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Modeling Credit Risks

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A major component in most asset/liability models is the projection of the credit risk. This risk is typically defined as the risk that the issuer defaults and is therefore unable to make timely principal and interest payments. Credit risk is gauged by quality ratings, which are assigned by commercial rating companies (e.g., Moody's, S&P, etc.).

When considering credit risk, we are also concerned with changes in the perceived credit risk in addition to the actual event of default.

Credit risk reduces the market price for an asset versus comparable US Treasury securities, which are assumed to be free of credit risk. Alternatively, the credit risk necessitates a yield spread to Treasuries called the credit spread. Note that this spread over Treasuries is not entirely attributable to the credit risk but also incorporates the liquidity spread. Note also that the credit spread is not directly linked to actual levels of default, but expresses the market's expectations of, and appetite for, the default risk.

In an asset model, the credit spread assumption is used for the following purposes:

- To determine the prices/yields paid on assets purchased in the future
- To determine the market value in the case of asset sales and
- To affect call and put option rates.

When developing the credit spread assumption, we can begin by looking at the current average credit spreads varying by credit rating and the term to maturity. For example, the current average spreads of corporate bonds as of November 27, 2000, are presented in Exhibit 1.

Exhibit 1
Current Average Credit Spreads as of 11/27/2000 (bps)

	Maturity (years)							
Rating	**1**	**2**	**3**	**5**	**7**	**10**	**30**	**Total**
AAA	64.2	73.6	79.6	98.6	113.4	135.0	152.2	102.4
AA	81.6	90.4	97.8	124.7	142.0	163.5	186.5	126.6
A	93.8	106.3	112.8	146.8	167.3	197.3	220.7	149.3
BBB	126.0	138.1	149.9	184.4	208.2	241.9	268.6	188.1
BB	264.0	284.3	300.9	330.7	371.7	431.0	473.3	350.8
B	483.0	513.7	541.0	582.0	658.0	756.2	804.3	619.7
CCC	597.0	630.0	682.0	723.0	820.0	900.0	966.0	759.7

Arithmetic averages are taken over all industries and rating agencies included in the data.
Source: RiskMetrics' 11/27/2000 Corporate Bond Spreads Dataset (www.riskmetrics.com/products/data/datasets)

An obvious observation from Exhibit 1 is that the credit spreads trend upward with decreasing credit rating and increasing maturity.

With an initial credit spread assumption selected, we then consider the progression of credit spreads in the future. We begin with the following decision process:

- Should we grade to an assumed set of ultimate spreads or not?
- If so, over what period of time should this grading take place?
- Also if so, what should the ultimate spreads be?
- Or, should the model use stochastic spreads?

In making these decisions, we need to consider how significant this assumption is for the purposes of the model. Furthermore, we need to consider how far off we think the current spreads are from the ultimate spreads. Finally, we should also consider how much weight to give to the historical past and which period of time is the most significant for our purposes and most applicable to the period being projected. The graph in Exhibit 2 displays the volatility of credit spreads by credit rating historically since late 1998.

