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Data Science Conversation

Legendary Career and Colorful Life: A Conversation with Dr. Bob Riffenburgh

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Abstract

In 2022 the American Statistical Association established the Riffenburgh Award, which recognizes exceptional innovation in extending statistical methods across diverse fields. Simultaneously, the Department of Statistics at the University of Connecticut proudly commemorated six decades of excellence, having evolved into a preeminent hub for academic, industrial, and governmental statistical grooming. To honor this legacy, a captivating virtual dialogue was conducted with the department's visionary founder, Dr. Robert H. Riffenburgh, delving into his extraordinary career trajectory, profound insights into the statistical vocation, and heartfelt accounts from the faculty and students he personally nurtured. This multifaceted narrative documents the conversation with more detailed background information on each topic covered by the interview than what is presented in the video recording on YouTube.

Keywords *consulting; data science; education; government statistics; industrial statistics; statistical application*

1 Introduction

Dr. Robert H. Riffenburgh recently retired after a long, remarkably diverse, and profoundly impactful career. In 2022, the American Statistical Association (ASA) established an award in his honor, which "recognizes the transfer or extension of statistical methods developed for or used in one field of application into another where it has never or seldom been used" (American Statistical Association, 2022). Dr. Riffenburgh is the founding head of the Department of Statistics at the University of Connecticut (UConn), which celebrated its 60th anniversary in 2022. These two events prompted us to write this paper about Dr. Riffenburgh's career. We had the pleasure to hold an interview, which is available on YouTube (Bar and Yan, 2022). Due to the time limit, however, the video does not include sufficient details about the background of the questions and answers of the interview. Here we provide an edited, more detailed version, adding citations of references and remarks when appropriate. Additionally, we include some commentaries about Dr. Riffenburgh's professional career and his contributions, and also the impact he had on his students, the profession, and on UConn Department of Statistics. We consider this a new style of conversation articles with more flexibility than solely dialog-based articles.

Dr. Riffenburgh's legendary career traversed the realms of academia, industry, and government, painting an illustrious tapestry of influence. The journey commenced in 1955 while he still had two more years of doctoral studies with his appointment as an Assistant Professor of Mathematics at Virginia Tech. In 1957 he joined the University of Hawaii, where he stayed until

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1961. For a brief time, he worked in the private sector, as a Systems Analyst, at the Laboratory for Electronics Inc, Monterey, CA. The zenith of his academic odyssey unfolded between 1962 and 1970, where he served as Professor and the founding Head of the Department of Statistics at UConn. Concurrently, he established the General Systems Analysis Company and worked as its President and CEO. In 1970, he moved back to the West Coast and worked as an oceanometrician and Headed the Biomedical Program at the Naval Undersea Center. During this time, he also worked part-time as a biostatistician at the Naval Hospital San Diego.

A significant part of Dr. Riffenburgh's career was spent overseas. Between 1974 and 1977, he worked at a naval facility in Wales, UK, performing analyses and evaluation of the Navy systems. He returned to the US in 1977 and worked as project leader/line manager at the Naval Ocean Systems Center, San Diego until 1982. Between 1982 and 1990 he returned to Europe as a senior officer (A-5, U.S. equivalent O-6) for the North Atlantic Treaty Organization (NATO). He served as leader for the Naval Operations Analysis for NATO's Supreme Headquarters Allied Powers Europe (SHAPE) Technical Centre (The Hague, Holland, until 1986), and then headed naval operations research for Supreme Allied Commander Atlantic until 1990 at NATO's Centre for Maritime Research & Experimentation (La Spezia, Italy).

Dr. Riffenburgh continued research and teaching after returning to the US from Europe. From 1991 until 2019, Dr. Riffenburgh served as Chief of Biostatistics, Clinical Investigation Department, Naval Medical Center San Diego. From 1968 until his retirement in 2021, Dr. Riffenburgh worked much of the time as Professor or Adjunct Professor in the Department of Mathematics and Statistics at the San Diego State University (either part- or full-time). A full professional history of Dr. Riffenburgh is in Appendix A.

The outline of this article conversation is as follows. In Section 2 we start our conversation with Dr. Riffenburgh about his personal and professional history, starting from his childhood, through his early years as a statistician and as a young department head, to his professional experience in government and academia. In Section 3, we bring some of Dr. Riffenburgh's perspectives about a career as a statistician, how he views the past and future of the field, and his advice on work-life balance. In Section 4, we include some comments by former students and colleagues. Section 5 concludes with our own comments.

In the interview portion, we use abbreviated names, so that **BR**, **HB**, and **JY** stand for Dr. Riffenburgh, Haim Bar, and Jun Yan, respectively. At places in the conversation, we added brief annotations via Remark.

