Introduction to CreditMetrics（第九章-第十一章）

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Outline

组合的计算

本章我们讨论三个资产的组合，以及组合的边际标准差的计算。
本章的方法可以直接的推广到多个资产的情况。

Outline

三个资产的组合

考虑三个资产的组合，前两个资产为前几章考虑的BBB and A rated firms，第三个资产是two-year bond paying a 10% coupon， 由一个CCC rated firm发行. 我们将这些公司分别记为Firms 1, 2, and 3.
假设Firm 1 issue 的总量为4 mm, the firm 2 issue 的总量为2 mm, and the firm 3 issue 的总量为1 mm. 三个资产在年末的价值分别为V_1, V_2, V_3
转移概率由下表给出：

Table 9.1
Transition probabilities (%)

	Transition probability (%)		
Rating	**Firm 1**	**Firm 2**	**Firm 3**
AAA	0.02	0.09	0.22
AA	0.33	2.27	0.00
A	5.95	91.05	0.22
BBB	86.93	5.52	1.30
BB	5.30	0.74	2.38
B	1.17	0.26	11.24
CCC	0.12	0.01	64.86
Default	0.18	0.06	19.79

在年末不同等级的价值在下表中给出:

Table 9.2

Instrument values in future ratings ($mm)

	Value of issue ($mm)		
Future rating	**Firm 1**	**Firm 2**	**Firm 3**
AAA	4.375	2.132	1.162
AA	4.368	2.130	1.161
A	4.346	2.126	1.161
BBB	4.302	2.113	1.157
BB	4.081	2.063	1.142
B	3.924	2.028	1.137
CCC	3.346	1.774	1.056
Default	2.125	1.023	0551

则有

$$\mu_1 = 4.28, \mu_2 = 2.12, \mu_3 = 0.97$$

以及

$$\sigma^2(V_1) = 0.014, \sigma^2(V_2) = 0.001, \sigma^2(V_3) = 0.97.$$

$$\begin{aligned}\sigma_p^2 \quad &= \sigma^2(V_1) + \sigma^2(V_2) + \sigma^2(V_3)\\ &+2Cov(V_1, V_2) + 2Cov(V_1, V_3) + 2Cov(V_2, v_3)\end{aligned}$$

有如下公式：

$$\begin{aligned}\sigma_p^2 &= \sigma^2(V_1+V_2)+\sigma^2(V_1+V_3)+\sigma^2(V_2+V_3)\\ &-\sigma^2(V_1)-\sigma^2(V_2)-\sigma^2(V_3).\end{aligned}$$

上面的公式可以用来将组合的标准差表示为两两资产的标准差的形式。

考虑the BBB and A rated bonds. 使用Table 9.2中的转移矩阵,相关系数为 30%. 我们假设每两支债券的相关系数为30%.

下表给出两个资产在年末的价值.

Figure:

Table 9.3

Values of a two-asset portfolio in future ratings ($mm)

New rating for Firm 1 (currently BBB)	New rating for Firm 2 (currently A)							
	AAA	AA	A	BBB	BB	B	CCC	Default
AAA	6.51	6.51	6.50	6.49	6.44	6.40	6.15	5.40
AA	6.50	6.50	6.49	6.48	6.43	6.40	6.14	5.39
A	6.48	6.48	6.47	6.46	6.41	6.37	6.12	5.37
BBB	6.43	6.43	6.43	6.42	6.37	6.33	6.08	5.33
BB	6.21	6.21	6.21	6.19	6.14	6.11	5.86	5.10
B	6.06	6.05	6.05	6.04	5.99	5.95	5.70	4.95
CCC	5.48	5.48	5.47	5.46	5.41	5.37	5.12	4.37
Default	4.26	4.26	4.25	4.24	4.19	4.15	3.90	3.15

使用下面的等式：

$$\sigma^2(V_1+V_2)=0.018, \sigma^2(V_2+V_3)=0.051, \sigma^2(V_1+V_3)=0.083$$

则有

$$\sigma_p^2=0.093$$

Outline

边际标准差

一个组合的边际标准差定义为组合的标准差减去不包括该资产的组合的标准差。

The firm 1 issue's 边际标准差为

$$\sigma_p - \sqrt{\sigma^2(V_2 + V_3)} = 0.46 - 0.225 = 0.080$$

比例为

$$\frac{\sigma_p - \sqrt{\sigma^2(V_2 + V_3)}}{\mu_1} = 1.9\%.$$

The difference between marginal and stand-alone statistics gives us an idea of the effect of diversification on the portfolio.

