MODELLING WEEK

OBTAINING AN ANALYTICAL APPROXIMATION FOR THE CALCULATION OF CAPITAL FOR CREDIT RISK

April 2011

1. Introduction

The credit risk of an institution is its risk of loss arising from the failure of third parties to repay loans.

Every financial institution must have enough resources to absorb credit losses.

In the legislation, such losses are broken down into:

- Provisions: the average value of losses (expected loss).
- Capital: the loss volatility (unexpected loss).

The progress of statistical and computational techniques has permitted the development of models that can be used to calculate losses based on internal information of each financial institution. In this sense, the legislation also allows, and has encouraged, the use of internal models[1] for the calculation of provisions and capital[2].

The variables used in the legislation on capital for the measurement of credit risk (hereafter labelled "risk parameters") are the following:

- Probability of default (PD)
- Exposure at default (EAD)
- Loss given default (LGD) %
- Maturity (M)
- Asset correlation (R)

These variables must be estimated based on internal information and should agree with the principles and hypotheses established in the legislation (New Basel Capital Accord, June 2006).

The estimation of risk parameters is performed for the different risk segments so that all credit portfolio operations have related risk parameters.

Thus, an expression is established for the different segments, from which the capital requirement over a one-year time horizon and with a confidence level of 99.9% is obtained for each operation.

For example, for companies with a turnover of less than 50 million euros and an EAD above 1 million euros, the capital is given by the following expression:

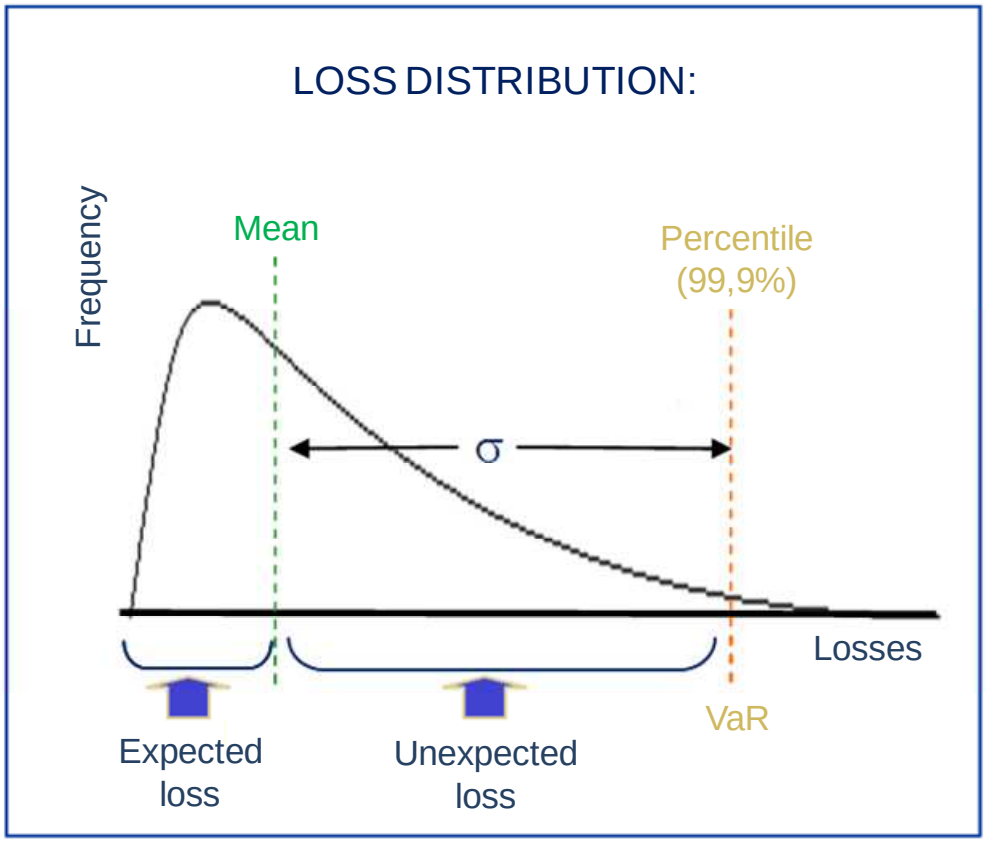
Correlation (R) = 0.12 × (1 – EXP (-50 × PD)) / (1 – EXP (-50)) + 0.24 × [1 - (1 - EXP(-50 × PD))/(1 - EXP(-50))]