2 Chronography

Dr. Riffenburgh had a rather nontraditional career path, which included work in the private sector, as well as in government and academia. His professional career took him across the globe, and also under the sea. We asked Dr. Riffenburgh about the circumstances which led him to this path, and what he learned from each experience.

2.1 Childhood and College Years

HB: *You grew up in challenging times, first the Great Depression and then World War II. What are the memories that stand out the most from your early years?*

Remark: See Figure 1 of Dr. Riffenburgh as a child.

Figure 1: Dr. Riffenburgh in his childhood.

BR: My father was a chemistry professor at Virginia Tech. We lived on campus, so I was raised in academics. I remember his lab where I watched him do experiments. A field next to our house was used for agricultural experiments that were designed by the young statistician Boyd Harshbarger, so I was brought up in this world of scientific experiments. They were more real to me than they were to kids raised in the worlds of business or entertainment or service or whatever their parents were in. Science pretty much molded my early life. Well, that plus living in a village surrounded by forests and fields to roam. That world ended when cancer took my dad during my last year in high school. They sent me to live with my uncle in Colorado. He was an attorney, so that posed an entirely different environment.

Remark: Boyd Harshbarger was the founder of the Department of Statistics, Virginia Tech (Arnold, 2000).

HB: *Before you did your Ph.D. in statistics, you actually studied psychology, so what drew you to statistics?*
BR: The question, really, was what drew me from mathematics, statistics, and science into a period of psychology. I loved mathematics and science as a kid. I counted everything. I tallied data. I didn't know anything about statistics, but I just made tallies and looked at the frequency distributions to make decisions about things. I made decisions based on subjective probabilities. For example, "What's the probability that we'll make it to the next fuel station on a trip? Or should I stop at this one and get gasoline?" and things like this. I just made lots of minor decisions on probability estimates from the time I was little. I had no idea I was edging on statistics.

After going to Colorado for my last year in high school I started college at Colorado University with a state scholarship. This was 1948, right after the war, and CU was inundated with veterans studying on the GI Bill. Suddenly the nation had like ten million men that wanted to go to college. My two-person room in the dorm housed four people. We had to do most of our studying in bed and take rationed turns at a desk. That's just an example of how crowded it was. They got faculty members to volunteer to advise new students. Somebody from liberal arts got me. He had no idea about math or science and he gave me very bad advice. He put me in third-year algebra, although I had had only first-year in high school. I had never had second-year algebra, so you can imagine what happened. Suddenly this A student failed. I lost

my scholarship and became terrified of mathematics. And by extension sciences that, of course, all used mathematics. I migrated into a field where I didn't have to use much math for a few years. Later, as part of my requirements, I took an applied course in statistics and realized that I had been following statistical thinking since childhood.

In addition, I was becoming disenchanted with psychology. I just married my classmate, who was also in psychology, and she and I both got disgusted with what at that time was a lot of conjecture and innuendo rather than data-based science explaining psychological effects. So we both left the field. She went into art and music and I went into statistics. At the time Boyd Harshbarger had just started one of the earliest statistics departments in the country at Virginia Tech, my hometown. They knew me and would accept me, even though I was shy in math. So I went there and managed to get my Ph.D. in Statistics, minor in Mathematics. That was the story of my short-term adventure into psychology.

Remark: Dr. Riffenburgh got his Ph.D. from Virginia Polytechnic Institute and State University in 1957. His dissertation was titled "Linear Discriminant Analysis", later published in to parts as Riffenburgh and Clunies-Ross (1960) and Clunies-Ross and Riffenburgh (1960) with his thesis advisor Charles W. Clunies-Ross.

JY: *Did you ever come back to working on any psychological problems later on?*
BR: Yeah, I did. My wife got her masters in it and I designed a nine-variable linear regression for her thesis. And I did an invited paper for the Annals of the New York Academy of Science on psychological processes located in the brain (Riffenburgh, 1969a). And there were a few others.

Remark: Among Dr. Riffenburgh's contributions to applications of statistics in psychology, see, for example, Riffenburgh (1959) and Riffenburgh (1960).

2.2 Early Career

HB: *What was your first job after graduating with a Ph.D.?*
BR: At Virginia Tech, after I had made up my mathematical shortcomings, in my last two years of doctoral studies, I taught elementary mathematics as an assistant professor of math. Upon graduation, I accepted the same rank at the University of Hawaii, which sounded very romantic and adventurous. By then I had married and had two children. In Hawaii, we bought a sloop and became ocean sailors. Housing was very expensive, so I had to take a second job to afford one. I worked for the US Bureau of Commercial Fisheries on the side. It was seagoing work and I fell in love with the ocean. However, after some years my wife became tired of the claustrophobic island life. We got Thanksgiving television at Christmas and Christmas television for Valentine's Day, and so forth. Every time you went over a hill there was an ocean saying you can't go any further than this. And then there was, to be honest, a bit of discrimination against haoles, i.e. white people, with some limitations on where we were allowed to live and on some of the activities we were allowed to do. So my wife wanted to return to the mainland.

