

# Evaluating Causal Inference Techniques Using the g-formula in Two Different Implementations

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## 1 Research Questions of Interest

In the realm of observational data, causal inference is frequently used to identify causal relationships. The goal is to effectively simulate a randomized trial experiment retroactively. The most widely used method for doing this is through using the g-formula, which parametrically estimates an average casual effect. This method depends on finding parametric models, which are marginal distributions of covariates in the data which can be empirically estimated. Subsequently, a Monte Carlo simulation is used on the estimated parameters so estimates of the causal effects can be measured.

The goal of the thesis is to implement a sequential version of the g-formula as a proof of concept. This has yet to be done in a sophisticated manner and will hopefully be scalable for wider research. In order to prove its efficacy, it will be applied to a dataset of interest, likely something of the epidemiological sort. The two implementations of the g-formula will be compared on this dataset and hopefully conclusions will be drawn. The biggest questions are whether implementation of this version of the g-formula is possible, whether it will be successful, and if it's more efficient than the existing implementation such that it could be scalable to large data sets.

I will be advised by Dave Harrington and Miguel Hernan (and perhaps Jamie Robbins in a less official capacity).

## 2 Outline

- November 10: Literature review and developing a deep understanding of causal inference and g-formulas. This will include building out why causal inference is of interest, the intuition behind both implementations of the g-formula, and outlining the limitations and assumptions of these methods. This part of the process may take longer than just November, but will at least be a significant start.
- End of 2016/early 2017: Hopefully, I will have the implementation of the formula almost complete. I will be using python to do this.
- January 2017: Do analysis of a dataset using the two methods. Building out the two models and their likelihood models will likely take quite a bit of time so I want to leave room in here for this.

- February/March 2017: Wrapping everything up and explaining all of the analyses and how the implementations worked/differed/etc.

## References

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