Maturity adjustment (b) = (0.11852 – 0.05478 × ln (PD))^2

Capital requirement (K) = [LGD × N [(1 - R)^-0.5 × G (PD) + (R / (1 - R))^0.5 × G (0.999)] -PD x LGD] x (1 – 1.5 x b)^ -1 × (1 + (M – 2.5) × b)

[1] An internal model is a model developed by the Institution using its own methodology and information.
[2] The approach for calculating capital requirements using internal models is known as the *IRB method*.

Note that the allocation of capital for a given operation[3] is an analytical approach at the 99.9th percentile of the loss distribution to a one-year horizon.



[3] For more detail on the development of this approach, see "*Explanatory Note on the Basel II IRB Risk Weight Functions"*, July 2005, from the Basel Committee (Apoyo_Doc1).

2. Problem to be solved

The objective is to define an **analytical expression**, for the portfolio of companies[4], which allows the estimation of capital based not only on internal estimation of parameters, but also on the **internal estimation of the loss distribution of each institution**.

3. Phases

3.1. Definition of the problem and clarification of doubts

In this first phase, Management Solutions will present the problem in greater detail, providing the ideas that have been developed so far, and will clarify any doubts raised concerning the understanding of the problem[5].

Management Solutions will also provide a fictitious loan sample, with real characteristics, in a polished and ready-to-use Excel file, so that as little time as possible will be spent on data processing. The fundamental information which the sample will contain is:

- Operation identifier.
- Client identifier.
- PD of the operation.
- EAD of the operation.
- LGD of the operation.
- Maturity of the operation.
- Correlation of the operation with the systemic risk (asset correlation).

For simplicity, it will be assumed that all operations have a maturity of one year so that the impact of the maturity on the risk losses will not be considered in the calculation.

Furthermore, there will only be one operation per client in order to simplify the calculations.

3.2. Phase 1: Loss distribution

Firstly, the portfolio loss distribution will be generated. In order to do this, **Monte Carlo** techniques can be used.

The objectives of this phase are the following:

- Delve into the nature and significance of different risk parameters.
- Estimate the sensitivity to changes of the credit risk loss distribution, or the hypothesis of different parameters.
- Estimate the capital of the portfolio being studied.

[4] Companies with a turnover of less than 50 million euros and an exposure of more than 1 million euros.
[5] To help with further understanding the problem see document "*Modelos factoriales de riesgo de crédito: el modelo de Basilea II y sus implicaciones"* (1) by Carlos Trucharte Artigas y Antonio Marcelo Antuña (Apoyo_Doc2).

3.3. Phase 2: Capital distribution

Once the loss distribution has been estimated and the capital requirement for the portfolio being studied has been calculated, **a stable method must be proposed for the distribution of capital between the different operations**[6]**.**

Once the capital consumption has been assigned to each client, this estimate must be compared to that obtained by the regulatory method. The differences must be quantified and analysed, providing a conclusion on the different aspects which could be producing them.

3.4. Phase 3: Proposal of an analytical estimate

From the results obtained in the previous two phases, an alternative analytical expression to that established in the legislation should be proposed for the allocation of minimum capital requirements, which should also depend on the parameters characterising the sample (PD, EAD, LGD, correlation, concentration and maturity[7]).

3.5. Phase 4: Exposure and discussion of results

The study will conclude with the students' presentation of the selected expression and the results obtained.

[6] As a guidance document see "*Sensible and Efficient Capital Allocations for Credit Portfolios"* by Michael Kalkbrener, Hans Lotter, Ludger Overbeck (Apoyo_Doc3).

[7] It is reminded that for simplicity the maturity is set equal to 1.