I found a job in Monterey, estimating the probabilities of collisions between rockets and satellites. They were just beginning to put satellites up around the earth and they wondered if rockets fired in testing or conflict would take out the satellites. We moved there and lived quite an idealistic life. I loved the place.

Remark: During this period Dr. Riffenburgh published his first (out of many to come) papers on environmental sciences. For example, see his paper on fish schooling (Brock and Riffenburgh, 1960), on which we will hear more about later in Section 3.

Figure 2: Dr. Riffenburgh during his time at UConn.

2.3 Founding Department Head of UConn Statistics

JY: *After several years ocean-side on the West Coast, you landed in Connecticut, to establish a new department of statistics. Tell us about that period in your life.*

Remark: See Figure 2 of Dr. Riffenburgh while he was Department Head of UConn Statistics.

BR: Yes, I got an offer I couldn't refuse, as a full professor to found the Statistics Department at the University of Connecticut. Well, that was a no-brainer. I was only thirty-one years old. So we moved again. I planned the offerings, hired faculty, recruited students, got approvals for master's and then doctorate programs, got assistantships and fellowships for our students, taught classes, published papers, established a faculty consulting service, secured a biostatistics grant, placed finishing students, and promoted the department as a marketing operation. I arranged a lecture series. We had many eminent statisticians visit: Frank Anscomb from Yale, C. R. Rao, P. C. Mahalanobis, M. G. Kendall, Dennis Lindley, John Tukey, and on and on. I was pretty successful in bringing leading people, and it was inspiring to our young faculty.

JY: *As the founding department head of UConn statistics, can you tell us your memories from that time about the department? How hard was it to recruit new faculty or students and to build a new department from scratch?*

BR: May I give a little preliminary note? As you know, in music a great many of the great composers like Strauss, Vivaldi, and Rachmaninov, were essentially born into their craft by having musical parents. In the same vein, as I mentioned before, I was born into academics and raised on a college campus. And the academic organization goals and processes were almost just the way of life. By the time I had followed with my own three degrees, I just sort of knew how everything worked and what needed to be done. The easy part was designing a fine department. And it was a fine department. And now it's even better. However, the designing and the doing are two different things. It was a Catch-22. You couldn't recruit faculty and students and secure funding and programs until you had a reputation, but you didn't get a reputation until you had good faculty and students, and funding and programs.

So, I guess my biggest challenge was to lift the department off the ground when there was no reputation. I projected what the department would be like in 5 years – if everything went

well. And I advertised the program as if we had already gotten there. Some people thought I was being a little fraudulent, but others believed me. Based on my sort of preliminary, not very solid claims, we began to get some faculty and students and some funding and programs, and then, after four or five years, they were there and we were, a solid, respected department. By then, all of my claims by then were quite honest. So I think that was my biggest challenge.

In seeking faculty and in placing students I had the honor of dealing with a lot of the statistical greats. like Dennis Lindsey and Maurice Bartlett at Cambridge, Harold Hotelling at North Carolina, John Tukey at Princeton, Frank Anscomb at Yale, Fred Mosteller at Harvard, George Snedecor at Iowa State, Herman Chernoff and Lin Moses at Stanford, Jerzy Neyman at Berkeley, and on and on. I became personal friends with a number of those people: Dennis and Frank and Herman Chernoff and John Tukey, and some others.

2.4 Government Work

HB: *Those were very productive, and sounds like very intense eight years as a department head. what did you do after you left UConn?*
BR: After almost a decade I was getting burned out. As you can imagine it was a pretty demanding job. I had been going in the summers to a Navy lab in San Diego where they had oceanography problems, giving me a source of data for research in statistics. I left Storrs and went to an oceanometrics position at the Navy lab in San Diego.

As part of my job, the Navy sent me to undersea diving school. I dove to plant measuring instruments on the sea floor and to monitor undersea data. Things like that. Eventually, the Navy sent us for three years to Wales in the United Kingdom, to help found a Soviet ballistic missile submarine surveillance system (try saying that real fast). For a couple of years after returning from Wales, I was seconded to the naval hospital in Balboa Park to advise on the design and analysis of medical studies. Some time after that, the Navy sent us to Holland, and then to Italy for an eight-year span. I headed naval operations research for NATO. Our team did military simulations and recommended the optimal mix of support that the respective NATO nations would contribute in a conflict, that is, in case the Soviets started World War III. For example, Belgium specialized in subsurface mine warfare, Norway in coastal patrols, Italy in diesel submarines. Each nation would contribute what its best capabilities were and we would mix them together to make an all-NATO team. Anyway, eventually the Soviet Empire collapsed and I returned to San Diego, retiring from the Government.

