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# INTRODUCTION

Blind Master Po: Close your eyes. What do you hear?

Young Kwai Chang Caine: I hear the water, I hear the birds.

Master Po: Do you hear your own heartbeat?

Kwai Chang Caine: No.

Master Po: Do you hear the grasshopper that is at your feet?

Kwai Chang Caine: Old man, how is it that you hear these things?

Master Po: Young man, how is it that you do not?
*Kung Fu,* Pilot

Economists' reputation for dismality is a bad rap. Economics is as exciting as any science can be: the world is our lab, and the many diverse people in it are our subjects.

The excitement in our work comes from the opportunity to learn about cause and effect in human affairs. The big questions of the day are *our* questions: Will loose monetary policy spark economic growth or just fan the fires of inflation? Iowa farmers and the Federal Reserve chair want to know. Will mandatory health insurance really make Americans healthier? Such policy kindling lights the fires of talk radio. We approach these questions coolly, however, armed not with passion but with data.

Economists' use of data to answer cause-and-effect questions constitutes the field of applied econometrics, known to students and masters alike as *'metrics*. The tools of the 'metrics trade are disciplined data analysis, paired with the machinery of statistical inference. There is a mystical aspect to our work as well: we're after truth, but truth is not revealed in full, and the messages the data transmit require interpretation. In this spirit, we draw inspiration from the journey

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of Kwai Chang Caine, hero of the classic *Kung Fu* TV series. Caine, a mixed-race Shaolin monk, wanders in search of his U.S.-born half-brother in the nineteenth century American West. As he searches, Caine questions all he sees in human affairs, uncovering hidden relationships and deeper meanings. Like Caine's journey, the Way of 'Metrics is illuminated by questions.

## *Other Things Equal*

In a disturbing development you may have heard of, the proportion of American college students completing their degrees in a timely fashion has taken a sharp turn south. Politicians and policy analysts blame falling college graduation rates on a pernicious combination of tuition hikes and the large student loans many students use to finance their studies. Perhaps increased student borrowing derails some who would otherwise stay on track. The fact that the students most likely to drop out of school often shoulder large student loans would seem to substantiate this hypothesis.

You'd rather pay for school with inherited riches than borrowed money if you can. As we'll discuss in detail, however, education probably boosts earnings enough to make loan repayment bearable for most graduates. How then should we interpret the negative correlation between debt burden and college graduation rates? Does indebtedness *cause* debtors to drop out? The first question to ask in this context is who borrows the most. Students who borrow heavily typically come from middle and lower income families, since richer families have more savings. For many reasons, students from lower income families are less likely to complete a degree than those from higher income families, regardless of whether they've borrowed heavily. We should therefore be skeptical of claims that high debt burdens cause lower college completion rates when these claims are based solely on comparisons of completion rates between those with more or less debt. By virtue of the correlation between family background and college debt, the contrast in graduation rates between those with and without student loans is not an *other things equal* comparison.

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As college students majoring in economics, we first learned the *other things equal* idea by its Latin name, *ceteris paribus*. Comparisons made under *ceteris paribus* conditions have a causal interpretation. Imagine two students identical in every way, so their families have the same financial resources and their parents are similarly educated. One of these virtual twins finances college by borrowing and the other from savings. Because they are otherwise equal in every way (their grandmother has treated both to a small nest egg), differences in their educational attainment can be attributed to the fact that only one has borrowed. To this day, we wonder why so many economics students first encounter this central idea in Latin; maybe it's a conspiracy to keep them from thinking about it. Because, as this hypothetical comparison suggests, real *other things equal* comparisons are hard to engineer, some would even say *impossibile* (that's Italian not Latin, but at least people still speak it).

Hard to engineer, maybe, but not necessarily impossible. The 'metrics craft uses data to get to *other things equal* in spite of the obstacles—called selection bias or omitted variables bias—found on the path running from raw numbers to reliable causal knowledge. The path to causal understanding is rough and shadowed as it snakes around the boulders of selection bias. And yet, masters of 'metrics walk this path with confidence as well as humility, successfully linking cause and effect.

