (sign reversed; from profit and loss account) and the extra tax calculated in §3.3.3.11.

3.3.3.24 Checksum year-surplus after tax

This is the sum of the insurance-technical result, the investment result, the result on service and mediation businesses, other results and expenses and the taxes. This should be the same as the gross year-surplus after tax, calculated earlier in this paragraph. This is true for both calculations.

3.3.4 CR

The outputs of this sheet are overviews of the required Combined Ratio, claim ratio, actual year claim ratio and the actual year payment ratio. All these overviews are per branch and per year (for all chosen branches, motor total, total of all branches and the other branches, which are not included in the model. Calculations for these overviews are done in the same sheet. The last four values for each branch for each year are put in an overview. For each branch a table with the following variables has been created:

Variable	Link
Premiums written gross	SQ
Commission ratio	Kosten
Other insurance-technical costs (in % premiums written gross)	Kosten
Actual year claim ratio	SQ
Actual year payment ratio	SQ
Claim ratio	SQ
Chain Ladder Combined Ratio	§Error! Reference source not found.
Capital profit from nominal claim expenses and the present value of the claim expenses	SQ
Contribution coverage	§3.3.4.2
Committed RBC	§3.3.4.3
ROE (=contribution coverage / committed RBC)	§3.3.4.4
Contribution coverage with ...% required ROE	§3.3.4.5
Required Combined Ratio	§3.3.4.6
Required Chain Ladder claim ratio	§3.3.4.7
Required actual year claim ratio	§3.3.4.8
Required actual year payment ratio	§3.3.4.9

Table 3.35: Calculation variables for Combined Ratio overviews

3.3.4.1 Combined Ratio

The Combined Ratio overview is composed of the 'Required: resulting Combined Ratio' for all the branches chosen for several years. The claim ratio overview, the actual year claim ratio overview and the actual year payment ratio overview are calculated the same way.

The formula used in this sheet to calculate the Combined Ratio is the following:

$$\text{Combined Ratio} = \text{commission ratio} + \text{other insurance - technical costs ratio} + \text{discounted claim ratio} \quad (50)$$

Since the commission ratio, the insurance-technical costs ratio and the claim ratio are all based on the written premium (the underwriting costs are divided by the written premiums); formula 50 can be written as:

$$\text{Combined Ratio} = \frac{\text{commissions} + \text{other insurance - technical costs} + \text{discounted claims}}{\text{gross written premium}} \quad (51)$$

3.3.4.2 Contribution coverage

The contribution coverage is the sum of profit on the premiums and the profit obtained from the difference of the claim expenses and the present value of the claim expenses, as shown in formula 52.

The difference of the claim expenses and the present value of the claim expenses will only be calculated when the switch 'Anrechnung KA-Erträge auf RST bei Soll-CR / Keine Anrechnung KA-Erträge auf RST



bei Soll-CR' in the sheet 'In' is put on 'Anrechnung KA-Erträge auf RST bei Soll-CR'. (See paragraph 2.1.1 for more information).

$$\text{Contribution coverage} = (1 - \text{Combined Ratio}) \bullet \text{written premiums} + \text{claim expense difference} \quad (52)$$

3.3.4.3 Committed RBC

The calculations of the committed RBC depend on the switch 'RBC VT gemäß EVA / RBC VT gemäß DFA'. When the switch is on EVA, then the RBC calculations will be done with data from the sheet (overview can be found in RBC_VT_EVA). When the switch is on DFA, the RBC calculations are done elsewhere and the data must be copied into the sheet (overview can be found in RBC_DFA).

3.3.4.4 ROE

The return on equity is calculated with the following formula:

$$\text{ROE} = \frac{\text{contribution coverage}}{\text{committed RBC}}. \quad (53)$$

3.3.4.5 Contribution coverage with ...% required ROE

The 'cost of capital for required Combined Ratio (before tax)' from the sheet 'In' is used to calculate the contribution coverage. The formula is as follows:

$$\text{Contribution coverage with ...% required} - \text{ROE} = \text{cost of capital (before tax)} \bullet \text{Committed RBC} \quad (54)$$

The cost of capital (before tax) can be found in the sheet 'In', within the 'rates'.