JY: *Even though you worked in the government, you still kept very much in touch with academia, and kept teaching.*
BR: Yes, throughout the whole post-UConn period wherever and whenever I could manage I taught University classes, including at San Diego State University in San Diego, Webster University in Holland (affiliated with Leiden University), and the University of Maryland-Europe in Britain and Italy. After retiring, the Naval Hospital asked me to return as their biostatistician under a contract, and I did that for the next twenty-eight years, designing and analyzing over 3,000 studies in all different fields of medicine. I wrote my biostatistics book, *Statistics in Medicine*, and shepherded it through four editions (Riffenburgh and Gillen, 2020a). In 2019 I left the hospital, returning to San Diego State for a couple of years. In 2021, I retired for real.

That said, I still work with some graduate students and a little study here and there. Mainly, I'm trying to start a new career writing novels. Anyway, that was the overview of my professional history.

HB: *It seems like you were always ahead of your time in the sense that you were dealing with measuring rising temperatures of oceans and dealing with rockets and satellites from the very early days of this technology.*
BR: I suppose that's true. There was one example I can tell you about from the 1970s. This was assessing the survival probability of a planned huge subsurface pipeline going along the coast of California to bring fresh water down from the Eel and Klamath Rivers in the north to parched Southern California. It had to survive hurricanes, earthquakes, storms, and unbelievably strong down currents in coastal canyons, like undersea waterfalls such as if you had Niagara Falls all buried under the ocean. Well, I developed a method to estimate the greatest force to be expected over an interval of time, 'GREXIT' by an acronym, that I published in the Proceedings of the IEEE (Riffenburgh, 1976). I wrote reports on my analysis of the project.

To give you an example, we wanted to know with these undersea waterfalls how great the force was. We buried inch-diameter rebar into rock, and then attached a flow meter on top of it. This was down undersea, done by divers. And then we came back after a period of time to read what were the maximum forces and we found that the force had taken off the monitoring device and bent this inch-diameter rebar 90 degrees, forces that were greater than we could even measure. Well, I added that to the possibility of earthquakes, tsunamis, and things like that and I recommended that, as it was planned, it wouldn't survive. I thought of ways to help bypass the undersea canyons later on, but by then they had canceled the project. So it came to nothing. Anyway, that was an introduction of a methodology to a field where it had never been applied.

Remark: Among his early contributions in statistical applications in medicine, we refer the reader to Getzen and Riffenburgh (1972) and Riffenburgh (1966).

3 Perspectives

Dr. Riffenburgh's experience in academia, government, and private companies gives him a very unique perspective about a statistician's career, and we asked him about how these three environments differ, and what they have in common. Since his career spans seven decades, we were also interested to hear from him how the fields have changed over the years, and how he sees its future. Dr. Riffenburgh also exemplifies how one may achieve a healthy life-work balance, and still be productive and successful. In this section, we also bring his perspectives about this topic.

3.1 Career as a Statistician

HB: *The ASA award in your honor summarizes well your career and contributions in many diverse areas, including fisheries, oceanography, education, psychology, sociology, economics, agriculture, space exploration, business marketing, military simulations and medicine. Can you describe the circumstances which led you to having such a broad range of interests and experiences?*
BR: One of the best ways to get a reputation is to become an expert in one field. You get a lot of publications since you're the expert, your papers are accepted with little difficulty, and you become well-known. Well, I didn't do that. I had too much curiosity. I'd do a paper and then something else would pique my curiosity and draw me out. I would start thinking about it, reading about it, and I'd find myself getting all involved. And the prior paper that I should have followed up on just stopped. And of course, when I started a new subject, I had to start all over and read all of the background, so I didn't get as many papers published that way.

Anyway, I didn't get well-known because I had only one paper in each of many fields. This was not professionally wise. But I just couldn't seem to help myself. I just got interested and migrated from one field to another.