Since we have only considered the standard deviation to this point, it may be that to adequately describe the riskiness of the portfolio, we need more detailed information about the portfolio distribution. In order to obtain this higher order information, it will be necessary to perform a simulation based analysis, which is the subject of the following two chapeters.

Outline

标准差的计算

考虑由n个资产的组合. 这些资产在年末的值为$V_1, V_2, \cdots, V_n$. 其均值和方差分别表示为$\mu_1, \mu_2, \cdots, \mu_n$以及$\sigma^2(V_1), \cdots, \sigma^2(V_2)$. 则我们有

$$\begin{aligned} \sigma_p^2 &= \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \sigma^2(V_i + V_j) \\ &-(n-2)\sum_{i=1}^{n} \sigma^2(V_i). \end{aligned}$$

模拟方法

Analytic estimates of risk: Speed and precision.

For large portfolios, it meets its problem.

To provide a methodology that better describes the distribution of portfolio values, we present in this chapter a simulation approach known as "Monte Carlo."

Monte Carlo 模拟:

- 1. 产生情景
- 2. 对组合进行估值
- 3. 对结果进行汇总

We will continue to consider the example portfolio of the previous chapter: three two-year par bonds issued by BBB,A and CCC rated firms. The notional values of these bonds are $4, 2$, and 1.

Outline

情景生成

- 1. 建立组合中的资产收益的阀值
- 2. 按照正态分布产生组合收益的情景
- 3. 将资产收益影射到信用评级情景

下表给出三者的转移概率。

Table 10.1

Transition probabilities (%)

	Transition Probability (%)		
Rating	**Firm 1**	**Firm 2**	**Firm 3**
AAA	0.02	0.09	0.22
AA	0.33	2.27	0.00
A	5.95	91.05	0.22
BBB	86.93	5.52	1.30
BB	5.30	0.74	2.38
B	1.17	0.26	11.24
CCC	0.12	0.01	64.86
Default	0.18	0.06	19.79

In the following table, the asset return thresholds for the three firms are given, which are obtained using the methods of Section 8.4.

Table 10.2
Asset return thresholds

Threshold	Firm 1	Firm 2	Firm 3
Z_{AA}	3.54	3.12	2.86
Z_{A}	2.78	1.98	2.86
Z_{BBB}	1.53	-1.51	2.63
Z_{BB}	-1.49	-2.30	2.11
Z_{B}	-2.18	-2.72	1.74
Z_{CCC}	-2.75	-3.19	1.02
Z_{Def}	-2.91	-3.24	-0.85

The asset returns for each firm are normally distributed, and the correlation in index is given in the following table.

Table 10.3

Correlation matrix for example portfolio

	Firm 1	Firm 2	Firm 3
Firm 1	1.0	0.3	0.1
Firm 2	0.3	1.0	0.2
Firm 3	0.1	0.2	1.0

Generate multi-normal distribution's random numbers, using Cholesky factorization, singular value decomposition.
我们给出十个场景.

Table 10.4
Scenarios for standardized asset returns

Scenario	Firm 1	Firm 2	Firm 3
1	-0.7769	-0.8750	-0.6874
2	-2.1060	-2.0646	0.2996
3	-0.9276	0.0606	2.7068
4	0.6454	-0.1532	-1.1510
5	0.4690	-0.5639	0.2832
6	-0.1252	-0.5570	-1.9479
7	0.6994	1.5191	-1.6503
8	1.1778	-0.6342	-1.7759
9	1.8480	2.1202	1.1631
10	0.0249	-0.4642	0.3533

Then rating scenarios are given in the following table.

