

A CLINICIAN'S GUIDE TO

# Statistics and Epidemiology in Mental Health

MEASURING  
TRUTH AND  
UNCERTAINTY



**S. NASSIR GHAEMI**

CAMBRIDGE  
Medicine

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# A Clinician's Guide to Statistics and Epidemiology in Mental Health

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# **A Clinician's Guide to Statistics and Epidemiology in Mental Health**

Measuring Truth and  
Uncertainty

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To my father, Kamal Ghaemi MD  
and my mother, Guity Kamali Ghaemi





Errors in judgment must occur in the practice of an art which consists largely of balancing probabilities.

William Osler (Osler, 1932; p. 38)

The genius of statistics, as Laplace defined it, was that it did not ignore errors; it quantified them.

(Menand, 2001; p. 182)



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# Preface

Medicine without statistics is quackery; statistics without medicine is numerology. Perhaps this is the main reason why clinicians should care about statistics.

Statistics in medicine began in the early nineteenth century (it was called “the numerical method” then) and its debut involved disproving the most common and widely accepted medical treatment for millennia: bleeding. From ancient Rome until 1900, all physicians – from Galen to Avicenna to Benjamin Rush – strongly and clearly advocated bleeding as the treatment for most medical illnesses. This was based on a theory, most clearly defined by Galen: four humors in the body, if out of balance, led to disease; bleeding rebalanced the humors.

Of course this was all wrong. Even the dumbest physician today would know better. How was it disproven?

Statistics.

Pierre Louis, the founder of the numerical method, counted 40 patients with pneumonia treated with bleeding and showed that the more they were treated, the sooner they died. Bleeding did not treat pneumonia, it worsened it (Louis, 1835).

Counting – that was the essence of the numerical method; and it remains the essence of statistics. If you can count, you can understand statistics. And if you can’t (or won’t) count, you should not treat patients.

Simply counting patients showed that the vaunted experience of the great medical geniuses of the past was all for naught. And if Galen and Avicenna could be mistaken, so can you.

The essence of the need for medical statistics is that you cannot count on your own experience, you cannot believe your eyes, you cannot simply practice medicine based on what you think you observe. If you do this, you are practicing pre-nineteenth century, prescientific, prestatistical medicine.

The bleeding of today, in other words, could well be the Prozac or the psychotherapy that so many of us mental health clinicians prescribe. We should not do things just because everyone else is doing it, or because our teachers told us so. In medicine, the life and death of our patients hang in the balance; we need better reasons for preserving life, or causing death, than simply opinion: we need facts, science ... statistics.

Clinicians need statistics, then, to practice scientifically and ethically. The problem is that many, if not most, doctors and clinicians, though trained in biology and anatomy, fear numbers; mathematics is foreign to them, statistics alien.

There is no way around it though; without counting, medicine is not scientific. So how can we get around this fear and begin to teach statistics to clinicians?

I find that clinicians whom I meet in the course of lectures, primarily about psychopharmacology, crave this kind of framing of how to read and analyze research studies. Residents and students also are rarely and only minimally exposed to such ideas in training, and, in the course of journal club experiences, I find that they clearly benefit from a systematic exposition of how to assess evidence. Many of the confusing interpretations heard by clinicians are due to their own inability to critically read the literature. They are aware of this fact, but are unable to understand standard statistical texts. They need a book that simply describes what

they need to know and is directly relevant to their clinical interests. I have not found such a book that I could recommend to them.

So I decided to write it.

A final preliminary comment, aimed more at statisticians than clinicians. This book does not seek to teach you how to *do* statistics (though the Appendix provides some instruction on conducting regression analysis); it seeks to teach you how to *understand* statistics. It is for the clinician or researcher who wants to understand what he or she is doing or seeing; not for a statistician who wants to run a specific test. There are no discussions of parametric versus non-parametric tests here; plenty of textbooks written by statisticians exist for that purpose. This is a book *by* a clinical researcher in psychiatry *for* clinicians and researchers in the mental health professions. It is not written for statisticians, many of whom will, I expect, find it unsatisfying. Matters of professional territoriality are hard to avoid. I suppose I might feel the same if a statistician tried to write a book about bipolar disorder. I am sure I have certain facts wrong, and that some misinterpretations of detail exist. But it cannot be helped, when one deals with matters that are interdisciplinary; some discipline or another will feel out of sorts. I believe, however, that the large conceptual structure of the book is sound, and that most of its ideas are reasonably defensible. So, I hope statisticians do not look at this book, see it as superficial or incomplete, and then simply dismiss it. They are not the ones who need to read it. And I hope that clinicians will take a look, despite their aversion to statistics, and realize that this was written for them.