3.3.4.6 Required Combined Ratio

The required Combined Ratio will only be calculated when the contribution coverage with ...% has a higher value than the contribution coverage. If this is the case, the following formula is used:

$$\text{Required Combined Ratio} = 1 - \frac{(\text{contribution coverage with ...%} - \text{contribution coverage})}{\text{gross written premium}}. \quad (55)$$

If the contribution coverage with ...% is lower than the contribution coverage, there is no calculation. The actual Combined Ratio is sufficient.

3.3.4.7 Required Chain Ladder claim ratio

This value will only be calculated when a value has been calculated for the required Combined Ratio. If this is not the case, the current claim ratio is well within the boundaries.

The Chain Ladder claim ratio is calculated with the following formula:

$$\begin{aligned} \text{Required Chain - Ladder claim ratio} = & \text{Required Combined Ratio} - \text{commission ratio} \\ & - \text{other insurance - technical costs ratio} \end{aligned} \quad (56)$$

3.3.4.8 Required actual year claim ratio

If a value has been calculated for the required Chain Ladder claim ratio, then the required actual year claim ratio will be calculated as well. The required actual year claim ratio can be found by multiplying the required



Chain Ladder claim ratio with the actual year claim ratio and dividing this with the Chain Ladder claim ratio. In formula this means:

$$\text{Required actual year - claim ratio} = \frac{\text{chain - ladder claim ratio} \bullet \text{actual year - claim ratio}}{\text{discounted chain - ladder claim ratio}} . \quad (57)$$

3.3.4.9 Required actual year payment ratio

The calculation of the required actual year payment ratio will only be calculated if the required Chain Ladder claim ratio has been calculated.

The required actual year payment ratio can be calculated with the following formula:

$$\text{Required actual year - payment ratio} = \frac{\text{chain - ladder claim ratio} \bullet \text{actual year - payment ratio}}{\text{discounted chain - ladder claim ratio}} . \quad (58)$$

3.3.5 DB

This sheet gives an overview of the contribution coverage per branch per year. The overview calculates the variables that are shown in table 3.36. This overview is calculated for all the chosen branches, total motor, all the branches together and the remaining branches that are not included in the sheet.

Variable	Link
Premiums written gross	SQ
Chain Ladder claim ratio	SQ
Commission ratio	Kosten
Contribution coverage I from insurance-techniques	§3.3.5.1
Other insurance-technical costs (in % written premium)	SQ
Combined Ratio	§Error! Reference source not found.
Contribution coverage II from insurance-techniques	§3.3.5.3
Capital profit from nominal claim expenses and the present value of the claim expenses	SQ
Contribution coverage	§3.3.5.4
Committed RBC on 01.01	same as §3.3.4.3
ROE	same as §3.3.4.4
Cost of capital (= ...% on the committed RBC)	§3.3.5.5
EVA	§3.3.5.6

Table 3.36: Calculation variables for contribution coverage overviews

The sheet also calculates the remaining costs from the profit and loss account. Table 3.37 shows the variables that are calculated.

Variable	Link
Remaining insurance-technical results (including changes in contribution transfers)	§3.3.5.7
Remaining capital profit	§3.3.5.8
Other profit / expenses	§3.3.5.9
Tax	§3.3.5.10
Sum other coverage contributions	§3.3.5.12
Year-surplus	§3.3.5.12

Table 3.37: Calculation variables for the remaining costs

The sheet also checks whether the calculations and values are correct by comparing some values that are calculated in the sheet 'DB' with values of the profit and loss account.