Our first line of attack on the causality problem is a randomized experiment, often called a randomized trial. In a randomized trial, researchers change the causal variables of interest (say, the availability of college financial aid) for a group selected using something like a coin toss. By changing circumstances randomly, we make it highly likely that the variable of interest is unrelated to the many other factors determining the outcomes we mean to study. Random assignment isn't the same as holding everything else fixed, but it has the same effect. Random manipulation makes *other things equal* hold on average across the groups that did and did not experience manipulation. As we explain in Chapter 1, "on average" is usually good enough.

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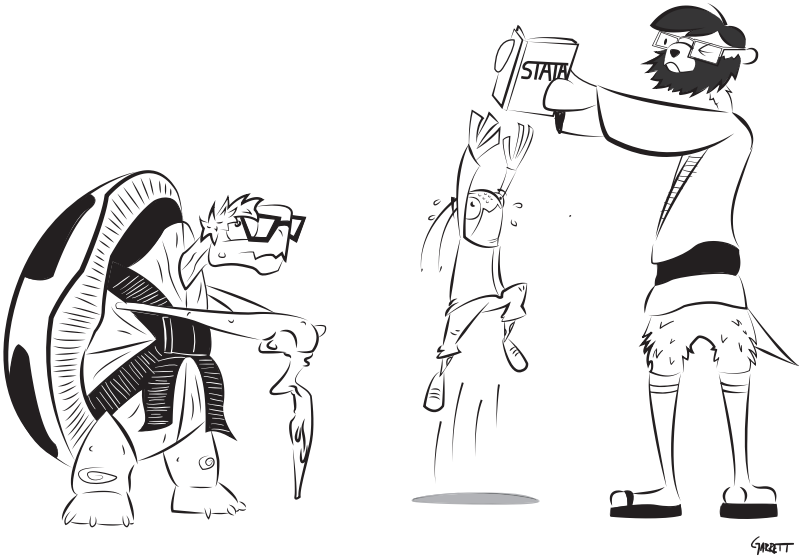


Randomized trials take pride of place in our 'metrics toolkit. Alas, randomized social experiments are expensive to field and may be slow to bear fruit, while research funds are scarce and life is short. Often, therefore, masters of 'metrics turn to less powerful but more accessible research designs. Even when we can't practicably randomize, however, we still dream of the trials we'd like to do. The notion of an ideal experiment disciplines our approach to econometric research. *Mastering 'Metrics* shows how wise application of our five favorite econometric tools brings us as close as possible to the causality-revealing power of a real experiment.

Our favorite econometric tools are illustrated here through a series of well-crafted and important econometric studies. Vetted by Grand Master Oogway of *Kung Fu Panda*'s Jade Palace, these investigations of causal effects are distinguished by their awesomeness. The methods they use—random assignment, regression, instrumental variables, regression discontinuity designs, and differences-in-differences—are the Furious Five of econometric research. For starters, moti-

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vated by the contemporary American debate over health care, the first chapter describes two social experiments that reveal whether, as many policymakers believe, health insurance indeed helps those who have it stay healthy. Chapters 2–5 put our other tools to work, crafting answers to important questions ranging from the benefits of attending private colleges and selective high schools to the costs of teen drinking and the effects of central bank injections of liquidity.

Our final chapter puts the Furious Five to the test by returning to the education arena. On average, college graduates earn about twice as much as high school graduates, an earnings gap that only seems to be growing. Chapter 6 asks whether this gap is evidence of a large causal return to schooling or merely a reflection of the many other advantages those with more education might have (such as more educated parents). Can the relationship between schooling and earnings ever be evaluated on a *ceteris paribus* basis, or must the boulders of selection bias forever block our way? The challenge of quantifying the causal link between schooling and earnings provides a gripping test match for 'metrics tools and the masters who wield them.

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