# Acknowledgements

This book reflects how I have integrated what I learned in the course of Master of Public Health (MPH) coursework in the Clinical Effectiveness Program at the Harvard School of Public Health. Before I entered that program in 2002, I had been a psychiatric researcher for almost a decade. When I left that program in 2004, I was completely changed. I had gone into the program thinking I would gain technical knowledge that would help me manipulate numbers; and I did. But more importantly, I learned how to understand, conceptually, what the numbers meant. I became a much better researcher, and a better teacher, and a better peer reviewer, I think. I look back on my pre-MPH days as an era of amateur research almost. My two main teachers in the Clinical Effectiveness Program, guides for hundreds of researchers that have gone through their doors for decades, were the epidemiologist Francis Cook and the statistician John Orav. Of course they cannot be held responsible for any specific content in this book, which reflects my own, sometimes contrarian, and certainly at times mistaken, views. Where I am wrong, I take full responsibility; where correct, they deserve the credit for putting me on a new and previously unknown path. Of them Emerson's words hold true: a teacher never knows where his influence ends; it can stretch on to eternity.

I would not have been able to take that MPH course of study without the support of a Research Career Development Award (K-23 grant: MH-64189) from the National Institute of Mental Health. Those awards are designed for young researchers, and include a teaching component which is meant to advance the formal research skills of the recipient. This concept certainly applied well to me, and I hope that this book can be seen in part as the product of taxpayer funds well spent.

Through many lectures, I expressed my enthusiasm to share my new insights about research and statistics, a process of give and take with experienced and intelligent clinicians which led to this book. My friend Jacob Katzow, perhaps the longest continual psychopharmacologist in clinical practice in Washington DC, consistently encouraged me to seek to bridge this clinician/researcher divide and helped me to keep talking the language of clinicians, even when describing the concepts of statisticians. Federico Soldani, who worked with me as a research fellow before pursuing a PhD in public health at Harvard, helped me greatly in our constant discussion and study of research methodologies in psychiatry. Frederick K. Goodwin, always a mentor to me, also has continually encouraged this part of my academic work, as has Ross Baldessarini. With a secondary appointment on the faculty of the Emory School of Public Health in recent years, I made the friendship of Howard Kushner, who also helped mature some of my epidemiological and public health-oriented thinking. Among psychiatric colleagues who share my passion on this topic, Franco Benazzi read an early draft, and Eric Smith provided important comments that I incorporated in Chapters 4–6. Richard Marley at Cambridge University Press first suggested this project to me, persisted in his request even after I expressed reservations, tolerated my passive-aggressive tardiness in the face of a daunting task, and, in the end, accepted the only end result I could produce, not a straightforward text, but a critique. Not all editors and publishers would be so patient and flexible.

My family continues to tolerate the unique gift, and danger, of the life of the academic: even when at home, ideas still roam around in one's mind, and there is no end to the potential effort of reading and writing. They set the limits, and provide the rewards, that I need.





**Section 1**  
**Chapter**

**1**

# Basic concepts

## Why data never speak for themselves

Science teaches us to doubt, and in ignorance, to refrain.

Claude Bernard (Silverman, 1998; p. 1)

The beginning of wisdom is to recognize our own ignorance. We mental health clinicians need to start by acknowledging that we are ignorant; we do not know what to do; if we did, we would not need to read anything, much less this book – we could then just treat our patients with the infallible knowledge that we already possess. Although there are dogmatists (and many of them) of this variety – who think that they can be good mental health professionals by simply applying the truths of, say, Freud (or Prozac) to all – this book is addressed to those who know that they do not know, or who at least want to know more.

When faced with persons with mental illnesses, we clinicians need to first determine what their problems are, and then what kinds of treatments to give them. In both cases, in particular the matter of treatment, we need to turn somewhere for guidance: how should we treat patients?

We no longer live in the era of Galen: pointing to the opinions of a wise man is insufficient (though many still do this). Many have accepted that we should turn to science; some kind of empirical research should guide us.

If we accept this view – that science is our guide – then the first question is how are we to understand science?

### Science is not simple

This book would be unnecessary if science was simple. I would like to disabuse the reader of any simple notion of science, specifically “positivism”: the view that science consists of positive facts, piled on each other one after another, each of which represents an absolute truth, or an independent reality, our business being simply to discover those truths or realities.

This is simply not the case. Science is much more complex.

For the past century scientists and philosophers have debated this matter, and it comes down to this: facts cannot be separated from theories; science involves deduction, and not just induction. In this way, no facts are observed without a preceding hypothesis. Sometimes, the hypothesis is not even fully formulated or even conscious; I may have a number of assumptions that direct me to look at certain facts. It is in this sense that philosophers say that facts are “theory-laden”; between fact and theory no sharp line can be drawn.

### How statistics came to be

A broad outline of how statistics came to be is as follows (Salsburg, 2001): Statistics were developed in the eighteenth century because scientists and mathematicians began to recognize the inherent role of uncertainty in all scientific work. In physics and astronomy, for