DAG LIFE

Casual Introduction to Causal Inference
with Directed Acyclical Graphs

Dogus Aktan

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Workshop Time and Location	Contact Information
To be determined	hayridogus.aktan@du.edu

1 Workshop Description and Objectives

> I didn't choose the thug life;
> the thug life chose me
>
> Tupac

This workshop aims to familiarize participants with some of the modern literature on causal inference in the observational social sciences. Primarily, the workshop is designed around understanding and using one type of causal graphs, DAGs. DAGs (Directed Acyclical Graphs) are qualitative visual models that are intuitive and easy to understand. Nevertheless they are powerful theoretical tools. They can be adopted easily by researchers of various stripes and be used to improve the quality of their research.

The workshop starts with a brief refresher on probability to bring all participants up to same speed. We then move on how to understand and build DAGs to understand problems like confounding, selection bias, and choice of control variables. Towards the end of the workshop, participants have time to discuss and work together to discuss how to use DAGs for their own research projects.

2 Required Text and Readings

The key readings for this workshops are:

Morgan, *Stephen L. Handbook of Causal Analysis for Social Research.* New York: Springer, 2013.

Pearl, Judea, Madelyn Glymour, and Nicholas P. Jewell. *Causal Inference in Statistics: A Primer.* John Wiley & Sons, 2016

Since we will only use a few chapters from each book, there is no need to buy them. Other supplementary readings will be listed in relevant sections and distributed by the instructor when necessary. The reading load is short, but the readings are dense, so we will take our time with the material.

3 Workshop Format and Policy

This workshop is aimed at the broader Korbel Research Community, with a particular focus on PhD students. Therefore, PhD students are expected to be regular, active participants and lead the discussions. Other members of the Korbel community are also more than welcome to their bring their own questions and substantive interests, but can do so on a non-committal basis. Nevertheless, regular attendance to all sessions is encouraged for all participants.

The workshop will meet weekly for six to eight weeks with one and a half hours sessions in Spring Quarter. We will start at second week of the Spring Quarter. There will be some brief lecturing -especially in the earlier sessions- in each session. However, methods are best learnt by doing and not listening or watching. So the primary goal of this workshop is to use our time together to answer questions, find applications, and discuss challenges.

4 Tentative Schedule

4.1 Why Care? Probability Basics

It's simple mathematics

Mos Def

We refresh the basics of probability theory and get a firm grasp on the necessary concepts such as conditional probability and Bayes' rule. This is probably as technical as we will get, but a good understanding of probability is essential for effectively using DAGs.

4.2 Basics of DAGs

I am the stone that the builder refused
I am the visual, the inspiration

Asheru

We start with the basics of graphs and familiarize ourselves with DAG terminology. We also draw graphs and discuss what they mean. The readings for this section are the most dense, but we will break them down in the following sessions.

Pearl et. al. Chapter 2

Chapter 13 in Handbook

4.3 Confounders & Colliders

Ain't nothin to it,
gangsta rap made me do it

Ice Cube

We talk about how confounders and colliders challenge analyses and how DAGs can help us differentiate between the two. Almost everyone is familiar with confounding but DAGs provide us some tools to eliminate common causes, so we will focus on them.

Cole, Stephen R, Robert W Platt, Enrique F Schisterman, Haitao Chu, Daniel Westreich, David Richardson, and Charles Poole. "Illustrating Bias Due to Conditioning on a Collider." *International Journal of Epidemiology 39*, no. 2 (April 2010): 417–20.

4.4 Selection Bias

> Ya see all I do is separate the game from the truth
>
> Biggie Smalls

We use DAGs to analyze and illustrate selection bias and overcome it. Similar to last session this topic is hardly new to anyone. But DAGs give us a good way to overcome a common challenge to inference in observational studies and forces us to think about data-generating processes.

Hafner-Burton, Emilie. 2005. "Trading Human Rights: How Preferential Trade Agreements Influence Government Repression." *International Organization 59* (3): 593-629

Spilker, Gabriele, and Tobias Böhmelt. 2013. "The Impact of Preferential Trade Agreements on Governmental Repression Revisited." *Review of International Organizations 8* (3): 343-361.

4.5 Mediation

> I bomb atomically, Socrates' philosophies
> And hypotheses can't define how I be droppin' these
>
> Inspectah Deck

A closer look at mediators and how conditioning on them can bias your research. In particular we look at how poor controls can bias our findings and how we can use DAGs to overcome post-treatment bias. DAGs help us visualize mediators and go from effects of causes to causes of effects.

Chapter 14 in Handbook.

Samii, Cyrus. "Causal Empiricism in Quantitative Research." *The Journal of Politics 78*, no. 3 (July 2016): 941–55..

4.6 Putting DAGs to Use

> Let a dog roam
> And he'll find his way home
>
> DMX

We put everything we have seen in action and draw DAGs for all the arguments in:

Chenoweth, Erica, and Maria J. Stephan. *Why Civil Resistance Works: The Strategic Logic of Nonviolent Conflict*. Paperback ed. Columbia Studies in Terrorism and Irregular Warfare. New York, NY: Columbia Univ. Press, 2013.

4.7 Bring Your Own Question Day

> No lie, just know I chose my own fate
> I drove by the fork in the road and went straight
>
> Jay Z

Bring your research question, working paper, or proposal draft. We see if we can draw DAGs for it.

4.8 Bonus Time

> I'm just glad we to the point, that we able to build
> If we could only stay able, maybe we will
>
> Lord Jamar

Bonus time in case a topic requires more time than one session. Or, if we want to repeat the exercises in the last 2 weeks.