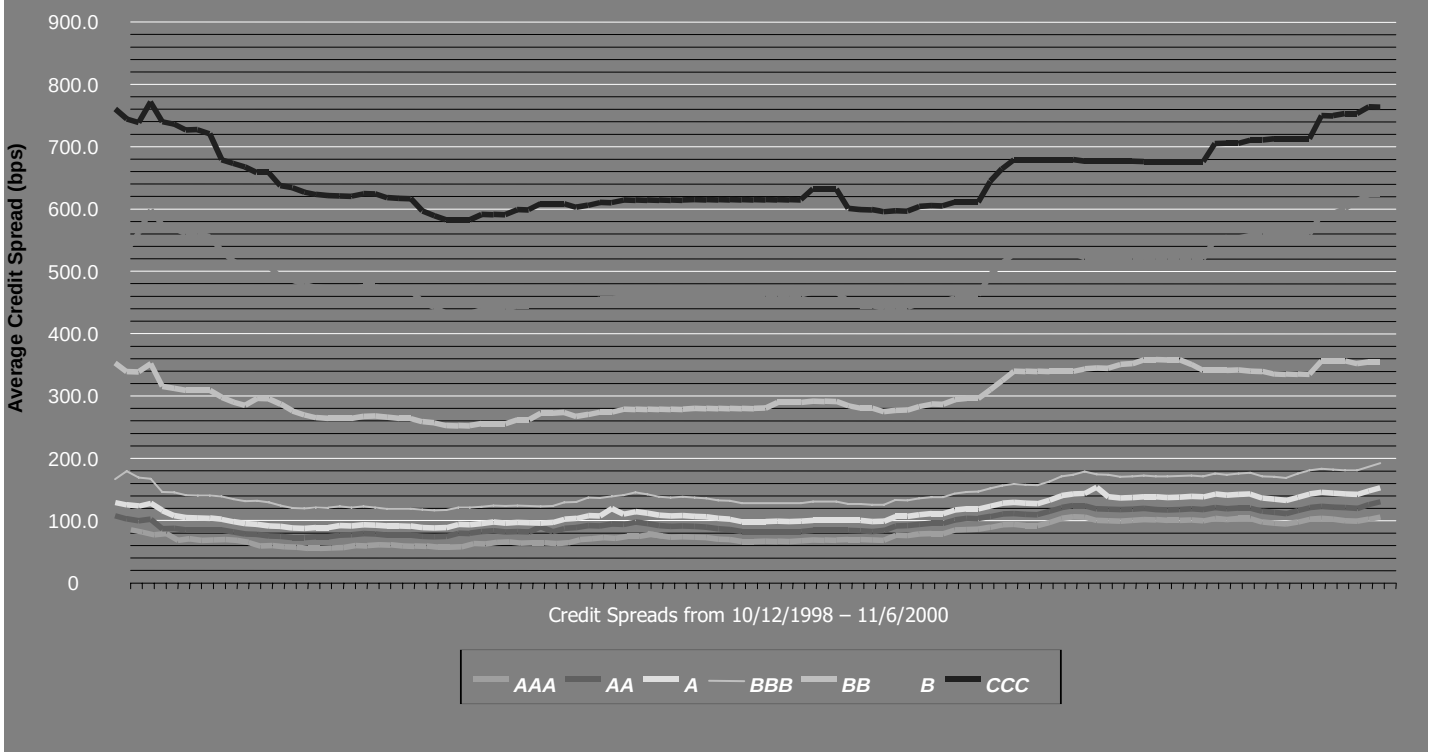
The other major assumption in an asset model that is closely related to the credit risk is the default cost assumption. Average default costs can be calculated based on historical default rates and recovery rates.

Since defaults reduce the coupon payments and par value payments received at the time of default and in the future, the default cost assumption is used to reflect the impact of defaults on future asset cash flows.

A significant consideration in determining the default assumption is whether to model rating class changes. Specifically, as a bond gets downgraded, the probability of default increases. If rating class changes are not being modeled, the default rate is inflated for the original rate class. Likewise, default rate deflation occurs in the case of rating class upgrades. The tradeoff for the increased precision of modeling rating class changes is increased model complexity.

Another consideration is the source of the information used to determine the historical default costs. There are a variety of studies available, each with a different time period in addition to a unique methodology.

Exhibit 2
Weekly Average Credit Spreads



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The determination of a default cost assumption begins with an analysis of cumulative default rates from a variety of sources. Again, consideration of the source is the key here. For high quality corporate bonds, there have not been very many defaults, and a seemingly inoccuous methodology difference such as weighting by dollar amounts versus weighting by number of issuers can significantly affect results.

Average default rates can then be developed by duration since a rating was determined. For high quality bonds, default rates tend to be low initially after a rating is identified because issues do not typically default straight away. However, over time, a credit rating may deteriorate and, ultimately, defaults occur. For lower rated bonds, the opposite effect occurs — the bonds that do not default may upgrade, and the aggregate default rate improves.

Exhibit 3 illustrates the pattern of expected defaults. This exhibit was calculated using data from two sources (Moody's Investor's Service report "Historical Default Rates of Corporate Bond Insurers, 1920-1998" and Standard & Poors *Credit Week* of January 26, 2000)

After determining a default rate assumption, a recovery rate assumption must be developed. The recovery rate determines how much of the bond value is recovered upon default. Historically, this percentage has decreased as the credit rating decreases, perhaps because of the greater securitization of higher rated debt. For corporate bonds the assumed recovery percentage might range from 70% for a AAA bond, to 50% for a BBB bond, to 40% for lower rated bonds.

Finally, combining the recovery rates and the default rates, we arrive at a default cost table showing the amount that will be lost upon default by duration.

The credit spread assumption in conjunction with the default cost assumption account for the credit risk inherent in corporate bonds. Appropriate analysis of the data in-hand and consideration of your modeling purpose are required when developing these critical asset assumptions.

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Exhibit 3
Default Rates

	Annual Rate by Year Since Rating				
Rating	1	2	3 to 5	6 to 10	11 to 20
AAA	0.00%	0.00%	0.05%	0.12%	0.13%
AA	0.02%	0.02%	0.10%	0.12%	0.13%
A	0.02%	0.06%	0.13%	0.21%	0.30%
BBB	0.16%	0.27%	0.44%	0.47%	0.70%
BB	1.10%	2.13%	2.38%	1.74%	2.28%
B	5.82%	6.39%	4.97%	3.15%	1.73%