Table 10.5

Mapping return scenarios to rating scenarios

	Asset Return			New Rating		
Scenario	Firm 1	Firm 2	Firm 3	Firm 1	Firm 2	Firm 3
1	-0.7769	-0.8750	-0.6874	BBB	A	CCC
2	-2.1060	-2.0646	0.2996	BB	BBB	CCC
3	-0.9276	0.0606	2.7068	BBB	A	A
4	0.6454	-0.1532	-1.1510	BBB	A	Default
5	0.4690	-0.5639	0.2832	BBB	A	CCC
6	-0.1252	-0.5570	-1.9479	BBB	A	Default
7	0.6994	1.5191	-1.6503	BBB	A	Default
8	1.1778	-0.6342	-1.7759	BBB	A	Default
9	1.8480	2.1202	1.1631	A	AA	B
10	0.0249	-0.4642	0.3533	BBB	A	CCC

Outline

组合计算

For non-default scenarios, this step is no different here than in the previous chapters.

For default scenarios, the situation is slightly different. Recovery rates are not deterministic quantities but rather display a large amount of variation. This variation of value in the case of default is a significant contributor to risk. To model this variation, we obtain the mean and standard deviation of recovery rate for each issue in our portfolio according to the issue's seniority.

For example, in our BBB rated senior unsecured issue, the recovery mean is 53% and the recovery standard deviation is 33%. For each default scenario, we generate a random recovery rate according to a beta distribution.

In the end, we obtain a portfolio value for each scenario. The results for the first ten scenarios for our example are presented in Table 10.6. Each default scenario requires an independently generated recovery rate.

Table 10.6

Valuation of portfolio scenarios ($mm)

	Rating			Value			
Scenario	**Firm 1**	**Firm 2**	**Firm 3**	**Firm 1**	**Firm 2**	**Firm 3**	**Portfolio**
1	BBB	A	CCC	4.302	2.126	1.056	7.484
2	BB	BBB	CCC	4.081	2.063	1.056	7.200
3	BBB	A	A	4.302	2.126	1.161	7.589
4	BBB	A	Default	4.302	2.126	0.657	7.085
5	BBB	A	CCC	4.302	2.126	1.056	7.484
6	BBB	A	Default	4.302	2.126	0.754	7.182
7	BBB	A	Default	4.302	2.126	0.269	6.697
8	BBB	A	Default	4.302	2.126	0.151	6.579
9	A	AA	B	4.346	2.130	1.137	7.613
10	BBB	A	CCC	4.302	2.126	1.056	7.484

Outline

Summarizing the results

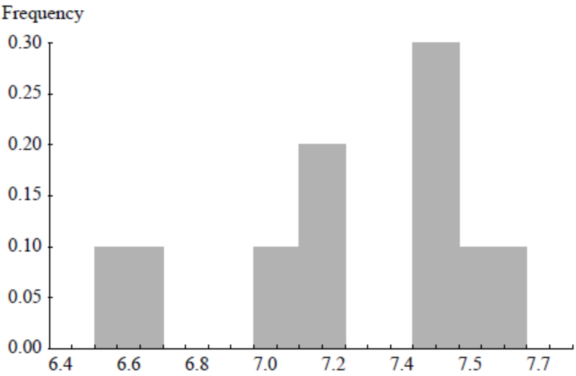
At this point, we have created a number of possible future portfolio values. The final task is then to synthesize this information into meaningful risk estimates.

In this section, we will examine a number of descriptive statistics for the scenarios we have created. In order to gain some intuition about the distribution of values, we first examine a plot of the ten scenarios for our example.

Frequency plot of portfolio scenarios

Chart 10.1

Frequency plot of portfolio scenarios



We have

$$\mu_p = \frac{1}{N}\sum_{i=1}^{N} V^{(i)} = 7.24$$

and

$$\sigma_p = \sqrt{\frac{1}{N-1}(V^{(i)} - \mu)^2} = 0.37$$

We are motivated to perform simulations in order to capture more information about the distributions of values.

We need to discuss marginal standard deviations previously.

The statistics obtained through Monte Carlo simulation are subject to fluctuations.

We have discussed marginal standard deviations previously. This concept may be generalized.

In general, the marginal statistic for a particular asset is the difference between that statistic for the entire portfolio and that statistic for the portfolio not including the asset in question.

For instance,

$$VaR_{0.10}(V_1 + V_2 + V_3) - VaR_{0.10}(V_1 + V_2).$$

Portfolio example

In this chapter, we examine a more realistic example portfolio and discuss the results of a simulation-based analysis of this portfolio.

