On the Life and Work of David Blackwell

Basically, I am not interested in doing research. I am interested in understanding, which is quite a different thing.
-David H. Blackwell

by

Jacqueline M. Hughes-Oliver

North Carolina State University

2021 Blackwell-Tapia Conference

David Blackwell was

a once in a lifetime

brilliant

off the charts

amazing

genius

in *"probability, game theory, information theory, Bayesian inference"*

David Blackwell 1919--2010

FOLLOW

GET MY OWN PROFILE

Professor of Statistics and Mathematics, University of California, Berkeley
Verified email at stat.berkeley.edu - Homepage

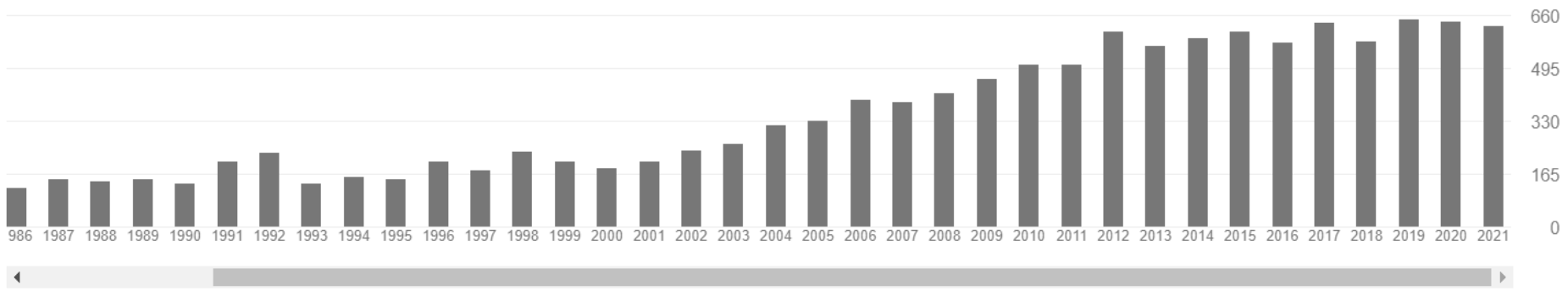
probability statistics logic game theory dynamic programming

84 papers
2 books
16853 citations

Cited by	All	Since 2016
Citations	16853	3717
h-index	41	23
i10-index	67	34

TITLE CITED BY YEAR

Citations per year



D Blackwell
The Annals of Mathematical Statistics 24 (2), 265-272

Comparison of experiments 1583 * 1951
D Blackwell
Second Berkeley Symposium on Mathematical Statistics and Probability 1, 93-102

84 Papers, 2 Books

You don't need to say a lot to SAY A LOT!

- Only 8 papers longer than 10 pages
- 23 papers have 3 or fewer pages
- Isolate and highlight main ideas
- Clarity!
- Brevity!
- A highly acclaimed teacher, who enjoyed teaching

