# Real-Time Financial Risk Profiler using DEA (C++)

A scalable C++ tool to analyze the efficiency of financial entities (like banks, branches, or firms) using the Data Envelopment Analysis (DEA) method. Supports both CSV-based evaluation and dynamic data generation.  
  
Ideal for financial modeling, risk profiling, benchmarking, and academic analysis.

## Features

- Implements CCR DEA Model (Output-Oriented)  
- Input/output-driven efficiency scores ∈ [0, 1]  
- Normalizes against best performer  
- CSV-based data or synthetic generation  
- Fast C++ implementation (scalable, OpenMP-ready)  
- Results saved in clean CSV format  
- Easily customizable for real-world KPI sets

## Project Structure

RealTime-Financial-Risk-Profiler-DEA-Cpp/  
├── include/  
│ ├── dea\_model.h # DEA logic + entity definition  
│ └── random\_data.h # Random input generator  
├── src/  
│ ├── main.cpp # Program entry point  
│ ├── dea\_model.cpp # DEA implementation  
│ ├── data\_loader.cpp # CSV file I/O  
│ └── random\_data.cpp # Dynamic entity generator  
├── data/  
│ └── sample\_financial\_data.csv # Example input  
├── results/  
│ └── risk\_scores.csv # DEA scores saved here  
├── Makefile # Build automation  
└── README.md # You're reading it!

## How to Build & Run

Ensure you have g++ with C++17 support.

Build:

make

Run:

./risk\_profiler

Select mode:

1) Load from CSV  
2) Generate random data

## Input Format (CSV Mode)

ID,Input1,Input2,Output1,Output2  
Bank\_A,100,50,150,200  
Bank\_B,120,60,160,180  
...  
File: data/sample\_financial\_data.csv

## Random Mode Example

Choice (1 or 2): 2  
Enter #entities, #inputs, #outputs: 5 2 2  
Enter min and max value for metrics: 50 200

## Output Format

ID,EfficiencyScore  
Bank\_A,1.000  
Bank\_B,0.872  
Bank\_C,0.765  
...  
Saved to: results/risk\_scores.csv

## Applications

- Financial institution benchmarking  
- Operational risk profiling  
- Branch efficiency comparison  
- Academic DEA experiments

## About DEA

- DEA evaluates how efficiently a Decision-Making Unit (DMU) transforms inputs (e.g. cost, staff) into outputs (e.g. revenue, loans).  
- A score of 1.0 means fully efficient (on the frontier).  
- This model uses the CCR Output-Oriented approach.

## References

- Charnes, Cooper & Rhodes (1978) – "Measuring the Efficiency of Decision Making Units"  
- DEA Theory: https://en.wikipedia.org/wiki/Data\_envelopment\_analysis

## License

This project is free to use for academic or non-commercial purposes.  
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## Contact / Contributions

Contributions welcome! Fork the repo and start profiling smarter.  
  
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