**KMV-Merton’s Distance-to-Default Model**

The pioneering work of Merton (1974) is the approach used to measure the bank distance-to-default and expected default frequency. Kealhofer, McQuown, and Vasicek (KMV, a unit of Moody’s Analytics) extended the model to calculate the expected default frequencies for publicly traded firms; hence the reference to KMV-Merton model). Implementing the model begins with premise of viewing the firm’s equity as a call option written on the distributional information on the value of the firm (current value (V) and its standard deviation (σV)), the face value of the firm’s debt representing the strike price (F), and the time to maturity of debt characterizing the horizon for this valuation (T).With the exception of V and σV, all other variables are either publicly available with exception of the standard deviation of equity returns, σE, which can be estimated from past data. The unobservable variables can be estimated using the option pricing and equity volatility equations (1), and (2) below.

(1)

(2)

[explain just like the paper, it my own word, how we come up with this equation, cite the paper]

where , , r is the risk free rate of interest and Φ is the standard normal cumulative probability distribution. A numerical root-finding algorithm is then applied to find V and σV simultaneously feeding directly into the distance-to-default calculation in equation (3). [explain this with own words]

[add a table of variables; each of them with a t or t-1 ]

(3)

Where

* is the natural logarithm of the ratio of total assets (V) to the total debt obligations (F) measured as short-term debt plus half of the long-term debt, assuming that not all long-term debt needs to be repaid within a short timeframe. A large and positive number indicates assets significantly exceed liabilities.
* accounts for the expected growth (or drift) of assets over the chosen timeframe (T), assumed to be one year [double check if this is based t or t-1 ], adjusted by a volatility of the asset value factor, . μ is an estimate of the expected annual return of the firm's assets using lagged monthly equity rates of return.
* measures asset-value fluctuations over the period.

Finally, the expected default frequency (EDF) representing the probability that the value of the firm will be less than the face value of the debt at maturity will be equal the cumulative probability of the DD represented in equation (4) and visually shown in Figure (1).

EDF = Φ {-( )} = Φ (-DD) (4)

A diagram of a graph

AI-generated content may be incorrect.

**KMV-Merton Model of Expected Default**

Tepe, M., Thastrom, P., and Chang, R. How Does ESG Activities Affect default Risk, <https://ficonsulting.com/wp-content/uploads/2022/04/FI_ESG_WP_2022.pdf>

Following Bharath and Shumway (2008), Badghdadi et al. (2019), and Mckenna (2021) a simplified version of the EDF is used where the asset value (V) is equal to the sum of market value of equity and face value of debt (E+ F), asset volatility (σV) is computed as the average volatility, and the drift of

asset value μ is an estimate of the expected annual return of the firm's assets using the previous monthly equity rates of return. The probability of default under the simplified model is presented in equation (5)

EDF = Φ {-( )} = Φ (-DD) (5)

Simplified σV = (E/(E+F)) σE + (F/E+F) (.05 + .25 σE)

[add a an example for 2 banks (ie. BAC 2016 and JPM 2016) create a table to explain what is each values used to calculate DD and PD and the expected default]

**Deliverables**

1. Variables definition
2. Exemples: 2 banks in given year