3.3.5.1 Contribution coverage I from insurance-techniques

The coverage from insurance-techniques can be found in the commission costs and the Chain Ladder-claim ratio. The next formula shows how the coverage is calculated.

$$\text{Contribution coverage I} = \text{Premiums written gross} \cdot \left(\frac{1 - \text{discounted chain - ladder - claim ratio}}{\text{commission ratio}} \right) \quad (59)$$

3.3.5.2 Combined Ratio

The Combined Ratio is the sum of the Chain Ladder claim ratio, the commission costs and the other insurance-technical costs, all divided by the written premiums. (See §2.3.5). The following formula is used in the sheet:

Confidential

Risk analysis

A first step on the road



Combined Ratio = discounted chain - ladder - claim ratio + commission ratio
+ other insurance - technical cost ratio

(60)



3.3.5.3 Contribution coverage II from insurance-techniques

This coverage from insurance-techniques is calculated with the Combined Ratio. The following formula is used:

$$\text{Contribution Coverage II} = (1 + \text{combined ratio}) \cdot \text{premium written} \quad (61)$$

3.3.5.4 Contribution coverage

The contribution coverage is the sum of the contribution coverage II from insurance-techniques and the capital profit from nominal claim expenses and the present value of the claim expenses.

$$\begin{aligned} \text{Contribution Coverage} &= \text{Contribution coverage II} \\ &+ \text{capital profit nominal claim expenses and the PV of claim expenses} \end{aligned} \quad (62)$$

3.3.5.5 Cost of capital (=...% on the committed RBC)

The cost of capital on the committed risk based capital is based on the committed risk based capital and the cost of capital rate before taxes. This rate can be found in the sheet 'In', within the 'rates'. The formula for the cost of capital is:

$$\text{Cost of capital} = \text{Committed RBC} \cdot \text{Cost of capital rate after tax for committed capital}$$

3.3.5.6 EVA

To show the difference between the calculations of the economic value added in the mobile business and in the EVA-model, I made the following tables.

Calculations EVA from example in §3.1	
Sales	
Production costs	-
Operating costs	-
Operating profit before interest and tax	=
Tax	-
Weighted average cost of capital	-
Economic value added	=

Table 3.38

EVA calculations in the EVA-model

Calculations EVA in the EVA-model	
Premiums	
Claim costs	-
Commission costs	-
Contribution coverage I	=
Other insurance-technical costs	-
Contribution coverage II	=
Capital profit from claim expenses	+
Contribution coverage	=
Cost of capital	-
Economic value added	=

: a) EVA calculation example

b)

As you can see in table 3.38, the economic value added can be calculated by subtracting the cost of capital from the contribution coverage.

3.3.5.7 Remaining insurance-technical results

The remaining insurance-technical results, including the changes in contribution transfers are costs that can be found in the profit and loss account. The formula used to calculate this value is:

$$\begin{aligned} \text{remaining insurance - technical results} &= \text{changes in contribution transfers} \\ &+ \text{other insurance - technical results} + \text{results other businesses} \end{aligned} \quad (63)$$



3.3.5.8 Remaining capital profit

The remaining capital profit is the profit that has not been taking into account elsewhere. In this case this means the investment result including the hidden reserve. The capital profit that has already been taken into account elsewhere has to be deducted from this investment result. In formula this means:

$$\text{remaining capital profit} = \text{investment result} - \left[\begin{array}{l} (\text{capital profit from claim expenses})_{\text{'5 branches'}} \\ + (\text{capital profit from claim expenses})_{\text{'other branches'}} \end{array} \right] \quad (64)$$

3.3.5.9 Other profit / expenses

Other profit / expenses, thus not insurance-technical results and investment results are for example profit from service- and mediation and other results. These results can be found in the profit and loss account. The formula for other profit / expenses is:

$$\begin{aligned} \text{other profit \& expenses} = & \text{profit provision of services \& company mediation} \\ & - \text{costs services \& mediation} + \text{other profit \& costs} \end{aligned} \quad (65)$$

3.3.5.10 Tax

The tax that has been paid for the profit can be found on the profit and loss account. In the year-surplus sheet (BerJÜ) the extra tax can be found.