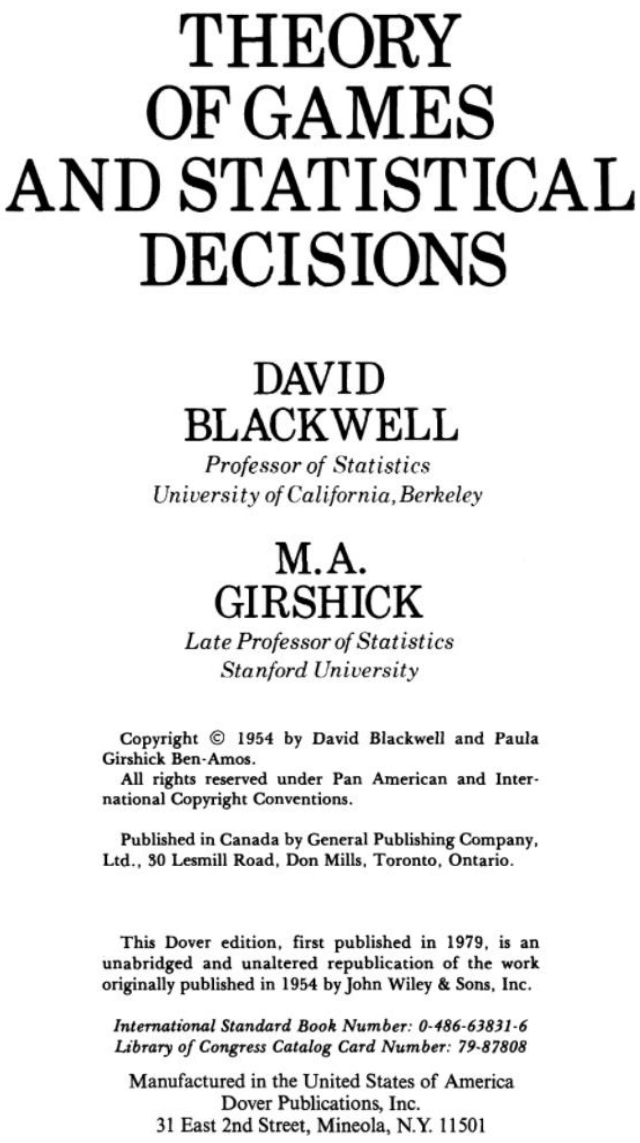
Thomas Ferguson, UCLA

- "He went from one area to another, and he'd write a fundamental paper in each"
- "He would come into a field that had been well studied and find something really new that was remarkable. That was his forte."

Peter Bickel, UC Berkeley

- "He had this great talent for making things appear simple"
- "He liked elegance and simplicity. That is the ultimate best thing in mathematics, if you have an insight that something seemingly complicated is really simple, but simple after the fact."

His most cited work, so far …



THEORY
OF GAMES
AND STATISTICAL
DECISIONS

DAVID
BLACKWELL
Professor of Statistics
University of California, Berkeley

M. A.
GIRSHICK
Late Professor of Statistics
Stanford University

Published in Canada by General Publishing Company, Ltd., 30 Lesmill Road, Don Mills, Toronto, Ontario.

This Dover edition, first published in 1979, is an unabridged and unaltered republication of the work originally published in 1954 by John Wiley & Sons, Inc.

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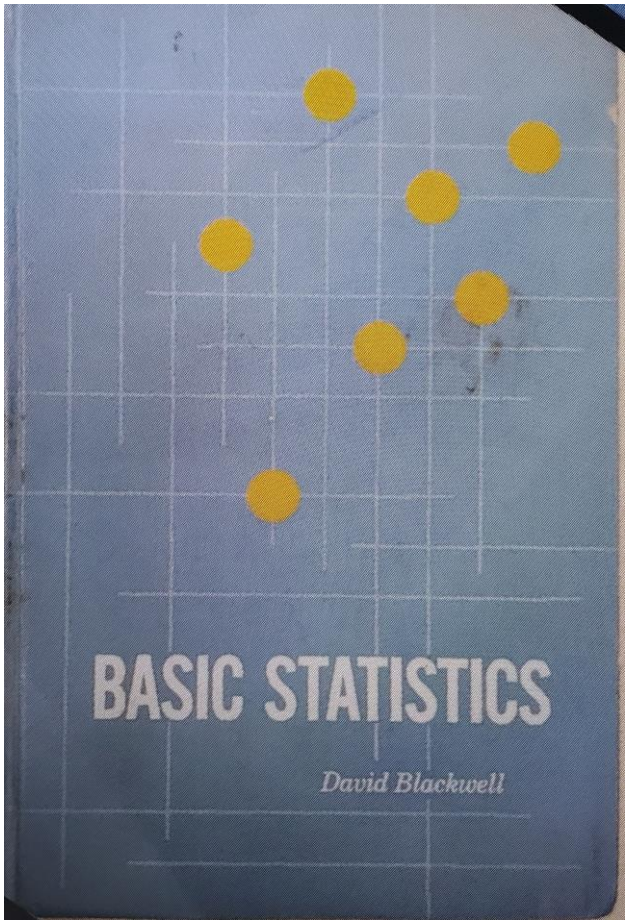
Library of Congress Catalog Card Number: 79-87808

