Here is the markdown with the grammar and British English fixed:

Introduction

The `model_name` (model) is designed to assess the creditworthiness of private small-to-medium sized companies based on their financial metrics. The model takes into account various financial ratios categorised into three main classes: Profitability, Leverage & Coverage, and Efficiency. By analysing these metrics, the model assigns a credit score and a corresponding credit rating to each company, as well as the probability of default.

Model Overview

The model follows a multi-step process to determine the credit score and rating for a given company. It relies on a set of predefined financial metrics, their respective weights, and threshold values. The key components of the model are as follows:

Financial Categories & Metrics

The model considers three main categories of financial metrics:

- **Profitability Metrics:** This category includes ratios such as EBITDA Margin, Total Assets, and Sales Growth, which assess the company's ability to generate profit and its overall financial performance.
- **Leverage & Coverage Metrics:** Ratios in this category, such as Debt to Equity, Debt to EBITDA, EBITDA to Interest Expense, and Debt to Tangible Assets, evaluate the company's debt levels and its ability to cover its financial obligations.
- **Efficiency Metrics:** This category comprises ratios like Asset Turnover, Inventory to Cost of Sales, and Cash to Assets, which measure how effectively the company utilises its assets/resources to generate revenue.

Metric Weight

Each financial category and metric is assigned a specific weight that reflects its relative importance in the overall credit assessment. The weights are determined based on the significance of each metric and ratio in evaluating the company's financial health and creditworthiness. The weights are derived from JSE All Share Index constituents by industry classification, which serves as company classification.

The model calculates quantile buckets for each ratio based on market data. For example, Banks' Debt/Equity 10th percentile is 8.3, 50th percentile is 163, and 90th percentile is 303.1. These quantile buckets are used to assign appropriate weights to the metrics, ensuring that the model's assessment aligns with industry and market norms.

Table 1: (metric industry percentiles)

Ratio	10th Percentile	25th Percentile	50th Percentile (Median)	75th Percentile	90th Percentile
Debt to Equity	0.25	0.50	1.00	2.00	5.00

Ratio	10th Percentile	25th Percentile	50th Percentile (Median)	75th Percentile	90th Percentile
Debt to EBITDA	0.50	1.00	2.00	4.50	9.00
Debt to Tangible Assets	0.20	0.40	0.60	1.00	2.00
Inventory to Cost of Sales	0.10	0.20	0.40	0.60	1.00
EBITDA to Interest Expense	25.00	15.00	6.00	1.00	0.00
EBITDA Margin	40.00%	30.00%	20.00%	10.00%	5.00%
Total Assets (millions)	500.00	50.00	5.00	0.50	0.10
Sales Growth	40.00%	25.00%	15.00%	5.00%	0.00%
Asset Turnover	5.00	3.00	2.00	1.00	0.50
Cash to Assets	0.50	0.30	0.20	0.10	0.05

Table 2 (aligning percentile with credit rating and score)

Metric	10th Percentile	25th Percentile	50th Percentile (Median)	75th Percentile	90th Percentile
Credit Score	1.5 - 2.5	3.5 - 4.5	5.5 - 6.5	7.5 - 8.5	> 8.5
Credit Rating	Aaa, Aa	A, Baa	Ba, B	Caa, Ca,	C

**The table shows a rough estimated alignment of the credit rating and the metric percentiles*

The specific metrics, their corresponding weights, and the category weights used in the model are as follows:

Category	Category Weight	Metric	Metric Weight
Profitability Metrics	35%	EBITDA Margin	40%
		Total Assets	30%
		Sales Growth	30%
Leverage & Coverage Metrics	40%	Debt to Equity	20%
		Debt to EBITDA	20%
		EBITDA to Interest Expense	20%
		Debt to Tangible Assets	40%

Category	Category Weight	Metric	Metric Weight
Efficiency Metrics	25%	Asset Turnover	40%
		Inventory to Cost of Sales	30%
		Cash to Assets	30%

Credit Score & Ratings

For each metric within a category, the model assigns a score based on the metric's value and its corresponding quantile position as per the industry. The model credit score ranges from 1.5 (highest rating) to 8.5 (lowest rating) in increments of 1.0.

For example, if the Debt/Equity falls between the 10th and 15th percentiles, it might be assigned a score of 1.5 based on the predefined quantiles. The model then maps the calculated credit score of the metric to a corresponding credit rating ranging from "Aaa" (highest rating) to "C" (lowest rating), as shown in the following table:

Credit Rating	Score Threshold
Aaa	1.5
Aa	2.5
A	3.5
Baa	4.5
Ba	5.5
B	6.5
Caa	7.5
Ca	8.5
C	> 8.5

The overall credit score for a company is calculated using the following formula:

$CreditScore = \frac{\sum_{j=1}^{m} (CategoryScore_j \times CategoryWeight_j)}{\sum_{j=1}^{m} CategoryWeight_j}$

where:

- m is the total number of categories
- $CategoryScore_j$ is the weighted average score of the metrics within the j-th category, calculated as:

  $CategoryScore_j = \frac{\sum_{i=1}^{n_j} (MetricScore_{i,j} \times MetricWeight_{i,j})}{\sum_{i=1}^{n_j} MetricWeight_{i,j}}$

  - n_j is the number of metrics in the j-th category

    - $MetricScore_{i,j}$ is the score assigned to the i-th metric in the j-th category based on its quantile position
    - $MetricWeight_{i,j}$ is the weight assigned to the i-th metric in the j-th category

- $CategoryWeight_j$ is the weight assigned to the j-th category

The final credit rating is determined by mapping the overall credit score to the corresponding rating in the table above.

Model Training

The model undergoes a training process to optimise the category and metric weights used in the calculation. The training process aims to minimise the difference between the predicted credit rating and the actual credit rating from Moody's, Fitch, and S&P (if available). The training process involves the following steps:

1. Category and metric weights are initialised using industry norms.
2. Using gradient descent, category and metric weights are iteratively adjusted to minimise the loss function, which quantifies the difference between the predicted credit rating and the credit rating from rating agencies. The loss function used is the Mean Absolute Percentage Error (MAPE), calculated as:

   $MAPE = \frac{1}{n} \sum_{i=1}^{n} \left| \frac{Actual_i - Predicted_i}{Actual_i} \right| \times 100$

   where:

    - n is the total number of companies in the training dataset
    - $Actual_i$ is the actual credit rating from rating agencies for the i-th company
    - $Predicted_i$ is the predicted credit rating by the model for the i-th company

3. The process repeats for a specified number of iterations or until convergence.

Through this training process, the model learns to assign appropriate category and metric weights, generating credit scores that closely approximate the actual credit ratings from rating agencies.

Conclusion

The Credit Rating Calculator provides a systematic approach to assess the creditworthiness of companies based on their financial metrics. By considering various ratios across three main categories - Profitability, Leverage & Coverage, and Efficiency - and applying a weighted scoring system, the model generates credit scores and ratings that align with industry standards and market data.

The training process, which utilises gradient descent to minimise the difference between predicted and actual credit ratings, ensures that the model's outputs closely approximate the assessments provided by established rating agencies such as Moody's, Fitch, and S&P.