The used formula is:

$$\text{tax} = \text{costs tax} - \text{tax on profit} - \text{more tax} \quad (66)$$

3.3.5.11 Sum other coverage contributions

The sum other coverage contributions is:

$$\begin{aligned} \text{sum other coverage contributions} = & \text{remaining insurance - technical result} \\ & + \text{remaining capital profit} + \text{other profit \& expenses} \\ & + \text{tax} \end{aligned} \quad (67)$$

3.3.5.12 Year-surplus

The year-surplus can be calculated by summing up all the coverage contributions, thus the sum of the contribution coverage for all the branches, the contribution coverage for the remaining branches that have not been taking into account in the sheet and the sum of other coverage contributions. In formula:

$$\begin{aligned} \text{discounted yearsurplus} = & \text{contribution coverage all branches} \\ & + \text{contribution coverage remaining branches} \\ & + \text{sum other coverage contributions} \end{aligned} \quad (68)$$



3.3.6 RBC_DFA

For each branch the risk based capital is calculated according to the DFA method. This is done for gross and net figures. That is why there is a copy of the gross written premium and net written premium per branch for several years in this sheet as well. These copies come from the sheet 'SQ'.

Variable	Link
Calculations gross insurance-technical risk capital in accordance with DFA per 31.12. of the year (per branch and total)	§3.3.6.1
Calculations gross investment risk capital in accordance with DFA	§3.3.6.2
Calculations net insurance-technical risk capital in accordance with DFA per 31.12. of the year (per branch and total)	§3.3.6.3
Calculations net investment risk capital in accordance with DFA	§3.3.6.4

Table 3.39: variables insurance risk in accordance with DFA

3.3.6.1 Calculations gross insurance-technical risk capital in accordance with DFA

This sheet calculates for every year the gross insurance-technical risk capital according to DFA with the RBC branches together from the sheet 'In', the risk based capital rate according to a DFA. It is calculated by the multiplication of the RBC branches together per branch times the gross written premium. The used rate is for each year the same, but branch dependent.

3.3.6.2 Calculations gross investment risk capital in accordance with DFA

The gross investment risk in accordance with DFA is calculated by the multiplication of the RBC invested capital (in % gross written premium) and the gross written premium (total of all branches). This is calculated for each year with the same rate.

3.3.6.3 Calculations net insurance-technical risk capital in accordance with DFA

The calculations for the net insurance-technical risk capital in accordance with DFA are the same as the gross insurance-technical risk capital in accordance with DFA, just using the net written premiums and the net RBC of the branches together.

3.3.6.4 Calculations net investment risk capital in accordance with DFA

The calculations of the net investment risk capital in accordance with DFA are the same as the gross investment risk capital in accordance with DFA, just using the net rate and the net written premium.

3.3.7 RBC_VT_EVA

This sheet calculates the risk based capital the volatility numbers of SVgl. The makers of this sheet thus called it RBC in accordance with EVA. Table 3.40 shows the variables that are calculated for all the chosen branches and Total Motor. For the total of all branches most of the variables in the table are also calculated. Furthermore there are overviews of the risk capital rate before the expected, the risk capital claim reserves, risk capital total insurance-techniques before the expected value of return and the expected value contribution coverage insurance-techniques (without reserve), which are all copies from the variables calculated in the table below.

Variable	Link
Premiums (Gross booked direct business)	Copy of SQ
Mean Chain Ladder claim ratio	Copy of SQ
Cost ratio	Copy of Kosten
Combined Ratio	§Error! Reference source not found.
Volatility claims =(variation coefficient required claim)	Copy of SVgl
Volatility claim ratio (standard error claim ratio)	§3.3.7.2
Risk capital rate before the expected value of return	§3.3.7.3
Risk capital rate before the expected value of return in % premium	§3.3.7.4
Expected value contribution coverage insurance-techniques (without reserve)	§3.3.7.5
Risk capital rate after the expected value of return	§3.3.7.6
Risk capital rate after the expected value of return in % premium	§3.3.7.7
Risk capital previous years reserve (before the expected value)	§3.3.7.8
Risk capital actual year reserve (before the expected value)	§3.3.7.9
Risk capital claim reserves	§3.3.7.10
Risk capital claim reserves in % premium	§3.3.7.11
Risk capital total insurance-techniques before the expected value of return	§3.3.7.12
Risk capital total insurance-techniques before the expected value of return in % premium	§3.3.7.13
Risk capital total insurance-techniques after the expected value of return	§3.3.7.14
Risk capital total insurance-techniques after the expected value of return in % premium	§3.3.7.15