Outline

The example portfolio

We consider a portfolio of 20 corporate (each with a different issuer) of varying rating and maturity. The bonds are listed in the following table.

Table 11.1.
Example portfolio

Asset	Credit rating	Principal amount	Maturity (years)	Market value
1	AAA	7,000,000	3	7,821,049
2	AA	1,000,000	4	1,177,268
3	A	1,000,000	3	1,120,831
4	BBB	1,000,000	4	1,189,432
5	BB	1,000,000	3	1,154,641
6	B	1,000,000	4	1,263,523
7	CCC	1,000,000	2	1,127,628
8	A	10,000,000	8	14,229,071
9	BB	5,000,000	2	5,386,603
10	A	3,000,000	2	3,181,246
11	A	1,000,000	4	1,181,246
12	A	2,000,000	5	2,483,322
13	B	600,000	3	705,409
14	B	1,000,000	2	1,087,841
15	B	3,000,000	2	3,263,523
16	B	2,000,000	4	2,527,046
17	BBB	1,000,000	6	1,315,720
18	BBB	8,000,000	5	10,020,611
19	BBB	1,000,000	3	1,118,178
20	AA	5,000,000	5	6,181,784

Asset correlation indexes for example portfolio:

Table 11.2

Asset correlations for example portfolio

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	0.45	0.45	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	0.45	1	0.45	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	0.45	0.45	1	0.45	0.15	0.15	0.15	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
4	0.45	0.45	0.45	1	0.15	0.15	0.15	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5	0.15	0.15	0.15	0.15	1	0.35	0.35	0.35	0.35	0.35	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.1
6	0.15	0.15	0.15	0.15	0.35	1	0.35	0.35	0.35	0.35	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.1
7	0.15	0.15	0.15	0.15	0.35	0.35	1	0.35	0.35	0.35	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.1
8	0.15	0.15	0.15	0.15	0.35	0.35	0.35	1	0.35	0.35	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.1
9	0.15	0.15	0.15	0.15	0.35	0.35	0.35	0.35	1	0.35	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.1
10	0.15	0.15	0.15	0.15	0.35	0.35	0.35	0.35	0.35	1	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.1
11	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	1	0.45	0.45	0.45	0.45	0.2	0.2	0.2	0.1	0.1
12	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.45	1	0.45	0.45	0.45	0.2	0.2	0.2	0.1	0.1
13	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.45	0.45	1	0.45	0.45	0.2	0.2	0.2	0.1	0.1
14	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.45	0.45	0.45	1	0.45	0.2	0.2	0.2	0.1	0.1
15	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.45	0.45	0.45	0.45	1	0.2	0.2	0.2	0.1	0.1
16	0.1	0.1	0.1	0.1	0.15	0.15	0.15	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	1	0.55	0.55	0.25	0.25
17	0.1	0.1	0.1	0.1	0.15	0.15	0.15	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.55	1	0.55	0.25	0.25
18	0.1	0.1	0.1	0.1	0.15	0.15	0.15	0.15	0.15	0.15	0.2	0.2	0.2	0.2	0.2	0.55	0.55	1	0.25	0.25
19	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.25	0.25	0.25	1	0.65
20	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.25	0.25	0.25	0.65	1

Outline

Simulation results

We generate 20000 portfolio scenaios. For each scenario, we then obtain a portfolio value for one year into the future. In Chart 11.1 through Chart 11.3, we present histograms of the portfolio value scenarios. The first chart illustrate the distribution of the most common scenarios, the second moves a bit further into the left tail of the distribution, and the third shows the distribution of the most extreme 5% of all cases. The vertical axis, which represents relative frequency, is ten times smaller in the second chart than in the first, and twenty times smaller in the third chart than in the second.

