

Technical Report: Merton Structural Credit Model with Exponential Smoothing Improvement

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1 Introduction

This report presents an implementation and improvement of the Merton (1974) structural credit model for estimating default probabilities. The baseline model treats equity as a call option on firm assets and calibrates unobservable asset values and volatilities from market-observable equity prices (stock prices) and volatilities. After implementing and diagnosing the baseline model on 2020 data for five U.S. firms (Apple, JPMorgan Chase, Tesla, Exxon-Mobil, and Ford), we identified **default probability (PD) instability** as the primary weakness: all firms exhibit coefficient of variation (CV) > 1.0 , making the model unsuitable for daily credit risk monitoring.

To approach this issue we implement **exponential smoothing** ($\alpha = 0.1$) as a minimal improvement that reduces PD volatility by 15–20% and daily changes by 25–50% while preserving the model’s ability to properly capture credit deterioration during crisis periods.