Table 3.40: abstract total risk capital from insurance-techniques in accordance with EVA

Variable	Link
Sum risk capital rate of the branches	§3.3.7.16
Sum risk capital rate of the branches in % premium	§3.3.7.17
Diversification risk capital rate	§3.3.7.18
Sum risk capital claim reserve of the branches	§3.3.7.16
Sum risk capital claim reserves of the branches in % premium	§3.3.7.17
Diversification risk capital claim reserves	§3.3.7.18
Sum risk capital insurance-techniques of the branches	§3.3.7.16
Sum risk capital insurance-techniques of the branches in % premium	§3.3.7.17
Diversification risk capital insurance-techniques	§3.3.7.18

Table 3.41: variables only calculated for all branches

3.3.7.1 Combined Ratio

The Combined Ratio is here calculated as the sum of the mean Chain Ladder ratio and the cost ratio.



3.3.7.2 Volatility claim ratio (standard error claim ratio)

The volatility on the claim ratio is the volatility on the claims times the mean Chain Ladder ratio.

3.3.7.3 Risk capital rate before the expected value of return

The risk capital rate is calculated using the normal distribution quantile (fall-out rate= 0,26%). The formula is as follows:

$$\text{risk capital rate} = \text{gross written premiums} \cdot \sigma_{\text{claim ratio}} \cdot \Phi(0,26\%)^{-1} \quad (69)$$

With $\sigma_{\text{claim ratio}}$ the standard error on the claim ratio and $\Phi(0,26\%)$ the normal distribution desitribution function and $\Phi(0,26\%)^{-1}$ its inverse.

3.3.7.4 Risk capital rate before the expected value of return in % premium

This value is calculated by dividing the risk capital rate before the expected value of return by the gross written premium.

3.3.7.5 Expected value contribution coverage insurance-techniques (without reserve)

The expected value contribution coverage insurance-techniques is calculated by the following formula:

$$\text{Expected value contribution coverage} = (1 - \text{combined ratio}) \cdot \text{gross written premiums} \quad (70)$$

3.3.7.6 Risk capital rate after the expected value of return

The risk capital after the expected value of return is the risk capital rate before the expected value of return minus the expected value of contribution coverage insurance-techniques (= expected value of return).

3.3.7.7 Risk capital rate after the expected value of return in % premium

This is the risk capital rate after the expected value of return as a ratio of the gross written premium.

3.3.7.8 Risk capital previous years reserve (before the expected value)

This is the formula for the calculation of the risk capital previous year reserve:

$$\text{Risk capital previous year - reserve} = \frac{\text{gross written premium} \cdot \text{mean chain - ladder claim ratio} \cdot \text{RBC previous years reserve}}{\text{moving average claim costs}} \quad (71)$$

RBC previous year reserve and the moving average claim costs can be found in the sheet 'In'.

3.3.7.9 Risk capital actual year reserve (before the expected value)

This is the formula for the calculation of the risk capital actual year reserve:

$$\text{Risk capital actual year - reserve} = \frac{\text{gross written premium} \cdot \text{mean chain - ladder claim ratio} \cdot \text{RBC actual years reserve}}{\text{moving average claim costs}} \quad (72)$$

RBC actual year reserve can also be found in the sheet 'In' for the chosen branches.



3.3.7.10 Risk capital claim reserves

The risk capital on the claim reserves is the sum of the risk capital on actual year reserves and previous year reserve.

3.3.7.11 Risk capital claim reserves in % premium

This value is the risk capital claim reserves as a ratio of the gross written premiums.

3.3.7.12 Risk capital total insurance-techniques before the expected value of return

The risk capital total insurance-techniques before the expected value of return is the sum of the risk capital before the expected value of return and the risk capital on claim reserves.

3.3.7.13 Risk capital total insurance-techniques before the expected value of return in % premium

The risk capital total insurance-techniques before the expected value of return is now given as a ratio of the gross written premium.

3.3.7.14 Risk capital total insurance-techniques after the expected value of return

The risk capital total insurance-techniques after the expected value of return is the risk capital total insurance before the expected value of return minus the expected value contribution coverage.