Manufactured in the United States of America
Dover Publications, Inc.
31 East 2nd Street, Mineola, N.Y. 11501

- 40 citations in 2021
- "Evaluating statistical procedures through decision and game theory … is the goal of this problem-oriented text in mathematical statistics."
- "This comprehensive and sophisticated introduction remains one of the strongest and most useful approaches to a field which today touches areas as diverse as gambling and particle physics."
- Focus on optimal strategies for games
- Formulates statistical decisions as games
- Sequential games, minimax procedures



- 1969
- One of the first textbooks on Bayesian statistics
- "The mathematical level of the course is modest: Any student who can do arithmetic, substitute in simple formulas, plot points, and draw a smooth curve through plotted points is ready for the course."
- In his book review, M.H. DeGroot said "The book is indeed decision-theoretic and Bayesian, which distinguishes it from most other elementary statistics books … Beneath its deceptively simple appearance, the intellectual content of this book is at least as great as most books that are two or three times as long."

A Sampling of Paper Topics

- Comparison of Experiments
  - k-decision processes, 187 citations in 2021
- Dynamic Programming
  - Structure of optimal solutions, 99 citations in 2021
- Dirichlet Process Priors
  - Fundamental derivations, 77 citations in 2021
- Blackwell Renewal Theorem
- Markov Decision Processes & Blackwell Optimality
- Logic & Blackwell Games
- Rao-Blackwell Theorem
- Bayesian Sequential Analysis

Recognition

- 1st African-American Institute of Mathematical Statistics (IMS) Fellow
- 1st African-American president of IMS, 1956
- 1st African-American American Statistical Association Fellow, 1962
- 1st African-American elected member of Natl Academy of Sciences, 1965
- 1st African-American winner of von Neumann Theory Prize, 1979

- Elected to American Academy of Arts & Sciences, 1968
- VP of ASA (78), Intl Stat Inst (75-77), AMS (68-71)
- Holds at least 12 honorary doctorate of science degrees

- MAA-NAM Blackwell Lecture, created 1994
- Blackwell-Tapia Prize, created 2002
- National Medal of Science, posthumously awarded in 2014
- David Blackwell Hall, new UC Berkeley dorm, opened 2018

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genius

in *"probability, game theory, information theory, Bayesian inference"*

whose success was enabled by

Stability Support Expectation Advocates Opportunity

Primary source … David Blackwell, "An Oral History with David Blackwell," conducted by Nadine Wilmot in 2002 and 2003, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2003. (transcript)

CHILDHOOD …

Stability Support Expectation Advocates Opportunity

The Beginning

Grandfather: David S. Johnson
- was a schoolteacher
- then a storekeeper

Father: Grover Blackwell
- a railroad worker
- left school after 4th grade

Mother: Mabel Johnson Blackwell
- housewife
- left school after 2nd yr high school

David Harold Blackwell
born April 24, 1919
Centralia, Illinois

Siblings:
- *Johnson Wesley, railroad worker*
- *Joe, lawyer*
- *Elizabeth Louella, schoolteacher*

Growing up

Great Depression: 1929-1939

- "I had an uncle who could add numbers, three columns at a time, and that always impressed me. He never went to school at all; my grandfather taught him."
- "I never knew [my grandfather]. Apparently he was a well-educated man—he left a large library of books. The first algebra book I ever saw was in his library. I don't think he graduated from college [. . .] The reason that his son, my uncle, never went to school was that my grandfather never let him. He was afraid he would be mistreated because he was black."
- "But that was in Ohio, not in Illinois! Southern Illinois was probably fairly racist even when I was growing up there. The school I went to was integrated, but there was also a segregated white school in that same town. There were in fact two segregated schools, one that only blacks could attend and one that only whites could attend."
- "Many black families owned their own homes."

