1. General Instructions

- This section of the assessment contains two tasks: conceptional discussion of your understanding about distance to default (DTD) and implied asset value (AV); coding of implied asset value computation given equity value.
- In your submission, provide a **README.md** detailing the project structure, user menu instructing on how the code is used, screenshots of key features.
- At the end of the assessment, you should compress all files into a zip archive named ***<your name>.zip*** *within a folder* `***DTD Calculator***` and submit it in accordance with the details provided via email.

2. Project Overview

You are tasked with developing a Python program that computes the Implied Asset Value (AV) and Distance to Default (DTD). It will be more desirable that this functionality is compiled into a web service where user can upload their own input data for AV and DTD calculations.

This mini project will be used to gauge your aptitude of the core technical skills required to be a Project intern at CRI.

3. Background Information

3.1 Scientific background of Implied Asset Value

Implied asset value is an important variable when computing DTD using the Merton model, while DTD is a vital input for predicting the probability of default (PD) of companies.

Main equations:

$$E_t = VN(d_+) - e^{-r(T-t)}LN(d_-)$$

Where

$$d_{\pm} = \frac{\log\left(\frac{V_t}{L}\right) + \left(r \pm \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}$$

$$\mathrm{L} = \text{Short term Debt} + 0.5 \times \text{Long term Debt} + \text{weight} \times \text{Other Liablity}$$

Et is the market capitalization, V is the implied asset value, r is the risk-free rate, N(·) is the standard normal cumulative distribution function

You can assume $\mathrm{T} - \mathrm{t} = 1$ (1 year).

More detailed explanation is available under section 3.2 in our technical report (https://d.nuscri.org/static/pdf/Technicalreport_2023.pdf)

3.2 Data Description for Function Input

- **Data**: n by 6 matrix with the following variables:
  1. Market capitalization
  2. Short term debt
  3. Long term debt

4. Other liability
5. Total asset
6. Daily risk-free rate

- **Other parameters you may need**:
  - Assume that there are 250 trading days in a year.
  - $\sigma = 4.6940$
  - $\text{weight} = 0.3466$
  - Apply a tolerance threshold of 1e-8 for the numerical methods involved;

4. Project Deliverables

4.1 Functionality Outputs

- The Implied value by solving the main equation.
- Message indicating whether the optimized output is valid.
- DTD computed using your final AV result (you can use the equation below)

$$\text{DTD} = \frac{\log\left(\frac{V_t}{L}\right)}{\sigma \times \sqrt{T - t}}$$

4.2 Main Components for Web Service

- All codes and configurations required to deploy a containerized web service
- Dockerfile for the webservice and database
- Basic documentation for web applications
- Tests for data processing and application
- A user-friendly display of computation results and intake of user uploads

4.3 src folder

- It should contain various codes essential to your AV calculation function, User menu.txt as well as detailed README.md (Please include in README.md a section that discusses your understanding of DTD and implied asset value, and what you think is their realistic significance).
- The functionality should be realized in Python (preferably V3.7).
- It is important to structure your code in a neat and reusable manner and design for maintainability and extendibility.
- We strongly recommend you to use a Class to encapsulate your code.