# Time-Varying Exposures and Marginal Structural Models: Key Concepts Worksheet

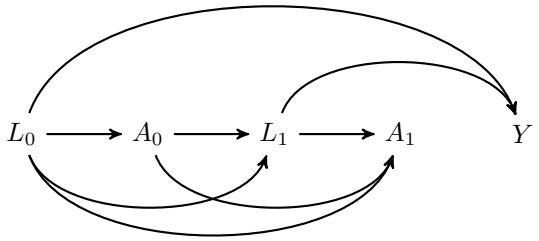
PHS 2000B: Lab 4

February 13, 2023

## Traditional Regression Methods

### Question 1:

In the DAG below, are these causal effects are identifiable using **traditional regression methods?** If yes, what model would you fit to estimate these effects?



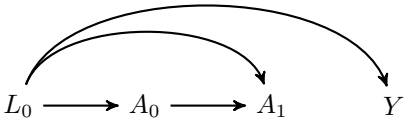

1. $E[Y^{a_0=1} - Y^{a_0=0}|L_0]$

2. $E[Y^{a_0=1,a_1=1} - Y^{a_0=0,a_1=0}|L_0]$

3. $E[Y^{a_1=1} - Y^{a_1=0}|L_0, A_0]$

### Question 2:

In the DAG below, are these causal effects are identifiable using **traditional regression methods?** If yes, what model would you fit to estimate these effects?




1. $E[Y^{a_0=1} - Y^{a_0=0}|L_0]$

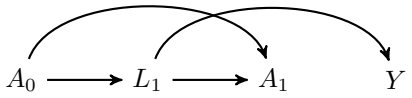
2. $E[Y^{a_0=1,a_1=1} - Y^{a_0=0,a_1=0}|L_0]$

3. $E[Y^{a_1=1} - Y^{a_1=0}|L_0, A_0]$

# Sequential exchangeability

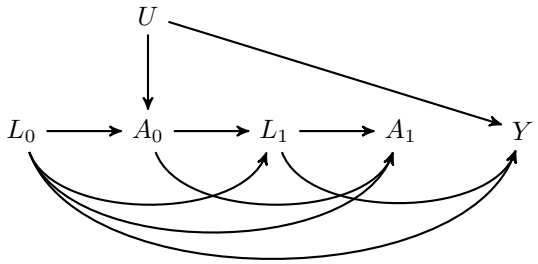
## Question 1:

Does sequential exchangeability hold in the DAG below? If yes, write out the independences involved.




## Question 2:

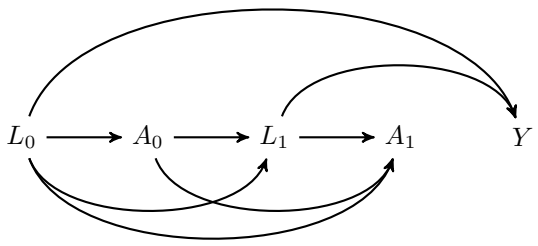
Does sequential exchangeability hold in the DAG below, where $U$ is an unmeasured variable? If yes, write out the independences involved.




# Building Marginal Structural Models

## Question 1:

Consider the DAG below. Write out the form that the marginal structural model should take under the following modeling assumptions.



1. What form should the MSM take if we assume no interaction between any variables on the DAG?

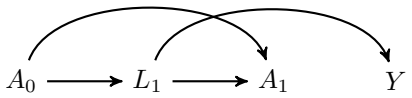
2. What form should the MSM take if we assume interaction between $A_0$ and $A_1$?

3. What form should the MSM take if we assume that baseline covariates interact with our exposures?

4. What form should the MSM take if we assume that the effect of exposure is cumulative over time, but that the timing of exposure does not matter?

## Question 2:

For the following questions, consider estimating the MSM $E[Y^{a_0,a_1}] = \beta_0 + \beta_1 a_0 + \beta_1 a_1$ based on the following DAG.




1. Define the **unstabilized** weights you should estimate to fit the MSM above. If you find it helpful, draw what the DAG will look like after weighting.

2. What models would you need to fit to estimate these unstabilized weights?

3. Define the **stabilized** weights you should estimate to fit the MSM above. If you find it helpful, draw what the DAG will look like after weighting.

4. What models would you need to fit to estimate these stabilized weights?