At the beginning of my career, I did some trivial papers, like growth curve estimation, assuming the normal curve in grading (Riffenburgh, 1966), and things like that. But my first major paper was on using Markov chains to model predation rates by trophic levels in oceanic fisheries (Riffenburgh, 1969b). A trophic level is a level where you get all the different fish that have the same predators and the same food sources. So, you have anchovies, sardines, and hake in one trophic level. You can estimate the probability that a randomly chosen sardine will survive for a given period of time. You compose a matrix of probabilities like that representing the progression of predation and survival. You raise the matrix to a power in the Markov chain and you can see the pattern over time. You multiply it by a vector of existing or proposed fishing pressures on, say, sardines, but with none on hake or anchovies. As you remove sardines from the ecosystem, you allow more predation on the hake and anchovies, but at the same time they get more food, so you can see a pattern through time. I used this to explain the disappearance of sardine fisheries off the coast of Northern California, off Monterey.

I was invited to give this paper at the 1960 ISI — International Statistics Institute — meeting in Tokyo. Somewhere I have a photo of me standing up talking about it with Gertrude Cox sitting as moderator behind me and Ronald Fisher sitting in the front row listening to me. After the talk, I was using a restroom when Fisher walked in. "My name's Fishah", he said. "Yes, sir," I answered, voice quavering, stutteringly intimidated. "I recognized you." He asked in a booming voice, "Wheah are you from?" "Hawai'i," I said. "Hm, hm. Wheah?" he asked. "Hawai'i," saying it very clearly. "Oh, yes," he said. "hm, hm, pip, pip. Uh." He looked at the ceiling thoughtfully, then gave up and, staring at me, boomed, "Wheah's that?" I reasoned that he wasn't familiar with the name and, being English, must know it by the former English name, so I answered, "The Sandwich Islands." His face lit up with understanding. "Ha, of course, of course," he said. Pause. "Hm, hm, uh. Didn't know you chaps still called them that."

Remark: The 75th anniversary of the International Statistical institute was held in Tokyo in 1960. For a description of this celebratory event and a list of the presenters, which included the young Dr. Riffenburgh, see Boldrini (1960).

In another paper in the fisheries field, I looked at fish schooling (Brock and Riffenburgh, 1960). When fish school together, there is less food to go around but also predators can eat only a smaller proportion of available stock, so more of them will survive. I asked what's the trade-off. I looked at the efficiency of schooling and showed that it was beneficial for survival. After that, I moved into physical oceanography and applied analysis of variance to estimate sea water temperature (Riffenburgh, 1971). As the sun hits the surface of the sea and wind blowing across stirs it up, the warmth level deepens. After the sun sets, the warmth level rises, because there is no warming and you still have circulation. I used temperature at different depths as components in an analysis of variance. We had one ANOVA for each location at each time. By connecting them together, I was able to demonstrate the pattern of temperature rise and drop, i.e. the ocean's warming and cooling.

Well, after that I became curious about other things, and I did one paper here and another there. I did papers in engineering, social science, biology, economics, agriculture, space explorations, business, military simulations, and then for the last thirty years in multiple different fields of medicine.

Remark: A full list of 164 publications by Dr. Riffenburgh can be found at his personal website https://robertriffenburgh.com/?page_id=199.

HB: *We would love to hear your take on how you perceive the differences and similarities among the different sectors for statisticians.*
BR: Well, please forgive me for over-generalizing. What I say will be an overall impression from my experience and there are certainly a vast number of exceptions. As to similarities: If the goal is to seek truth, statistics is pretty much statistics, wherever. You can find a fascinating spread in any one of the professional venues in both breadth and depth of scientific challenges. There is much more difference in the types of questions within a venue than there is between venues.

However, now let's look at differences: The similarities I just commented on don't hold for different goals. It is much more common in some fields to use statistical methods to generate a desired answer than it is to seek the truth. For example, in some dollar-driven businesses, the survival of the business may depend on showing that your product is better than the competitor's and showing it through statistical analysis. Also, because they're so dollar-conscious, they tend to limit the cost per project and look for fast answers even if a bit sloppy. (One exception to that rule is with our illustrious graduate, one of our first graduates, Dave Salsburg, who had a career with Pfizer. I worked with David a lot and know him very well. He would never, ever do anything unethical.) But apart from that, using statistics to seek a pre-determined answer did occur in some of the consulting gigs that I endured.

In contrast, government for the most part has a goal of serving the public, so there is much less incentive for "quick-and-dirty" analyses. They do a more thorough design process and analyses are permitted with less stress on speed and with less oversight. Government workers get a lower salary and fewer perks, but the pressure is less and the goal is more satisfying. Well, that's kind of an over-generalization. When I was working for the government, we used to joke that science workers were in either a 30-hour per week group or a 60-hour group and there was no in-between.

Your third category is academic, which contrasts with both business and government. There is much, much more freedom in academics, but the goal is more to develop new methodology than to solve applied problems. You turn a person loose on his own, and after a year or so, you call him in and say "What great new theory have you created and published on?" There is no daily pressure, but you don't have the luxury of being free from long-term, deep pressure.