Chart 11.1

Histogram of future portfolio values – upper 85% of scenarios

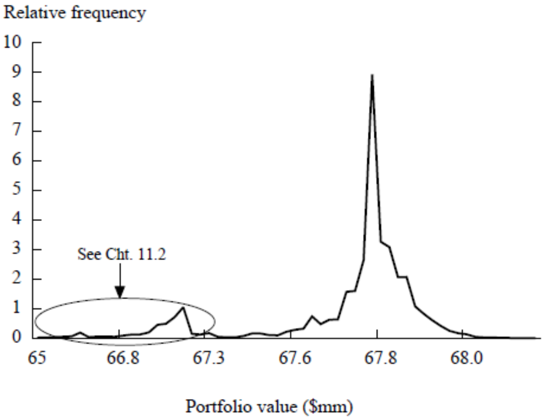


Chart 11.2

Histogram of future portfolio values – scenarios between 95th and 65th percentiles

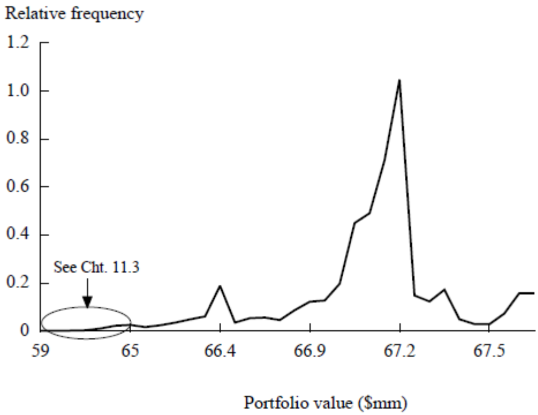
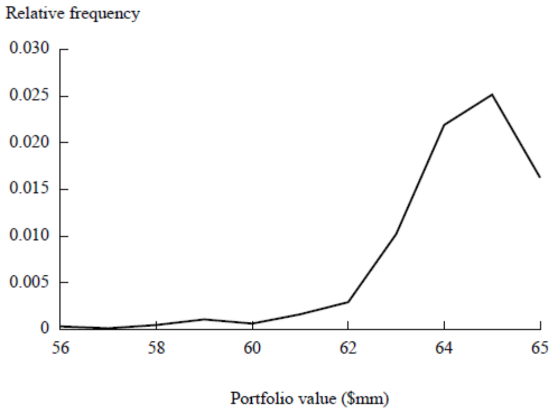


Chart 11.3

Histogram of future portfolio values – lower 5% of scenarios



- The most common occurrence is that none of the issuers undergoes a rating change.
- Further, in well over half of the scenarios, there are no significant credit events, and the portfolio appreciates
- Heavy downward skew.
- $\mu = 67284888, \sigma = 1136077$
- Estimate the percentiles directly from the empirical distributions.

Percentiles of future portfolio values:

Table 11.3

Percentiles of future portfolio values ($mm)

	Actual scenarios	Normal distribution	
Percentile	Portfolio value ($mm)	Formula	Portfolio value ($mm)
95%	67.93	$\mu+1.65\sigma$	69.15
50%	67.80	μ	67.28
5%	64.98	$\mu-1.65\sigma$	65.42
2.5%	63.97	$\mu-1.96\sigma$	65.06
1%	62.85	$\mu-2.33\sigma$	64.64
0.5%	61.84	$\mu-2.58\sigma$	64.36
0.1%	57.97	$\mu-3.09\sigma$	63.77

Outline

Assessing precison

In this section, we give confidence bands around our estimated statistics, and examine how these confidence bands evolve as we increase the number of scenarios which we consider.

The results are shown in the following Table:

Table 11.4

Portfolio value statistics with 90% confidence levels ($mm)

Statistic	Lower bound	Estimate	Upper bound
Mean portfolio value	67.27	67.28	67.30
Standard deviation	1.10	1.14	1.17
5th percentile	64.94	64.98	65.02
1st percentile	62.66	62.85	62.97
0.5 percentile[1]	61.26	61.84	62.08
0.1 percentile[2]	56.11	57.97	58.73

[1] 1 in 200 chance of shortfall
[2] 1 in 1,000 chance of shortfall

With regard to the question of how many scenarios we need to obtain precise estimates, we may examine the evolution of our confidence bands for each estimate as we consider more and more scenarios. We present this information for the six statistics above in the following charts:

Chart 11.4

Evolution of confidence bands for portfolio mean ($mm)

