Causality, prediction and improvements that (don’t) add up

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Significance of option combinations on TREC5

[Armstrong et al. 2009]
Ferro & Silvello 2016: A General Linear Mixed Models Approach to Study System Component Effects

- ANOVA analysis of the effect of different factors on system performance
- Biggest variance due to topics
- Remaining error still large
- → suitability of linear model?
Current machine learning approaches
Causal Inference Networks

Miasma, Poverty, etc.

Water Company → Water Purity → Cholera

Smoking Gene

Smoking → Tar → Cancer
Pearl's Causal Inference Engine

**Background**
- Knowledge

**Inputs**
- Assumptions
- Query
- Data

**"Inference Engine"**
- Causal model
- Can the query be answered?
- Statistical estimation

**Outputs**
- Testable implications
- Return to boxes 2 and 3
- Estimand (Recipe for answering the query)
- Estimate (Answer to query)

Performance Prediction
Towards Causal Networks for IR

Document Term Weighting
  - stemming
  - DTW quality
  - QTW quality

Query Term Weighting
  - IR model
    - performance
      - topic difficulty
        - topic
      - perceived quality
        - user standpoint
Conclusion

- We are lacking a multi-stage model of performance
- We have no clue how methods interact
- Effect of collections (Documents x Queries) unexplored
- Causal inference modeling might be a way to address these issues