

AI for Financial Risk: Use Cases, Data, and Challenges

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New Challenges in Financial and Energy Markets: Math, Data & AI
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Table of Contents

① DICE

② Use cases

③ Cross-cutting challenges

④ PHAROS AIF

⑤ Conclusion

DICE at a glance

- Document Intelligence Center of Excellence
- Located at the campus of NCSR Demokritos



Mission

- Develop novel **AI methods** for business documents
- Apply ML for **business/financial documents** and decision support
- Connect scientists and AI professionals with business experts
- Bridge **academia-industry** via demos, datasets, pilots, and methods
- Accelerate **innovation**

Members

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Director of NCSRD

- Private funding (EY Global, QUALCO SA)
- Industry fellowships
- Co-created pilots
- Student theses
- **Outputs:** publications, open resources, benchmarks, reproducible pipelines

- Document intelligence for finance:
 - Filings
 - Tables and numerical data
 - Narratives
 - News
- From use cases to prototypes and demos
 - Data → Methods → Evaluation → Demo
- Scientific rigor and practical constraints
- Complementary signals:
 - Bankruptcy events
 - Financial misstatements
 - ESG issues

Table of Contents

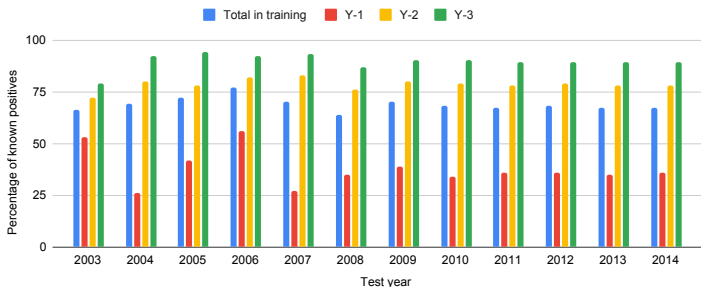
- ① DICE
- ② Use cases
- ③ Cross-cutting challenges
- ④ PHAROS AIF
- ⑤ Conclusion

Problem

- Goal: identify potential misreporting in annual reports
- Input: multi-modal evidence (text, auditor cues, numeric data) from SEC/EDGAR
- Users: analysts, auditors, compliance teams, investors
- How: ML methods; Train on historical data, predict on new data

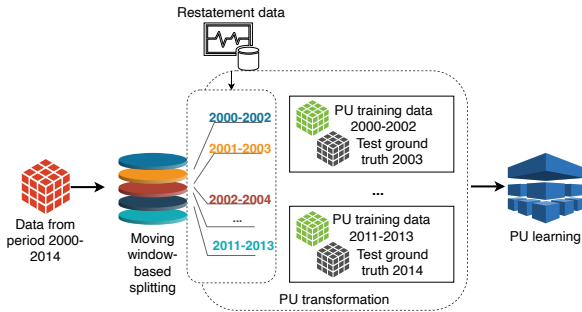
Misstatement risk: Challenges

- Scarce positive examples; many unlabeled cases
- Severe class imbalance (1% positive cases)
- Templated language in texts; hard to distinguish positive cases



Misstatement risk: Methods

- Realistic evaluation setting
 - Respect time dimension; train on past data, predict on future data
 - Create realistic data splits; respect class imbalance
 - Handle the unlabeled examples at training; realistic scenario
- PU-learning approaches; cost-sensitive and adaptive loss functions



Bankruptcy risk

Problem

- Goal: early warning for distress/bankruptcy risk
- Input: financial ratios, textual narratives (manager, auditor) from SEC/EDGAR
- Users: credit risk teams, portfolio managers, regulators, investors

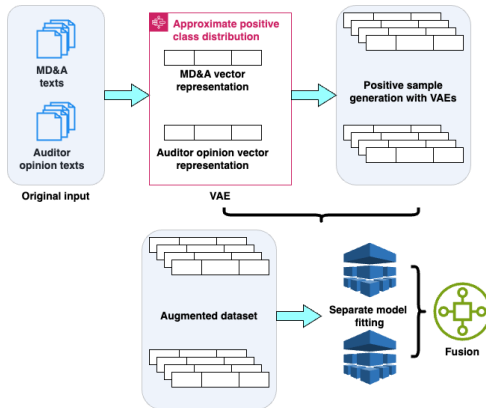
Challenges

- Severe class imbalance
- Imbalanced outcomes; heterogeneity across firms/years
- Label noise; actual bankruptcies vs filing for bankruptcy
- Textual narratives; too big



Bankruptcy risk: Methods

- Realistic modeling
- Train on past data, predict on future data
- Multimodal models combining multi-source input
- Handle class imbalance
- Use LLMs for data augmentation



The risk of LLMs in financial cases

- Mostly used for zero-shot classification
- Prompting / prompt-engineering
- Ask the LLM to make predictions given text input

Pitfalls

- Retrospective evaluation with data that could have been used for LLM pretraining
- Need to guide the model not to use prior knowledge from pretraining
- Mask words that may indicate firm/year



Table of Contents

- ① DICE
- ② Use cases
- ③ Cross-cutting challenges**
- ④ PHAROS AIF
- ⑤ Conclusion

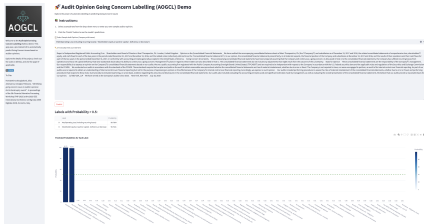
Cross-cutting challenges

- Domain/temporal shift
- Data challenges (label noise, imbalance)
- Data access
 - Data behind paywalls
 - Licensing issues
 - Privacy concerns
- Multi-source/modal and possibly contradictory signals
- How can an ML practitioner get started in the field?