3.3.7.15 Risk capital total insurance-techniques after the expected value of return in % premium

The risk capital total insurance-techniques after the expected value of return is given as a ratio of the gross written premium.

3.3.7.16 Sum risk capital rate, claim reserves or insurance-techniques of the branches

This is the sum of the risk capital rate, claim reserves or insurance-techniques of all the chosen branches that have full calculations in the model and the branches that were not fully calculated.

3.3.7.17 Sum risk capital rate, claim reserves or insurance-techniques of the branches in % premium

This is the risk capital rate, claim reserves or insurance-techniques as a ratio of the gross written premium of all the branches.

3.3.7.18 Diversification risk capital rate, claim reserves or insurance techniques of the branches

The diversification effect of the risk capital rate, claim reserves or insurance-techniques is the difference between the risk capital rate respectively claim reserves or insurance-techniques before the expected value of return that was calculated for the group 'all branches' and the sum risk capital rate respectively claim reserves or insurance-techniques of the branches.



3.3.8 Plmp

The input and graphs for the planning file were made for the management of GENERALI Germany. It is a sheet with graphics and stapled columns. All the numbers were copied from other sheets. This sheet is mostly a summary sheet of the other sheets with the most important figures given in this sheet with graphical representation.

Plmp gives an overview of the year-surplus, with the shareholders' equity and ROE on the shareholders' equity. The ROE of five years is also (three planning years) is also given in a figure.

Furthermore a composition of the year-surplus is given, that means the year-surplus is split into insurance-technical results, investment results, other results and tax. This composition is also represented in a figure. The contribution coverage per category (total motor: motor liability & motor material damage; total general liability: personal general liability and commercial general liability; personal fire) is also given, with stapled column.

There is also an overview of the return on risk capital in which the economic value added is given for each year. The percentages of return on risk capital as a percentage of the total risk capital are also put in a graphic.



3.4 Conclusions

Translating, acquiring data and understanding the EVA-model costs a lot of time. Furthermore, I have spent much time on making a documentation of the EVA-model, which can be used for reference in the future. The third chapter can be used as reference guide to understanding the EVA-model, filling it in and changing and using the information acquired from the EVA-model. In the supplement the model has been filled in with GENERALI data. A description of how the data was acquired and modified to fit the EVA-model is all written in the supplements. The EVA-sheet has been modified in several places to have correct output for the branches and the total overview.

The EVA-model gives a lot of overviews that can be used in several ways. Depending on the purpose of the analysis, several reports can be created. For example a sensitivity test on the economic assumptions or other variables. Scenarios with different planning numbers would give an idea about the claim- and reserving behaviour. When there are enough years that can be compared with, trend analysis can be done and with that planning gets a whole new dimension.

For several years (past, present and future), the EVA-model gives the following overviews:

1. Overview of the year-surplus, gross and net and with actual capital profit and normalised capital profit.
2. Overview of the shareholders' equity.
3. Risk based capital, gross and net, from investments and from the insurance-techniques.
4. Excess Capital (gross and net).
5. EVA and ROE on the shareholders' equity and on the risk capital, gross and net.
6. Contribution coverage per branch.
7. Required and actual Combined Ratio per branch.
8. Required and actual claim ration per branch.
9. Committed risk capital per branch

There are more overviews, the ones stated here above are the most important ones.

A lot of information is asked and used to calculate more information. Making changes and doing new calculations is not so difficult, because of the many variables available.

Because the EVA-model needs input for several years (past, present and future), illogical values can be discussed and issues that were not foreseen can now be dealt with, by analysing the data.

The EVA-model uses input from the reinsurance efficiency program (REP) and the claim reserve analysis system (CRAS) within GENERALI. The EVA-model calculates with these values and gives some output that is also used in REP and CRAS. The calculations are different than in REP and CRAS, but the outcome should be almost the same. The EVA-model can be used as an extra check on the already used systems.

The output of the EVA-model can be used as an indication whether or not there is something wrong with a branch, in which case the premium can be changed or another steering tool can be used to better the future of that branch.

When it is spotted that the actual Combined Ratio is not sufficient (thus the required Combined Ratio is smaller than the actual Combined Ratio), then the managers can be urged to get a better Combined Ratio.

