

# Credit Ratings

## Default Rates, Recovery Rates, and Credit Spreads

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In this white paper we will detail how the historical default rates, recovery rates, and credit spreads table below was constructed.

A corporate bond's credit rating at default may be lower than the bond's credit rating at origination due to the original rating transitioning over time to a lower rating due to deteriorating credit conditions. The table below accumulates defaults over the time interval  $[0, 20]$  by credit rating at origination (i.e. a static pool analysis)...

**Table 1: Average Default Rates, Recovery Rates, and Credit Spreads**

Credit Rating	Default Rate		Credit Spread		Recovery Rate
	Cumul	Annual	Mean	Std Dev	
AAA	0.80%	0.04%	0.78%	0.52%	69.58%
AA	2.26%	0.11%	0.97%	0.66%	43.18%
A	5.53%	0.28%	1.29%	0.84%	44.17%
BBB	9.65%	0.51%	1.97%	1.02%	43.52%
BB	28.71%	1.69%	3.57%	1.77%	41.59%
B	48.71%	3.34%	5.40%	2.44%	38.36%
CCC/C	52.53%	3.73%	11.23%	5.24%	38.86%

Table Construction:

**Credit Rating** (Column 1) - Letter credit rating. Letter grades AAA to BBB are investment grade. Letter grades BB and below are non-investment grade.

**Cumulative Default Rates** (Column 2) - Cumulative default rates over a 20 year period by credit rating at origination. Data source: Moodys' Average Cumulative Issuer-Weighted Global Default Rates By Letter Rating, 1970-2017 (Exhibit 33).

**Annual Default Rates** (Column 3) - Annual default rate (i.e. hazard rate) by credit rating at origination. See Appendix A for how this rate was calculated.

**Credit Spread - Mean** (Column 4) - Credit spread distribution mean. Data source: St Louis Federal Reserve (FRED) option-adjusted spreads - 1997 to 2023.

**Credit Spread - Standard Deviation** (Column 5) - Credit spread distribution standard deviation. Data source: St Louis Federal Reserve (FRED) option-adjusted spreads - 1997 to 2023.

**Recovery Rates** (Column 6) - Post-default recovery rates. Data source: Moodys' Average Cumulative Issuer-Weighted Global Default Rates By Letter Rating, 1970-2017 (Exhibit 21).

## Appendix

A. Table construction: Annual default rates (i.e. hazard rate).

We will define the function  $S_t$  to be the survival function (probability that bond does not default) at time  $t$  and the variable  $\lambda$  to be the hazard rate, which can be viewed as the annual default probability. The equation for the survival function is...

$$S_t = S_s \text{Exp} \left\{ -\lambda (t - s) \right\} \quad (1)$$

Using Equation (1) above and solving for the hazard rate...

$$\lambda = -\ln \left( \frac{S_t}{S_s} \right) / (t - s) \quad (2)$$

Given that Table 1 above accumulates defaults by original credit rating over a 20 year term (i.e. subscripts  $s = 0$  and  $t = 20$ ), for our purposes Equation (2) above becomes...

$$\lambda = -\frac{\ln(S_t)}{t} \text{ ...where... } S_t = 1 - \text{Cumulative default rate} \quad (3)$$

For example, using Table 1 above and Equation (3) above, the equation for the annual default probability for A rated debt is...

$$\lambda = -\frac{\ln(1 - 0.0553)}{20} = 0.002844 = 0.28\% \quad (4)$$