HIGH SCHOOL …

Stability Support Expectation Advocates Opportunity

High School

Great Depression: 1929-1939

- "I had always been pretty good at math and somewhat interested in it, but geometry really excited me."
  - Teacher was **Caroline Luther** … "She invited me to come and visit her a couple times after I was in college."
- Math Club teacher, **Raymond Huck**
  - "There was a mathematics magazine that was partly for high school mathematics students, and it had a problems section. Mr. Huck encouraged us to try to solve the problems there, and sometimes we did. I solved a couple of them, and Mr. Huck wrote up my solution and mailed it into the mathematics magazine. And a couple of times, my name appeared in the magazine and once even my solution—really Mr. Huck's write-up of my solution—appeared in the magazine. I was very pleased with that."
- "There was an English teacher, **Grace Seiler**, who encouraged me to go to college. In fact, she wanted me to go to her alma mater, which was DePauw University"

High School

Great Depression: 1929-1939

- "they had a general interest in the students, not just me particularly. They kept up with students after they left."
- "I had an absolutely fabulous high school education. When I went to college, I was a semester up on most of the college students there. There were things that they studied in college algebra I had already studied in high school. Things that they studied in freshman English I had already studied in high school. High school was harder for me than college!

- Every high school graduate was admitted to the University of Illinois
- State exam: top scorer in each county got a 4-year tuition scholarship

"There was never any doubt in my mind, I wanted to go to the University of Illinois, and I intended to go there."

COLLEGE & GRAD SCHOOL …

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University of Illinois

Great Depression: 1929-1939

- Started at age 16
- Arrived on campus with no place to stay
  - invited to stay at Alpha Phi Alpha house … all 6 years
- ~100 Black students of ~12000 total students

"I got much more help from students than from faculty in choosing courses and in learning things."

- Father took loans to cover books, living expenses – 1st yr
- Worked – after 1st yr
  - washed dishes, waited tables at Pi Beta Phi sorority
  - entomology lab, NYA (Roosevelt's Natl Youth Auth.)
  - odd jobs, e.g., with **Prof Crathorne** (calculus; probability)
- Crathorne introduced him to Jerzy Neyman in 1937

"I didn't appreciate it at the time. It was only when I look back on it that I realize how [Prof. Crathorne] helped me."

University of Illinois

Great Depression: 1929-1939

- BA in math 1938, age 19
- Still had a year of scholarship
  - Decided to keep studying
  - MA in math 1939, age 20
- During master's degree, applied for funding to complete the PhD

"there were two kinds of awards, fellowships and teaching assistantships. They paid the same amount of money, but for a fellowship you didn't have to do any teaching. So they were the preferred award. And there were maybe three fellowships and twenty teaching assistantships every year."

"One of the other graduate students told me that I was going to get one of the fellowships. I said, "How do you know that?" He said, "Well, you're good enough to be supported and they're not going to put you in a classroom!" Because I was black, of course.

He was right, sure enough I did get one of the three fellowships. And I'm sure that a partial consideration was "Well, we need to support this fellow, and we can't put him in a classroom, so let's give him a fellowship."

World War II: 1939-1945

University of Illinois

Great Depression: 1929-1939

- PhD advisor was **Joseph Doob**
  - PhD 1932, Harvard, analytic functions
  - Self taught in probability theory—helped lay foundations
- Dissertation title "Properties of Markov chains", 1941, age 22
- Joe Doob was going to the Institute for Advanced Study in Princeton 1941-1942. Paul Halmos & Warren Ambrose had finished and were going with him. So it was important to Joe Doob that David Blackwell should finish.

"That's, hurry up and finish your thesis, so I can go to the institute without worrying about you. And so, he not only pushed me to finish my thesis and approved it but [. . .] got a Rosenwald Fellowship for me so that I could go to the institute, also.

When I say, "He got it," I'd never heard of such things. He told me to apply for it. He got the necessary information, and he sort of suggested what I should say."

