# Notes on Latent Variable Modeling

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## Introductory Notes

The Ideal experiment: a single independent variable is manipulated, and the consequences are observed in a single dependent variable.

Experiments in reality : the variables which are observed are typically not the one of real theoretical interest but are merely some convenient variables acting as proxies. A full analysis will turn out to be multivariate, with a number of alternative experimental manipulators on the one side, and a number of alternative response measures on the other.

There is a variety of statistical techniques for dealing with situations in which multiple variables, some of which unobserved, are involved. In [1] are discussed a variety of methods with the following common features:

( a ) multiple variables – three or more - are involved

( b ) one or more of these variables are unobserved i.e. *latent*

*Latent variable analysis*, discussed in [1], encompasses specific methods such as factor analysis, path analysis and structural equation modeling applied to (a) and (b).

### Path Models in Factor, Path, and Structural Equation Analysis

#### Path Diagrams

*Path diagram* is a representation of the relationships among a number of variables. We use capital letters to denote variables in such diagram. The connection among variables are represented in path diagrams by two kinds of arrows : a straight, directed arrow represents *a causal relationship* between two variables, while a curved bidirectional arrow represents *a correlation* between the variables which it connects.

Figure 1: example of a path diagram

Variables , , and are all assumed to have causal effects on . Variables and are assumed to be correlated with each other. Variable is assumed to affect but to be uncorrelated with either or .

What the diagram on Figure 1 might model?

Example: Modeling intelligence in single child family

would represent the child intelligence, and would represent father’s and mother’s intelligence which are assumed to have causal influence on child intelligence. The intelligence of the mother and father is correlated. represents the other variables, independent on the father and mother intelligence, which influence child’s intelligence.

## References

[1] [Latent Variable Models: Introduction to Factor Analysis and Structural Equation Analysis, John C. Loehlin, 2004](https://github.com/dimitarpg13/information_theory_and_statistical_mechanics/blob/main/literature/books/Latent_Variable_Models_Loehlin_2004.pdf)