Erich L. Lehmann

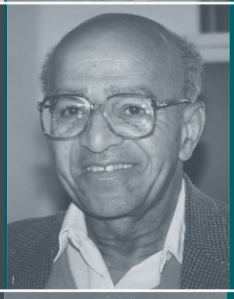
Reminiscences of a Statistician

THE COMPANY I KEPT

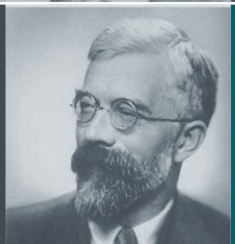
Springer

Erich L. Lehmann

Reminiscences of a Statistician



THE COMPANY I KEPT



Springer

Reminiscences of a Statistician

Reminiscences of a Statistician

The Company I Kept

E.L. Lehmann

Springer

E.L. Lehmann
University of California,
Berkeley, CA 94704-2864
USA

ISBN-13: 978-0-387-71596-4 e-ISBN-13: 978-0-387-71597-1

Library of Congress Control Number: 2007924716

Printed on acid-free paper.

9 8 7 6 5 4 3 2 1

springer.com

To our grandchildren

Joanna, Emily, Paul
Jacob and Celia
Gabe and Tavi
and great-granddaughter Audrey

Preface

It has been my good fortune to meet and get to know many remarkable people, mostly statisticians and mathematicians, and to derive much pleasure and benefit from these contacts. They were teachers, colleagues and students, and the following pages sketch their careers and our interactions. Also included are a few persons with whom I had little or no direct contact but whose ideas had a decisive influence on my work. To provide some coherence, the account is largely chronological and follows the steps of my own career.

Taken together, these sketches provide a very personal picture of the development of statistical theory from the 1930s to the 1970s. It is the period between two revolutions: that of Fisher, Neyman, and Pearson, which laid the foundations for the classical statistical theory of that period; and the second revolution, forty years later, brought about by the advent of the computer, which turned statistics in new directions.

The present account of this history is a highly selective one, which emphasizes the persons, institutions, and statistical topics that were close to my interests. One narrowing effect of this perspective stems from the fact that my career took place in the United States. As a consequence, the book focuses on American statisticians and institutions. Only the last two chapters discuss, briefly and very incompletely, developments in some other countries.

For writing these reminiscences, I did not have to rely entirely on my memory. There is much published material on many of the persons covered here, such as biographical sketches in Festschrifts and collected works, and—unfortunately—obituaries and memorial articles. Of particular value were the "Conversations," which are a regular feature of *Statistical Science,* and which provide firsthand accounts of the subjects being interviewed. An indispensable source for the Berkeley chapters was Constance Reid's book, *Neyman—from Life*.

In addition, I sent copies of their sections to all living subjects, asking them for corrections and criticism, and I am most grateful for their helpful responses. At my request, most of them also sent me pictures of themselves, which form an important part of the book. Other pictures were provided

by Steve Stigler (of Raj Bahadur and Jimmie Savage), and David Brillinger (of John Tukey).

Nearly 20 pictures were put at my disposal by Ingram Olkin from the extensive collection he has assembled at Stanford; another dozen I owe to the courtesy of the archives of the Mathematische Forschungsinstitut Oberwolfach, and still others to the archives of St. Andrews University. An important source for many pictures was the Berkeley Statistics Department, and four pictures came from Reid's book, *Neyman—from Life*. To all of these I extend my thanks. For preparing the pictures for publication, the help of Julie and Tamya Shaffer was invaluable.

I also want to thank Martina Schneider for helpful correspondence concerning the section on van der Waerden; to my editor, John Kimmel, for his encouragement and support; and to Agnes Herzberg for reviewing the book for Springer, and for many corrections and suggestions. To Len Shaffer, I am grateful for his typing of the manuscript from my hard-to-read handwritten version and for correcting many errors.

To conclude these acknowledgments, I want to express my deep gratitude to Persi Diaconis and Julie Shaffer, with both of whom I discussed the project as it went along, and who gave me advice and criticism when I needed it. They also read the manuscript after its completion, corrected many errors of fact, and greatly improved the exposition. To them I owe my greatest debt.

Contents

1
Mathematical Preparation

The crucial event of my early life was the coming to power in 1933 of the Nazis in Germany. This changed my future in two fundamental ways. As an immediate consequence, we left Germany (where my family had lived for many generations), and—after five years in Switzerland and two in England—I moved to America. On January 1, 1941, I arrived in Berkeley, California, where I have lived for the last sixty-six years.

The other basic change concerned not where I was going to live but what profession I was going to follow. My love as a teenager was German literature and, had we remained in Germany, I would have expected to become a professor of literature (or perhaps a writer). Since these were not promising professions outside of Germany, instead I became a mathematician and later a statistician.