POST PHD …

Stability Support Expectation Advocates Opportunity

World War II: 1939-1945

The Institute: ’41-’42

- Continued work on dissertation topics
- Became interested in game theory … met **John von Neumann**
- Became mildly interested in statistics … lectures by **Sam Wilks**
- *“Again, as in my graduate days, I learned more from my contemporaries than I did from the higher-ups, so to speak.”*
- Met contemporary **Jimmie Savage**

- *“And I was just welcomed cordially along with everybody else. It was only much later that I found out that there had been all of this to-do.”*
  - Members of the Institute became honorary faculty at Princeton
  - **Frank Aydelotte** was Director, staunch supporter
  - President of Princeton objected, because of race
  - Several professors (**Oswald Veblen** and others) in the Institute threatened to disconnect the Institute from Princeton, so the president backed down

World War II: 1939-1945

Job search

- Wrote letters to all 105 black colleges, only
- Driving tour of ~30 black colleges on East Coast: Morgan, Howard, …
- Accepted 1st offer – from Southern University, Baton Rouge, LA
  - 1942 to 43, only taught elementary undergrad courses
  - After ~3 months at Office of Price Administration in DC
- Clark College, Atlanta, GA
  - 1943 to 44
  - Regional strength: Morehouse + Morris Brown + Atlanta Univ
  - Joint seminar
  - Graduate teaching
  - Met **Ann Madison**, wife-to-be
- West Virginia State College also made an offer

World War II: 1939-1945

Howard University: ’44-’54

- Interviewed by head of math department during ’41-’42 driving tour
  - Another man, not the head, was listening from his desk. After the head was done, this other man asked 1-2 questions.
  - Two years later, this other man became head and made an offer.
  - **Dudley Woodard**
    - Had previously been dean of the College of Letters and Sciences at Howard
    - At age 45 he quit to go earn PhD in math … 2nd AfrAm PhD in math, 1928 UPenn
    - Started a math library at Howard
    - Started a math seminar at Howard
- **Elbert Cox** was also there … 1st AfrAm PhD in math, 1925 Cornell
- Promoted to professor and head in 1947
  - Hired **William Claytor** … 3rd AfrAm PhD in math, 1933 UPenn

- *Married Ann Madison on December 27, 1944*
  - *Ann, Julia, David, Ruth, Grover, Vera, Hugo born while at Howard*
  - *Sara born in California*

World War II: 1939-1945

Howard University: '44-'54

"My interests were basically formed at that time, while I was at Howard."

- Consultant at Operations Research Office in DC
  - game theory, optimization theory
- Met **Abe Girshick** (USDA, PhD Columbia) at ASA DC Chapter meeting
  - Major influence to work in statistics
  - Wald's sequential analysis
  - Moved to Rand fulltime; Blackwell became consultant at Rand
  - While at Rand, **Jimmie Savage** influence Blackwell to be Bayesian
- Rao-Blackwell Theorem

"Three statisticians—Abe Girshick, Fred Mosteller, and Jimmie Savage—found a way to get an unbiased estimate from a sequential sample. But their formula was rather mysterious; people didn't understand it. They could prove that it worked; but it wasn't clear what was going on. So I was one of those who was trying to understand their estimate, trying to understand why it worked. And I was walking along one day and all at once, the idea popped into my mind that, It's a conditional expectation. That's what their estimate is."

World War II: 1939-1945

Howard University: '44-'54

- More on the Rao-Blackwell Theorem …

"that told people how to do unbiased estimation in sequential sampling, so people paid attention to it. But that's really all there was to it. I was just trying to understand their estimate and I was able to explain it."

"I probably did it in 1946; it was published in 1947. Now, two years before that, though, in 1945, [C.R.] Rao published his thesis. And the same result that I had was one of many results in his thesis."

"So, because in his thesis, the result was buried among several other results, people hadn't paid much attention to it, and I didn't know anything about it. But, when I rediscovered it, and used the rediscovery to explain the Girshick-Mosteller-Savage estimate, people paid attention to it."

"I don't remember what our first meeting was like. I do know, though, that he's not especially happy that my name is attached to the theorem. And he shouldn't be, because he has the priority by two years. It's just that somehow when I did it, it got publicity."

"there were maybe twenty citations in the first couple of years"

"I may never have cited that paper after that."

