

Portfolio Management

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Abstract. The goal of this paper is the analysis of the performance of Monte Carlo simulation based method for the computation of credit-portfolio loss-distributions and for the estimation of various risk measures for the credit portfolio. Our tool named **MyPortFolio** focuses on four principal risk measures : Value At Risk (VaR), Expected Shortfall (ES), Expected Loss (EL) and Unexpected Loss (UL). **MyPortFolio** also includes credit derivatives which are synthetic contracts to buy or sell protection against credit-related losses. Instead of working on the losses of the portfolio as we tend to do in portfolio management, we will consider the losses of CDO tranches. **MyPortfolio** computes the price of a CDO.

Keywords: Expected Shortfall · Value At Risk · Expected Loss · Collateralized Debt Obligation (CDO)

1 Introduction

Risk is a central element in the fields of finance and insurance. And although it is crucial to their existence, risk is of course very rarely a desirable phenomenon in excessive quantities. The great challenge that every economic agent faces in carrying out their activity is to manage their risks in such a way that they do not threaten their economic existence. Over the last century, agents have therefore endeavored to find technical tools to facilitate this management of the risk they were constantly confronted with. These tools aim at quantifying market exposures. They can be used as performance evaluation (performance will only really be better if, in terms of risk, it has maintained comparable levels) or investments development strategy metrics. In this paper, we propose a Monte Carlo simulation based method which not only provide companies and financial organizations with a tool that allows them to perform credit portfolio modeling but it also compute four risk measures in addition to calculating the price of a CDO. Our Monte Carlo tool comprises many advantages. It takes for instance into account all possible loss events. Its flexibility makes it possible to take into account thick tails in the distribution of profitability. Since the tool comes with a graphical user interface, this will also help companies in their internal reporting to management, their external reporting to supervisory authorities etc.

2 Approach : Monte Carlo

Monte Carlo simulation is a computational method that can be used for Portfolio Credit Risks. The approach is an example of using Simulation Models for the purpose of establishing a Risk Distribution. Once the distribution is obtained it is possible to estimate various risk measures for the credit portfolio.

Contrary to the historical or J.P. Morgan approaches, the Monte Carlo method does not assume any distributional hypothesis and in particular no assumption of normality. This avoids undervaluing Value at Risk (see section below) when distributions have tails that are too thick. Moreover, it does not make any assumption about the linearity of asset prices.

Our simulation tool uses a Gaussian 2 factor as default model with the spread distribution given by this formula :

$$Z_i = \sqrt{\rho}X + \sqrt{\rho_S - \rho}X_S + \sqrt{1 - \rho_S}\epsilon_i$$

Before presenting how **MyPortFolio** compute risk indicators, we will first discuss the default parameters taken into account by our solution. Among those parameters, we can find the Probability of Default (PD), Exposure At Default (EAD), Loss Given Default, Exposure Maturity and parameters like Rating and Sector correlations.

3 Risk indicators computed by MyPortFolio

MyPortFolio allows to compute 4 risk measures : Value At Risk, Expected and Unexpected Loss and Expected Shortfall.

- ✓ **VaR** : quantifies the level of financial risk within your firm, portfolio or position over a specific time frame. MyPortFolio will help answer questions like what is the maximum percentage I can—with $\alpha\%$ confidence—expect to lose over T time frame?
- ✓ **Expected Loss** or the average credit loss that we would expect from an exposure or a portfolio over a given period of time. MyPortFolio with its dashboard helps you monitor what your business expects to lose within a T frame time. Our solution will therefore help you borne losses as a part of the normal operating cash flows.
- ✓ **Unexpected Loss** or the average total loss over and above the mean loss. With MyPortFolio, your business will safeguard itself from unexpected losses by for instance allocating capital.
- ✓ **Expected Shortfall** : a risk measure designed to assess the likelihood of loss exceeding the value at risk. By computing Expected Shortfall, MyPortFolio allows you to answer questions like this : if things go bad, what could the expected loss be?

4 MyPortFolio features

4.1 Dashboard

MyPortFolio comes up with a simple interactive dashboard allowing you to chose parameters for your credit portfolio modeling.

The dashboard contains the following controls:

- confidence**: A dropdown menu set to 0.99.
- maturity**: A dropdown menu set to 1Y.
- global_corr**: A slider set to 0.11.
- strike**: A slider set to 11.
- size**: A slider set to 1.
- n_simu**: A slider set to 10000.
- Run Interact**: A button to execute the simulation.