- We publish large financial datasets
 - Data with firm/year financial statements
 - Enriched datasets with textual information from annual reports
 - Enriched datasets with auditors' opinion from annual reports
 - Curated datasets to simulate realistic production environments (misstatement PU data, bankruptcy data)
- We create pilot use cases and prototype demos
 - <https://dice.iit.demokritos.gr/outreach/#Demos>
 - Loading: chatbot on Γ.Ε.ΜΗ annual reports
- Toolbox / published methods/code:
 - <https://github.com/iit-Demokritos>

Indicative demos



 Instructions:

1. Select a sample company from the drop-down menu or enter your own company's REBA and Audit/Inspection tool.
2. Click the Reader button to see the model predictions.

John is a sample of the general population of people who are 25 years old.

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respective financial condition and results of operations (including related notes) of the Company. The information provided here in Management's Discussion and Analysis of Financial Condition and Results of Operations is not intended to be a substitute for the information contained in the other documents, including the financial statements and the notes thereto.

Report of independent licensed Public Accounting firm: Bureau of Finance and Auditors Bureau, Inc., Washington, DC. It has audited the company's consolidated balance sheet of December 31, 2005 and the related consolidated statements of operations and comprehensive income, stockholders' equity, and cash flow for the year then ended in accordance with the audit of financial statements. We have also audited the financial statement schedule set forth for the year ended December 31, 2005 and the accompanying notes. The financial statements and schedule were prepared by the Company's management. For independence purposes, we are not related to the Company and we are not associated with the Bureau of Finance and Auditors Bureau, Inc. We conducted our audit in accordance with the standards of the Public Company Accounting Oversight Board ("PCAOB"). Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements and financial statement schedule are free of material misstatement.

Bankruptcy Probability using the M2SA test: 0.719

Bankruptcy Probability using the Auditor's Opinion test: 0.993

Bankruptcy Probability using both tests: 0.854

11

- Bankruptcy prediction based on multi-source text
- Going-concern issues prediction based on auditor's opinion
- <https://dice.iit.demokritos.gr/outreach/#Demos>

Table of Contents

- ① DICE
- ② Use cases
- ③ Cross-cutting challenges
- ④ PHAROS AIF**
- ⑤ Conclusion

AI Factories

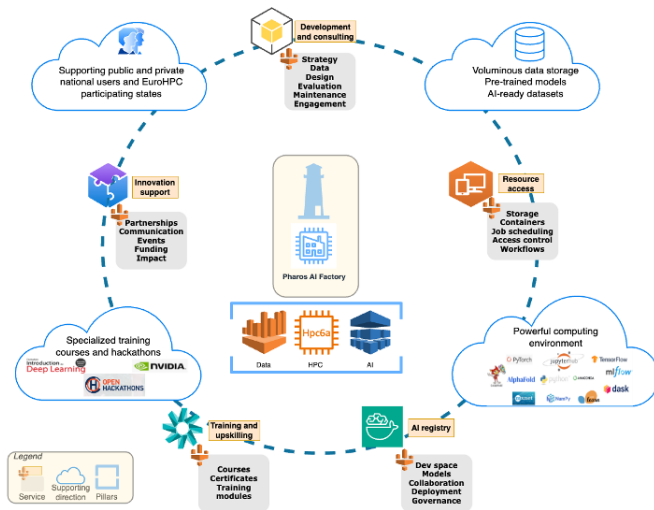
- A hub for developing, testing and scaling AI-driven solutions
- Leverages cutting-edge technologies (AI, ML, HPC)
- Focuses on addressing specific industry or sector challenges
- Support collaboration between researchers, industries and policymakers
- Provide training capacity for building AI adoption



- Launch and maintain a trusted AIF for South-Eastern Europe
- Capitalize on existing investments in the area of HPC, AI, and data centers
- Empower start-ups and SMEs:
 - Health
 - Language and culture
 - Sustainability (energy, environment, climate)



PHAROS services



- Standardized components for data loading and processing
- **Registries** for datasets and models
- Reusable **training recipes** for multimodal tasks
- **HPC accelerated** training
- Large-scale training and fine-tuning of (financial) LLMs
- Workflow orchestration and experiment tracking
- Deployment facilities

Collaboration pathways

- Co-develop PoCs on partner data
- Foundation models tailored for finance/energy documents
- **Expand services** for stakeholders
- **Knowledge transfer** and capacity building
- **Networking opportunities** and joint ecosystem building activities
- Test-before-invest services



Table of Contents

- ① DICE
- ② Use cases
- ③ Cross-cutting challenges
- ④ PHAROS AIF
- ⑤ Conclusion

Conclusions

- Domain-aware data + robust evaluation + MLOps
 - **impact in practice**
- DICE + PHAROS + Collaborators
 - **shorten the path from idea to pilot to production**
- Open to discuss new use cases and ML methods in a joint pilot



Thank you

Useful links

- DICE: <https://dice.iit.demokritos.gr>
- DEMOs: <https://dice.iit.demokritos.gr/outreach/#Demos>
- PHAROS AIF: <https://www.pharos-aifactory.eu/>

Call to action

Open for collaborations / pilots on Greek documents/data

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