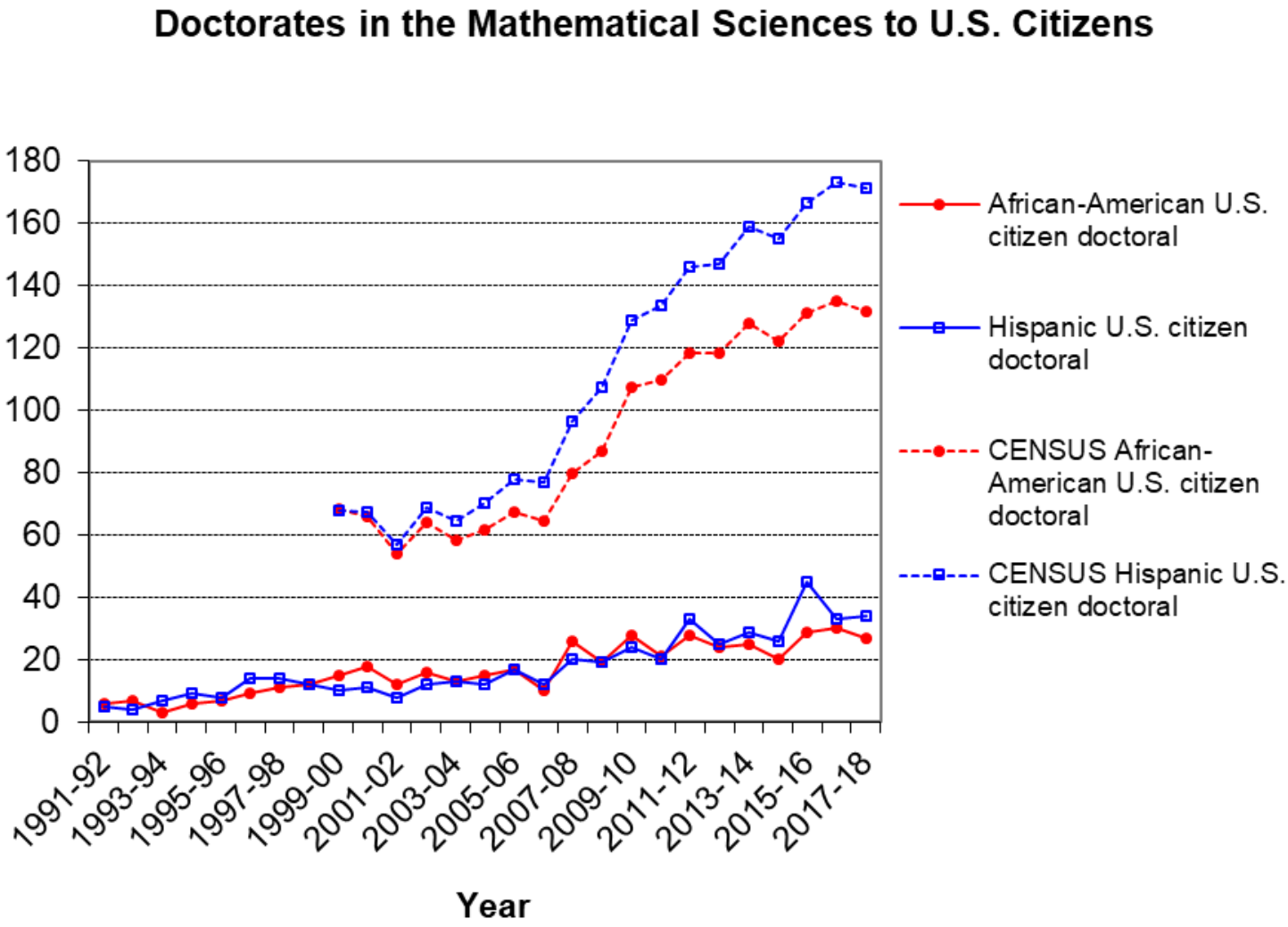
UC Berkeley: ’54-’88

- 1954, visiting professor
- 1955, Professor of Statistics
- 1957-61, Chair of Department of Statistics
- 1964-68, Assistant Dean
- 1st AfrAm tenured at Berkeley