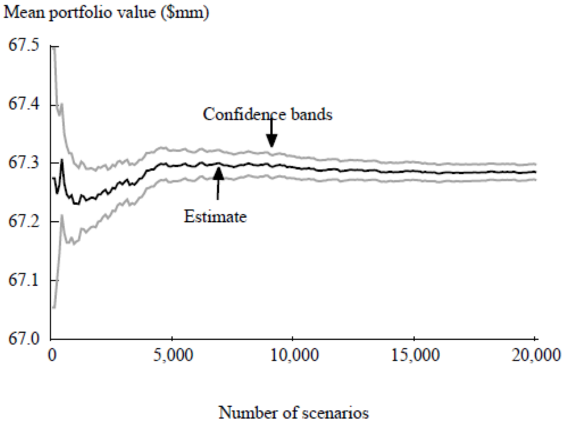


Chart 11.5

Evolution of confidence bands for standard deviation ($mm)

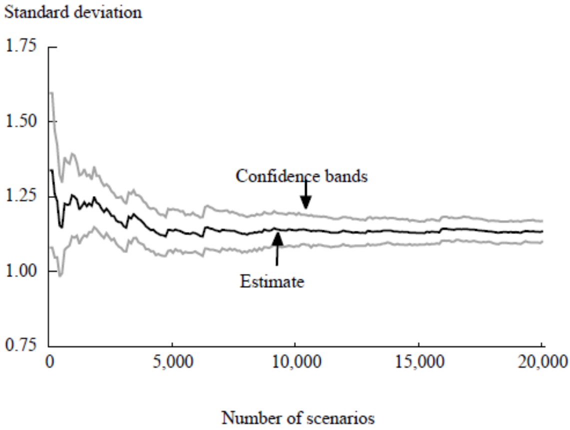


Chart 11.6

Evolution of confidence bands for 5th percentile ($mm)

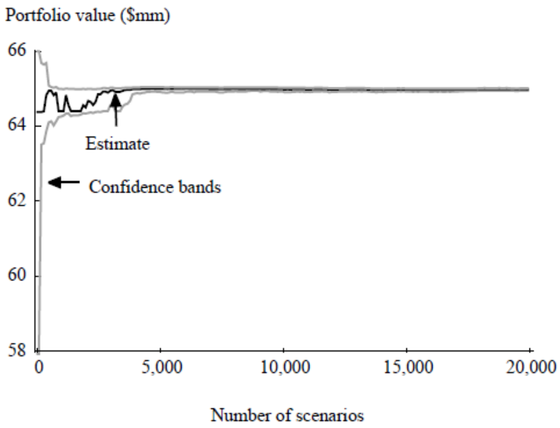


Chart 11.7

Evolution of confidence bands for 1st percentile ($mm)

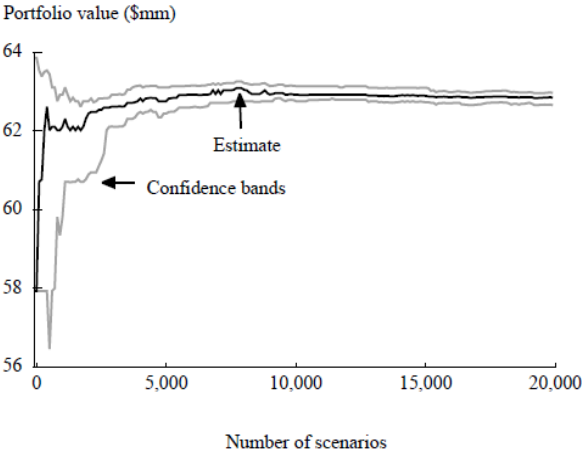


Chart 11.8

Evolution of confidence bands for 0.5 percentile ($mm)