HB: *Your career spans almost seventy years in statistics and related areas. In your view, how has the field changed over this time?*
BR: I'll mention two areas – technical and conceptual. Technically, when I started, our hardware was essentially a number-2 pencil and our software was a statistical methods book. Well, we did have Frieden and Monroe machines (see Figure 3), hand-crank and later electric, that could very slowly add. They could multiply numbers by repeated addition. You had to key in every number digit by digit. Even so, they were very costly, available only at institutions. It was a morning's work to do the calculations for a t-test. Samples were necessarily very small. In 1954, when I was a doctoral student at Virginia Tech, I designed a linear regression with three 9 by 9 matrices for my wife's M.S. thesis. We rented a machine and spent a three-week between-terms break spending 18-hour days, hardly sleeping, calculating the inverse of the matrices. We managed to do it in those three weeks. She read the numbers and I punched, punched, punched. Eventually, we finished it and she got the degree and published the paper. By the time I was at the University of Hawaii in, I think, early 1959, the University got its first electronic computer in the territory. (That was

Figure 3: A Frieden machine.

before statehood.) The computer was a huge affair, an IBM 650, with scads of vacuum tubes, in a special frigid room to keep it cool. I learned to program in binary machine language and wrote the first program that ran on the 650 in the territory. Throughout the following years, I have watched the change to pre-programmed software and to personal computers where you can actually have a computer in your own home or office. And to statistical software where you don't have to punch in all the formulas digit by digit. You have software that anyone can use – or misuse.

On the conceptual basis, the burgeoning of theory and methods has been continual. In my first statistics course in 1949, I asked the professor, who had written a popular book on quality control, why he didn't cover ANOVA. He said, "Look at the date. It was published before the war." ANOVA had not made its way into popular usage although it existed in some books. Now, every year, we see new advances. It is getting increasingly difficult to keep up with it all. And that's my comment on the progression.

HB: *Looking forward, what is your opinion about the role of statistics and data science in other areas of sciences?*
BR: The roles of statistics and data science are pretty clear. They are disciplines that form two bridges. One bridge goes from forming a concept through development to a specific how-to-do-it and scientific design. The other is a physical bridge from holding raw data in your hand through analyzing it to saying what the set of data implies, what it's measuring. I think one anecdote may illustrate the essence of it.

I've already mentioned how sample sizes in the early days were necessarily small. The problems all seemed to be how to get enough data to satisfy assumptions. In 1957, when I was finishing my doctorate, one of my professors, John Freund, was called to consult with an aircraft construction company. At that time, jet aircraft were emerging. They had been used in the military, but now they were beginning to be used in civilian lives. The power was greater, their speeds were increasing, and that put a lot of jiggle onto the aircraft, generating wing flutter. So, they asked Dr. Freund to analyze wing flutter. The day he came back we were all sitting around a calculation room eating our brown-bag lunches when he walked in with his eyes as big as salad plates. He said "You won't believe this. They have data like I have never seen. Wing flutter is recorded by the thousands. It's not a problem of how to get data; it's a problem of how to choose what subsets of data to use for analysis." Well, that trend has only increased over time. The amount of data and statistical methodology we need to analyze the effects has grown over the intervening sixty-five years. Now we have vast sets of genomic data, demanding new forms of statistical thinking.

JY: *Do you have any suggestions for the younger generation of statisticians or data scientists?*
BR: There are a lot of things I could say, what most anybody would say. But one thing I don't hear people talk about, and I'd like to impart to the younger generation, is you need to come

to have a feel for statistical methods rather than just follow a formula. Formulas are like road maps – you need them to navigate, but they are not the trip. The trip was in the mind and the emotions. You need a gut feeling for a method, not a stiff protocol. A statistical problem lies in a process. Data shine a light on that process. Often there are different windows that you can look through at a problem. While there might be one that's more efficient than another, they may all show your insights on the process. The feeling that most younger people get from taking courses in statistics is that there is one best way of looking at a process and that's the way to do it, and you shouldn't use others because that one is best. But the whole point of statistics is to understand how the process works, not to produce some optimal but dry statistic.

When I left the University of Connecticut for the Navy's oceanometrics position, their statistician was none other than Professor George Snedecor who was using it as a retirement gig, he was doing a little part-time consulting with it. He found very shortly that he was just too feeble to continue and retired completely, but it was a great honor to be able to work with him for a short time. On one occasion, he was asked to review a report by an oceanographer. Now, this guy was ignorant of statistical methods, so he had analyzed data his own way, not using standard statistical procedures. Dr. Snedecor was asked to review this report. He examined it, and he said, "Well, it's not the way I would do it, but I think it shows the picture. I don't see anything wrong with it." That, I think, is the lesson to give the younger generation. Don't think of statistics as a pairing between static problems and static methods. Think of it as discovering the picture that the data tell you.