Fig. 1: MyPortFolio Dashboard

As you can see in the figure above, MyPortFolio gives you the possibility to set the parameters that suit your needs. Our solution is able to generate a large number of simulations (portfolio loss-distributions) with the parameter **n_simu** which makes it possible to easily study and calculate other characteristics such as the expectation of extreme losses, which the parametric method does not easily allow. The dashboard enables you compute risks indicators and CDO price (strike and size parameters).

4.2 Plots

Once parameters are chosen, MyPortFolio provides you with graphs, portfolio table, indicators dataframe and CDO price. The indicators dataframe consists of the risk measures discussed in Section 3. The portfolio table is displayed for 10 assets and it includes the the expected loss of each of these assets, their maturity barrier in addition to the default parameters (PD, EAD, LGD etc.)

Regarding the graphics, MyPortFolio displays the convergence graph of the average portfolio loss (The Rolling Mean) and Rolling standard deviation as a function of the number of simulations. The output looks like in Fig2.

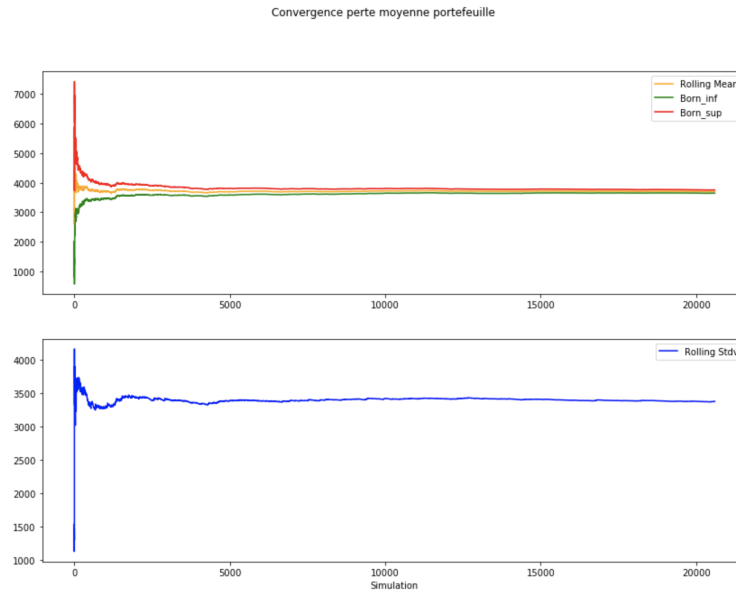


Fig. 2: Rolling Mean & Rollinh standard deviation

A part from the graphs, MyPortFolio also displays as said above your portfolio as well as the CDO price.

Simulation

THIS IS YOUR PORTFOLIO

	Exposure	Rating	LGD	Sector	1Y	3Y	5Y	Correlation	Barrier1Y	Expected Loss
Id										
1	1894	1	0.59	2	0.001	0.0015	0.00225	0.32	-3.090232	1.11746
2	1095	4	0.44	1	0.016	0.0240	0.03600	0.23	-2.144411	7.70880
3	1627	6	0.69	1	0.036	0.0540	0.08100	0.23	-1.799118	40.41468
4	1914	10	0.57	3	0.100	0.1500	0.22500	0.15	-1.281552	109.09800
5	1662	8	0.46	4	0.064	0.0960	0.14400	0.18	-1.522036	48.92928
6	1899	10	0.51	1	0.100	0.1500	0.22500	0.23	-1.281552	96.84900
7	1747	9	0.52	1	0.081	0.1215	0.18225	0.23	-1.398377	73.58364
8	1595	3	0.41	5	0.009	0.0135	0.02025	0.20	-2.365618	5.88555
9	1229	7	0.42	5	0.049	0.0735	0.11025	0.20	-1.654628	25.29282
10	1955	3	0.64	5	0.009	0.0135	0.02025	0.20	-2.365618	11.26080

PORTFOLIO INDICATORS

	VaR	Average Loss	Expected Loss	Unexpected Loss	Expected Shortfall
value	15508.5339	3683.08223	3683.2199	11825.314	18396.0766

COLLATERALIZED DEBT OBLIGATION : CDO

Price : 53.08

Fig. 3: MyPortFolio portfolio analysis