How do Bayesian Networks support impact-based forecasting for informed decision-making?

Nishadh Kalladath[1], Viola Otieno[1], Jully Ouma[1,2], Collison Lorez[1], & Ahmed Amdihun[1]

[1] IGAD Climate Prediction and Applications Centre- ICPAC, Nairobi, Kenya
[2] United Nation Office for Disaster Risk Reduction, Africa Office, Kenya

Introduction

- Impact-based forecasting (IBF) guides proactive decisions in disaster risk management to reduce damages and casualties from hydro-meteorological events.
- Integral to IBF are risk matrices, which evaluate impact probabilities and magnitudes.
- These matrices frequently overlook conditional elements, potential interventions, and the consequences of varied actions [1]. To enhance IBF's efficacy as a tool for reasoning under uncertainty, better tools are essential [2].
- The Bayesian Network (BN) [3], representing the interrelations of a set of variables graphically, offers a systematic approach to probabilistic reasoning about uncertainty. This study explores its implementation within IBF.

Methods

- The figure illustrate the method for creating a BN model for a mind map on flood hazard anticipatory action. Uses GPT-4V[4] thorugh ChatGPT web application for BN model generation and compute for decision making by Python library pyAgrum[5].

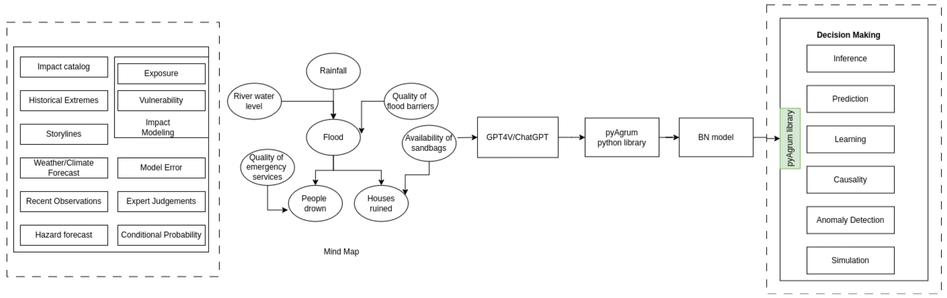

Figure 1: Steps for BN generation. The input mind map is adapted from Fenton and Neil [1].

Result

- The study highlights the application of BN within IBF, leveraging ChatGPT to produce a BN model for risk analysis in anticipatory action against flood hazards. This methodology can be further refined to integrate essential IBF inputs and tools for informed decision-making.

References

[1] Norman Fenton and Martin Neil. *Risk assessment and decision analysis with Bayesian networks*. CRC Press, 2018.

[2] Edward Geist. Why reasoning under uncertainty is hard for both machines and people—and an approach to address the problem. *Adaptive Engagement for Undergoverned Spaces*, page 265, 2022.

[3] Judea Pearl and Stuart J. Russell. Bayesian neworks. Technical report, UCLA Cognitive Systems Laboratory, 1997.

[4] OpenAI. GPT-4 technical report, 2023. `https://arxiv.org/abs/2303.08774`.

[5] Gaspard Ducamp, Christophe Gonzales, and Pierre-Henri Wuillemin. aGrUM/pyAgrum : a Toolbox to Build Models and Algorithms for Probabilistic Graphical Models in Python. In *10th International Conference on Probabilistic Graphical Models*, volume 138 of *Proceedings of Machine Learning Research*, pages 609–612, Skørping, Denmark, September 2020.

[6] Nassim Nicholas Taleb. *Skin in the game: Hidden asymmetries in daily life*. Random House, 2018.

Current IBF practices, lacking in addressing **uncertainty**, **diverse views**, and **transparency**, miss the **'skin in the game'[6]**.

Integrating **Bayesian Networks** with **GPT-4V/ChatGPT** could enhance **IBF**.

Scan the QR Code for supporting materials
@ GitHub Repository:
icpac-igad/bn-ibf
For Comments & Queries:
icpac-igad/bn-ibf/issues