JY: *I think many of our younger colleagues want to start collaborations with scientists from other fields, but they may not know how. Do you have some specific suggestions, on how to start a collaboration with people from other fields?*

BR: I can give some tips, here and there. One thing is, you can't be too simple. As long as you're true to honesty and completeness, you make it just as simple as possible and try to explain things simply. When I first started out, I felt self-importance in my ability to wow people using my great knowledge. But, as I grew older, I realized that I was just pontificating, and the important thing was to try to convey understanding to the other person, not to impress them. I think that's what's really important. So I say again, you can't be too simple.

To listen is another tip. Listen to the client. A lot of investigators are afraid of statistics, intimidated by statistics. But if you ask the investigator you're working with to tell you all about his problem, about the process that he's involved in, you get two benefits. First, it helps him become confident because he's the one telling you. Once he becomes confident, he sees you as a colleague instead of someone to impose mystery upon him, then you have a much better working relationship. Second, it gives you an opportunity to understand the process because you can't do good statistics if you don't understand the processes you're simulating. You get him to talk, and you listen. You listen very carefully. You process in your mind what statistical methods you might use to shed light and what statistical windows you can look through to understand this process, while he's talking.

Still another tip is to use explanatory examples in his field. He can understand his field. If you use some other field for illustration, what you're doing is asking him to split his mentality, one, to understand the field you're describing and, two, to understand the process. But if you talk about his field, he already understands it, so he puts his whole mental effort into understanding the statistical methodology. That helps a great deal in conveying the statistics to him. In my book, I started out with very simple stages and progressed to more complicated ones. I started out trying to explain things such that anybody can understand, well, somebody who maybe

knows some algebra but not sophisticated mathematics. We're speaking of the non-statistician statistical user, what I used to call the "average man on the street", or AMOS. So the goal is, to get the idea from your mind excised and implanted into his mind. To do this you have to do it in a way that his mind can accept. You can see what the issue is with the p-value problem. It has been very overused by AMOS. You can try to explain that, but it gets quite involved, quite complicated, and you get into quibbles between statisticians and into conflicts on what are the most important subtleties to show views and make assessments.

I go back to saying you've got to understand the process, to see the picture of what's going on. And you can tell AMOS that in order to see the picture, we can look through different windows. We can look at the window of a p-value, we can look through the window of variability, we can look through the window of biasing variables, we can look through the window of covariates, and they all show us some image of it. Suppose you're looking at an elephant in a room. Through one window you see the trunk, through another you see the tail, and through yet another you see this huge side body. But you need to look through all the windows in order to get a picture of what an elephant is like.

3.2 Work-Life Balance

HB: *In addition to your rich career as a statistician, you also have many other diversions, as you call them, on your website. They include running, cycling, sailing, diving (you mentioned the diving training that you got in the military), playing music, writing fiction, learning languages, cooking, and authoring fiction books, not to mention raising five children. So what is your secret for maintaining such a remarkable work-life balance?*

Remark: See Figure 4 of Dr. Riffenburgh in April 2012 at an ASA San Diego chapter meeting in Balboa Park (left), and with his family in April 2006 (right). As of August 2023, five of the seven grandchildren in the photo have finished university and are out in the world – a cybersecurity specialist, an airline pilot, a neurobiologist at MIT, a drama director, and on leave bicycling through South America. The youngest two are currently in college.

BR: Well, there's no secret. I just stayed so busy that I never had time to think about what to do next. Everything just happened to me. Marriage, children, jobs, moving about, fitting

Figure 4: Left: Dr. Riffenburgh in April 2012 at an ASA San Diego chapter meeting in Balboa Park. Right: Dr. Riffenburgh and his family, April 2006.

in, learning new material. I just did whatever I had to do to get by. I don't think I balanced anything. I think I just survived the buffeting of the waves of life. If you want a secret, I'll reveal what I want for these last few years of my life. Of course, there are always chores that come with the house and the garden and the car, feeding yourself, paying bills and taxes, and all that kind of stuff. What I really want is a few days a week when I can wake up feeling there is just nothing, nothing at all driving me, nothing I have to do. In other words, freedom from all this buffeting that life has handed me. Now, when you wake up feeling that way, it doesn't mean that you do stay in bed. You get up and you start doing things that interest you. The point is, you don't have to. You can stay in bed if you want to, and it makes all the difference in the world, to do something because you want to do it instead of because you have to. I think that is what I want in the rest of my life to do, only things that I want to do, not what I have to do.