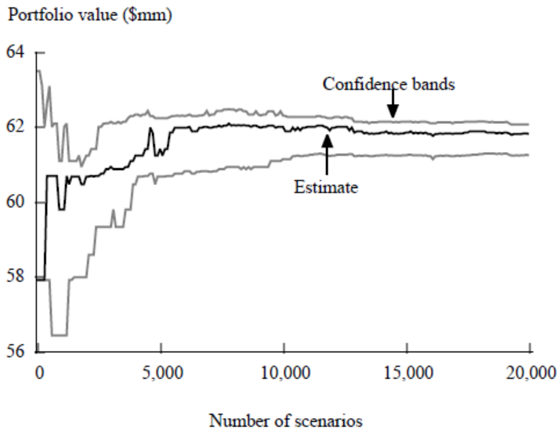
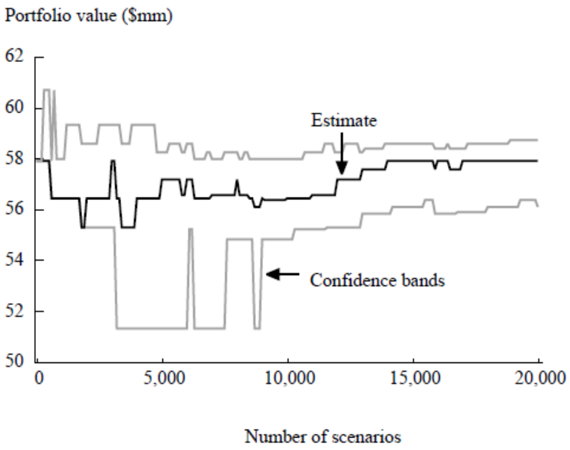


Chart 11.9

Evolution of confidence bands for 0.1 percentile ($mm)



Outline

Marginal risk measures

To examine the contribution of each individual asset to the risk of the portfolio, we compute marginal statistics.

Stand-alone standard deviation

Stand-alone percent standard deviation

Marginal standard deviation.

Percent marginal standard deviation.

The results are shown in the following table.

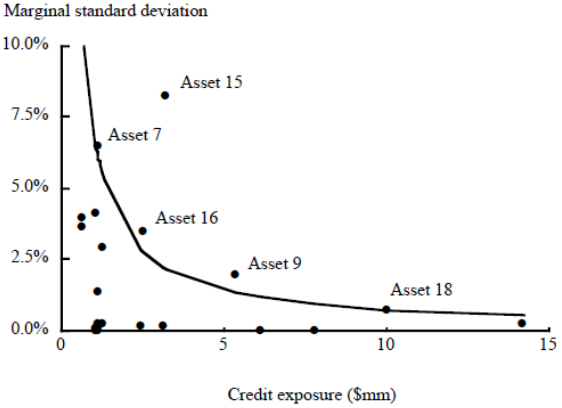
Table 11.5
Standard deviation of value change

		Stand-alone		Marginal	
Asset	Credit rating	Absolute ($)	Percent	Absolute ($)	Percent
1	AAA	4,905	0.06	239	0.00
2	AA	2,007	0.17	114	0.01
3	A	17,523	1.56	693	0.06
4	BBB	40,043	3.37	2,934	0.25
5	BB	99,607	8.63	16,046	1.39
6	B	162,251	12.84	37,664	2.98
7	CCC	255,680	22.67	73,079	6.48
8	A	197,152	1.39	35,104	0.25
9	BB	380,141	7.06	105,949	1.97
10	A	63,207	1.99	5,068	0.16
11	A	15,360	1.30	1,232	0.10
12	A	43,085	1.73	4,531	0.18
13	B	107,314	15.21	25,684	3.64
14	B	167,511	15.40	44,827	4.12
15	B	610,900	18.72	270,000	8.27
16	B	322,720	12.77	89,190	3.53
17	BBB	28,051	2.13	2,775	0.21
18	BBB	306,892	3.06	69,624	0.69
19	BBB	1,837	0.16	120	0.01
20	AA	9,916	0.16	389	0.01

An interesting way to visualize these outputs is to plot the percent marginal standard deviations against the market value of each asset.

Chart 11.10

Marginal risk versus current value for example portfolio



Based on the discussion above, we may identify with the aid of the curve the five greatest contributors to portfolio risk.

模型输出的应用

信用风险的度量有各种不同方面的应用。

- To set priorities for actions to reduce the portfolio risk;
- To measure and compare credit risks so that an institution can best apportion scarce risk-taking resources by limiting over-concentrations
- To estimate economic capital required to support risk-taking.

Prioritizing risk reduction actions

We will make reference to Chart 12.1, for a hypothetical portfolio with a very large number of exposures.
There are at least two features of risk which we are worth reducing, but the trade-off between them is judgmental: (1)absolute exposure size; (2)statistical risk level.

