Thesis Project Portfolio

Optimal Sequencing of Projects with Uncertain Regulatory Costs

(Technical Report)

Ensuring Transparency and Reducing Bias in AI

(STS Research Paper)

An Undergraduate Thesis

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Malek Thabet

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Department of Systems Engineering

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Executive Summary

I will be addressing my technical topic using a stochastic, optimization-based decision model, aided by a judgmental forecasting procedure and a statistical cost analysis, so that clients can be educated on project planning through data driven decision making. For my STS topic, I will be outlining why it is crucial for an AI fairness framework to be developed and what that framework must consist of. This capstone research, "Optimal Sequencing of Projects with Uncertain Regulatory Costs", aims to assist businesses who often face uncertain costs with compliance with external requirements, such as regulatory mandates or industry standards. This research provides methods for specifying solvable optimization models where uncertainty is quantified using expert judgement and empirical data. Additionally, as advancements in AI become increasingly frequent, inadvertent biases and fairness issues in both public and private sectors become more prevalent. As a result, it is crucial to establish guidelines that can be adopted by all relevant entities, promoting fairness amongst AI whilst not overreaching to thwart the development of this technology. Both the technical and STS components of this capstone are rooted in principles of systems engineering through analytical methods and systems problem solving.

This research contributes a stochastic optimization model that is operationalized for a specific application, through the uncertainty of random inputs by expertly assessed quantiles. These assessments are used to estimate parametric distributions from selected families, enabling complete quantification of uncertainty. Where available, historical data supplements the expert's judgment—statistical analysis of carbon offset futures provides credible intervals to guide quantile assessment for the cost of mitigation instruments.

Packaged together with a mixed-integer linear program, the optimization model integrates these uncertainty inputs and selects an optimal sequence of projects and mitigation instruments to achieve the specified regulatory target. This allows CapTech, the company funding this research, to enable its clients with a decision-support tool to combine empirical data with expert assessment, providing organizations with a framework for project planning in a regulatory environment.

To ensure fairness and transparency without stifling innovation, regulatory bodies must evolve at a pace that keeps up with rapid technological advancements in AI. Establishing structured, adaptable guidelines is essential for promoting ethical AI development. The integration of RRI with current regulatory orders and academic literature allows for a comprehensive analysis of AI regulation, providing insights into how these frameworks can better account for the ethical, social, and technological challenges posed by AI.

It is crucial to adopt a holistic approach that involves improving data quality, increasing diversity in development teams and throughout the AI lifecycle, ensuring transparency in AI decision-making through explainable AI, and integrating robust regulatory frameworks. Government agencies like the FTC and EEOC, under the current legal landscape, will play pivotal roles in enforcing fairness in AI. Furthermore, the DOJ must develop a dedicated AI unit to address and monitor malpractice as the legal landscape evolves to be best prepared to handle this rapidly evolving technology. By drawing on frameworks like RRI, this research aims to contribute to the development of comprehensive, adaptable guidelines that promote fairness while fostering innovation.