The EVA from the lines of businesses show which branch is profitable and which one is not. Bad future EVA figures can be used to change the planning.

The EVA-model gives an extensive overview of the branches. If the company does not have that year, the EVA-model is very handy.



The EVA-model also calculates the reserves and the assets. These calculations can show whether the company is underreserving or not.

With the EVA-model the output can be used for management reports. With understanding in the EVA-model, risk management can be pursued.

At the moment planning is done with ratios. Using the EVA-model, planning can be done differently.

The big question that is answered by the EVA-model is: 'Is the premium of a year high enough to cover the costs of that year?' And how is the EVA-figure? It is very important for a company to know whether a branch is creating or destroying value, because this would mean that in the first years that these losses can be absorbed by the reserves, but in the longer run, a value destroying branch will cause a company to go bankrupt, when not taken care of.

When the interest rate is good, losses can be absorbed by interest profit. But when the interest rate is not good and the EVA figure is negative, then reserves will be used. This means that the branch is not profitable.

Even though understanding the EVA-model is time-consuming, the EVA-model has a lot of benefits and changing the model to the wishes of GENERALI can be done easily.

All in all, the model is definitely usable and very interesting to use as an analysis tool.



4 Lessons learned

This internship taught me the following things:

1. Do not try to be too independent and stubborn to find out things that other people already know. You can search things on internet. But communicating and learning from others is faster and with luck they can exactly explain the whole situation. When other people do not know, discussing about the subject will get more insight in the problem for yourself and the other people.
The best answers can be found at the source of the subject. In my case, with the DNB and in Germany. This means that a person can better ask for information with other people before searching further.
2. Do not spend too much time finding theory on the subject. Search some theory, try to fill in what you do know and search for the rest when you get there.
Learning about a subject goes faster when thrown into the pit.
3. Filter information, too much information from different sources will not give a good result. Choose the best information that fits together, try finding it at the same source.
In my case I had different sources of information. Some could not be used together. In other cases I was sent to the wrong place and got the wrong information.
There also were different ways the data was sorted (per type of business, per line of business and another categorisation within the lines of businesses).
4. Try to change your daily activities; do not work on exactly the same thing for hours. This will divert the focus. The best ideas for one thing will come sooner when thinking of other things.
In my case this is
5. Colleagues pick up information better when given in small doses. Do not try to get them to understand a lot of information at the same time (=data-overflow). Take them along in the project. They will probably even give you good ideas then, when discussing about it.
This means that I should have taken along my colleagues much sooner. Then I could have discussed with them.

The most important thing I learned though, is that I have to be myself.



5 Used sources

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6 Vocabulary

C

CRAS Claim Reserve Analysis System

D

DFA Dynamic Financial Analysis
DNB 'De Nederlandsche Bank', the Dutch supervisor for banking, insurers, pension funds etc.

Dynamic Financial Analysis Dynamic Financial Analysis is the process by which an actuary analyses the financial condition of an insurance enterprise

E

Economic Value Added A financial performance measure used to evaluate a company's true profit

EVA Economic Value Added

F

Financieel Toetingskader financial assessment framework, a Dutch assessment framework, working to Solvency II

FTK see 'Financieel Toetingskader'

G

GAAP General Accepted Accounting Principles (U.S.)

H

HGB Handelsgesetzbuch, German version on GAAP

I

IAS International Accounting Standards

P

Pensioen- en verzekeringkamer pension- and insurance authority, the former Dutch supervisor, now working under the DNB

PVK see 'Pensioen- en verzekeringkamer'

R

RBC Risk Based Capital
Rentetermijnstructuur interest term structure, a curve that shows an interest curve, this can be used instead of using the premium according to the market

REP Reinsurance efficiency project within GENERALI

RTS see 'Rentetermijnstructuur'

S

Solvency II European solvency framework, not yet finished

SoPo Short for 'Sondern Posten'. In Germany it is law to revalue their real-estate when the value comes below a certain point, the difference between the new value and the old value should be put in the 'Sondern Posten'.

T

TEAM Technical Evaluation & Actuarial Monitoring