The approaches include

(1)reevaluate obligors having the largest absolute size(the lower right corner of the chart)arguing a single default among these would have the greatest impact

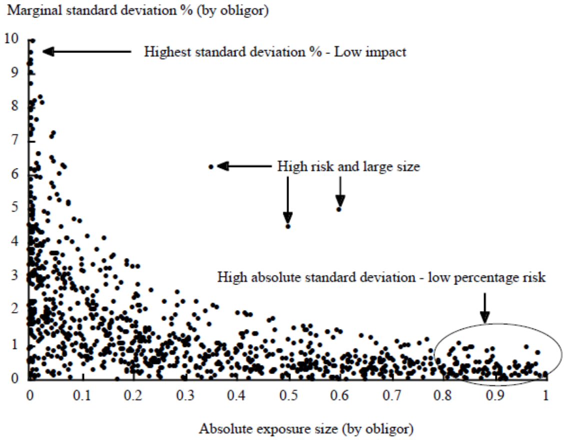
(2)reevaluate obligors having the highest percentage level of risk (the upper left corner of the chart)arguing that these are the most likely to contribute to portfolio loss

(3)reevaluate obligors contributing the largest absolute amount of risk (points towards the upper right corner of the chart)arguing that these are the single largest contributions to portfolio loss

在一个典型的信用组合中，风险以及风险暴露的额度

Chart 12.1

Risk versus size of exposures within a typical credit portfolio



credit risk limits的类型

In terms of policy rigor, the next step beyond using risk statistics for prioritization is to use them for limit setting.

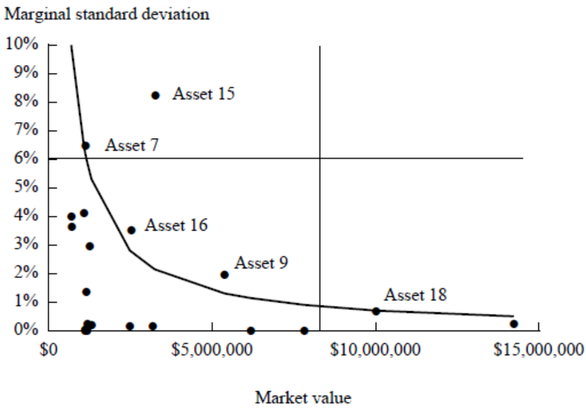
What type of risk measure to use for limits, as well as what type of policy to take with regard to the limits, are management decisions.

In this section, we discuss three aspects a user might consider with regard to using CreditMetrics for limit purposes: what type of limit to set, which risk measure to use for the limits, and what policy to employ with regard to the limits.

This section's discussion will make reference to Chart 12.2.

Chart 12.2

Possible risk limits for an example portfolio



We might consider each of the three possibilities mentioned in the previous section as candidates for credit risk limits.

Set limits based on percentage risk

Set limits based on exposure size

Set limits on absolute risk.

风险度量的选择

Given a choice of what type of limit to implement, it is necessary next to choose the specific risk measure to be used.

There are two choices to make: first, whether to use a marginal or stand-alone statistic, and second, whether to use standard deviation, percentile, or another statistic.

使用四个统计量.
最基本的统计量是标准差.
可以使用分位点.
也可以使用平均的shortfall.
需要注意其应用价值.

Policy issues

经济资本评估

For the purpose of prioritization and limit setting, the subjects of the first two sections, we examined risk measures in order to evaluate and manage individual exposures. The total risk of the porfolio might guide the limiting-setting process, but it was the relative riskiness of individual exposures which most concerned us.

To consider risk in this way, we look at risk in terms of capital; but rather than considering the standard regulator or accounting view of capital, we examine capital from a risk management informational view.

In this section, we examine a different application of credit risk measure, that of assessing the capital which a firm puts at risk by holding a credit portfolio. We are no longer trying to compare different exposures and decide which contribute the risk of the entire portfolio with regard to what this risk implies about the stability if our organization.

Summary

总结来说, the CreditMetrics methodology 给投资者各种选择的权利来度量经济资本.

考虑了三个经济资本的度量方式: 风险降低（exposure reduction），限额设定（limit setting），表现评估（performance evaluation）.

An assessment of economic capital may guide the user to actions which will alter the characteristics of his portfolio.

On the other hand, one might wish to use the measure of economic capital in order to aid the limit-setting process, assuring that if individual or industry level exposures are within the limits, then the level of capital utilization will be at an acceptable level.

A third use is performance evaluation.