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Title

From Predictive Pricing to Fair Pricing: A Causal Fairness Audit Framework for Insurance Models

Speaker/Company

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Abstract

Background: The pervasive adoption of Machine Learning in insurance pricing raises fundamental questions: when does a predictive variable become discriminatory? How can we distinguish spurious correlations from legitimate causal relationships? The EU AI Act classifies credit scoring—and implicitly insurance pricing—as a high-risk system, imposing stringent transparency and non-discrimination requirements.

Objective: We propose an operational audit framework enabling actuaries to systematically assess predictive model fairness, distinguishing between variables with legitimate causal links to risk and discriminatory proxies masquerading as predictors.

Methodology: Using the French Motor Third-Party Liability dataset (freMTPL2freq), we develop a three-phase structured audit:

1.   Calibration Audit: Statistical sufficiency tests verifying that, for a given predicted premium, expected risk is uniform across demographic groups (age, gender, geographic area)

2.   Proxy Detection via XAI: SHAP analysis to quantify each variable's contribution and identify potential proxies for protected attributes through residual correlations

3.   Counterfactual Fairness Check: Counterfactual scenario simulation to distinguish "option luck" (modifiable behaviors such as vehicle type, coverage choice) from "brute luck" (immutable or semi-immutable characteristics)

Expected Results: A replicable audit protocol producing:

(i) group-stratified calibration metrics,

(ii) stratified SHAP attribution maps,

(iii) operational recommendations for mitigating identified biases, with documentation compliant with EU AI Act requirements.

Contribution: The framework evolves the actuary's role from loss ratio optimizer to "causal nexus curator," providing concrete tools to balance technical sustainability, social equity, and regulatory compliance.

Keywords: Algorithmic fairness, Insurance pricing, Machine Learning, Explainable AI, SHAP,

Counterfactual fairness, EU AI Act, Actuarial science

Biography

• 10+ years of experience in insurance and actuarial sector, Full Stack Actuary

• Insurance background: Life & Non-Life Risk Manager, specialized in Internal Model Premium Risk, Catastrophe Modeling, ORSA, ESG Risk, Cyber Risk, Actuarial Advanced modeling.

• Expert in Legal Tech - developing AI solutions (autonomous agents, RAG systems) for legal applications

• Specialized in AI governance, focusing on EU AI Act compliance, bias mitigation, and responsible AI implementation in insurance.

• IAA AI Task Force Leader - guiding strategic initiatives at the intersection of AI and actuarial science

• Senior Actuary with expertise in AI, Machine Learning, Big Data, Software Developing