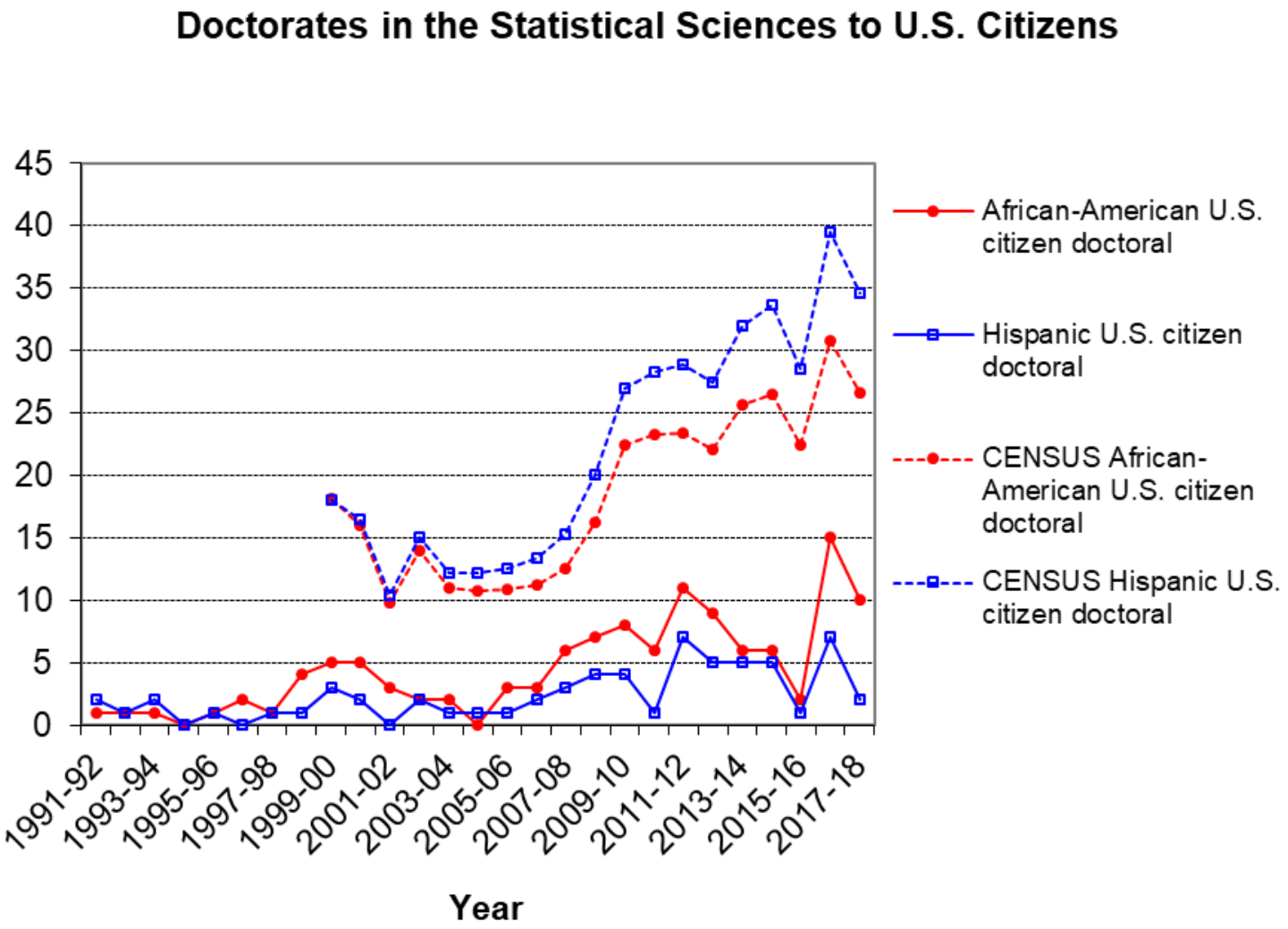
- 1942
  - Interviewed by **Jerzy Neyman**
  - Math department agreed to hire him
  - Wife of dept head *“would not have any darkies in her house”*

Diversity by the Numbers

Richard Tapia: "Racial equality cannot be achieved without educational equality"



Diversity by the Numbers



Lessons to be Learned

Success can be enabled by

Stability Support Expectation Advocates Opportunity

Anyone can play a critical role

Requires commitment, even in the face of pressure

Sources

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