Instrumental in both these changes was my father, who had the foresight to make the difficult decision to leave Germany quite early and who persuaded me that mathematics (for which I had shown some affinity) offered much better prospects than German literature because of its international nature.

From the start, the atmosphere in Berkeley was much more encouraging than it had been in Switzerland and England, where I had felt like a foreigner who would never be fully accepted. In Berkeley, on the contrary, I immediately felt at home. In addition, the way the study of mathematics was organized was much more congenial to me than it had been in England. Within a year, it seemed as if an academic career in mathematics was a realistic possibility.

1. Edmund Landau (1877–1938)

My interest in mathematics originated not at school, where the early courses in the subject seemed boring and my performance was mediocre, but rather from my reading a book, *Der Wettlauf mit der Schildkröte* (*The Race with the Tortoise*), by Th. Wolff. It was given to me by my uncle Alfred Schuster when I was thirteen. The title chapter discusses Zeno's paradox about Achilles and the tortoise, which claims to prove that the fast runner can never catch up

with the tortoise, who has been given a start on him. I found this intriguing, but what really captured my interest was the material on prime numbers.

It presented Euclid's proof of the infinity of primes and followed it with a section titled, "The Law of Prime Numbers," in which the question is posed of whether they follow some regular pattern. It mentions that the gaps between prime numbers tend to become larger as the numbers increase, but also that nevertheless from time to time prime twins continue to appear, such as (5, 7), (17, 19), and (101, 103). What was particularly fascinating was that at that time (the book was published in 1929), as is still true today, it was not known whether there exists an infinite number of prime twins.

If the impulse for mathematics is the desire to bring order into chaos, the prime numbers provide an ideal prototype because they combine extreme simplicity with behavior that is quite chaotic despite their obviously deterministic character. Today, we know much about their properties statistically—for example, they tend to get rarer and we know at what rate—but their local behavior is still completely unpredictable. To find a pattern in the sequence of primes became a great interest for me over the next few years, and I spent much time looking, calculating, and speculating. Two years later, as a high school sophomore, I was rewarded with what seemed a surprising discovery. It appeared that for any positive integer a and any prime number p, if you raise a to the p^{th} power and subtract a, the difference $a^p - a$ is always divisible by p.

On a vacation a few weeks later, it turned out that we were staying at the same hotel as Matthias Landau, the son of the famous number theorist Edmund Landau, whose wife had been one of my mother's closest girlhood friends. I mentioned my curious result to him, but he did not believe it, and bet me a chocolate bar that he would disprove it by the end of the day. He lost the bet but continued his efforts for another two days. He then decided to write to his father about the matter. The reply came that the result was well known as Fermat's little theorem, and that Landau would send me a proof.

In due time, his letter arrived. One would have expected it to start with an explanation—that he had heard from his son, etc., etc.—but explanations were not Landau's way. *"Sehr geehrter Herr Lehmann,"* the letter began (I was sixteen at the time), "all letters denote integers, p a prime number, x/y means x is a divisor of y," and after more notation came Theorem 1 and its proof and then Theorem 2 (Fermat), which was my result, and its proof. After this, the letter concluded: "With best regards, *unbekannterweise* [i.e., "without our having met"], E. Landau."

I did not understand one step in the proof, and in my thank-you letter I had the temerity to ask whether it did not contain a gap. By return mail came a postcard with his patient reply: "Thank you for your letter! There is no gap in the proof," followed by a slight elaboration on the point in question.

Later that year, my father asked me what I wanted to study after completing high school. The answer was obvious: My passion was German literature, my dream to become a writer, perhaps another Thomas Mann or Gottfried Keller. However, my father pointed out that Germany was barred to me (this was in 1935, two years after the Nazis had taken over Germany, and we were living in Zürich at the time), and that opportunities for German literature were extremely limited in Switzerland. He suggested that mathematics, for which I also seemed to have an affinity, was much more international in character and would provide much better career possibilities. I was used to taking directions from him and, without much inner turmoil, agreed to his suggestion. Thus, the crucial decision regarding the work in which I would spend my life came from the outside, rather than from within me. However, at this point it seemed a good idea to my father to get Landau's opinion regarding my aptitude for the subject. Because of my mother's friendship with his wife, it was not difficult for my parents to ask Landau to do this as a personal favor.

Accordingly, the next time he passed through Zürich, Landau came to our house to have a talk with me. His first words as I opened the door were: *"Machen Sie Ihre Eltern unschädlich!"* (Render your parents harmless; get them out of the way!) Next he asked me for some sheets of paper, as large as possible (the best I could produce were still not considered satisfactory but had to do). Then he withdrew with me to my room and told me about some recent results of a young Hungarian mathematician, Paul Erdös, of whom he thought very highly.