JY: *I guess many people want to do a lot of things like, for example, if I'm working on statistical papers, but I also want to write fiction. How do you find time to write fiction when you have these statistical papers to write?*
BR: There's a lot of overlap. Some people write fiction that just start writing and go wherever it takes them, but I don't think they have too much luck. They have to go back and organize a mess. To write a scientific paper, you have to know what your goal is, know the background, and you have to lay out what you want to impart. Only then can you write it. And then you edit it and fine-tune it. Well, you do the same thing with fiction. Only, instead of dealing with data, you deal with images from your mind or memories. Dealing with mental images is even more fun, I think.

HB: *All right, Bob. It's been a real pleasure talking to you, and a very interesting conversation.*
BR: Well, it's been a pleasure and an honor for me to see the great department that statistics at the University of Connecticut has become and to become acquainted with you two outstanding professors as part of that department. I'm honored that you have given me this opportunity and I thank you for the time to recall past years.

Remark: In addition to 164 papers (see https://robertriffenburgh.com/?page_id=199 for a complete list), and his famous book *Statistics in Medicine* (Riffenburgh and Gillen, 2020b) which is now at its fourth edition, Dr. Riffenburgh is the author of three fiction books and numerous short stories – an unusual achievement in general, and especially among statisticians and other scientists. His book titles are:

1. *Thank Ye, Mister Sun*
2. *A Theft of Sanity*
3. *A Theft of Joy*

Remark: See Figure 5 of Dr. Riffenburgh during our interview, which was recorded on Friday, August 26, 2022.

4 Commentaries

We asked three of Dr. Riffenburgh's former students and colleagues to provide their comments about Dr. Riffenburgh's impact on their career. Their commentaries are quoted in *italic*.

Figure 5: Dr. Riffenburgh during the interview.

4.1 David Salsburg

David Salsburg is one of the first Ph.D. graduates (1966) from UConn Statistics. He taught at the University of Pennsylvania, University of Connecticut, and Connecticut College, before joining Pfizer where he spent 27 years, working on the development of new drugs and rising to the top of the company's scientific ladder. He remained active after retiring from Pfizer in 1995. In addition to his academic contributions, he is known for two popular science books, *The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century* (Salsburg, 2001) and *Errors, Blunders, and Lies: How to Tell the Difference* (Salsburg, 2017). He is the first recipient of the UConn Statistics Distinguished Alumni Award in 2008.

> *I became a graduate student in the Department of Statistics of the University of Connecticut in 1965. Bob Riffenburgh had recently founded the Statistics Department at UConn with a promise that he'd have successful Ph.D. candidates within three years.*
>
> *Bob's plan was to seek out students who had finished most or all of their course work and were looking around for an appropriate thesis topic. I fit this pattern since I had received an MS in math at Trinity College in Hartford and was continuing my studies at Brown University. However, I was discovering at Brown that the only faculty members looking for graduate students were doing their research in algebraic topology, a branch of math that did not attract me. A friend of mine (Jimmy Woods) from Trinity had just signed on as a Ph.D. candidate in math stat at UConn and he suggested I contact Riffenburgh. Bob offered me a place as a graduate student and arranged for a National Defense Education Act fellowship to support me and my growing family, since I was the dad of three little girls — one of them born a week after we arrived at UConn. Bob knew where to get money to support graduate students, and several of my fellow students at UConn were being funded by grants for research in various departments of the school.*
>
> *I found the atmosphere among the students and faculty of the department one of excitement and intellectual ferment. True to his word, Bob had three successful candidates within the first three years, first Vidya Taneja, then Larry Hatch, then me.*
>
> *Mathematical statistics was an exciting new world of investigation. Recognizing the need for scholars in that field, new departments of statistics were opening up throughout the world, and there was a demand from both academia and industry. In my earlier studies I had been fascinated by measure theory. Now I was in a field where measure theoretical problems were crying for solutions. My wife Fran and I shall ever be grateful to Bob Riffenburgh for opening those doors for me.*

4.2 Chris P. Tsokos

Chris P. Tsokos earned his Ph.D. in Statistics from UConn in 1968. He is Distinguished University Professor of Mathematics and Statistics at the University of South Florida, where he has been since 1972 after brief years at Virginia Tech and University of Rhode Island (URI). In 2010, he was recognized with the Distinguished Alumni Award of UConn Statistics along with the recognition of the State of Connecticut General Assembly Award for outstanding public and philanthropic service to our country. He has authored over 25 monographs/books and over 400 papers, and advised 80 Ph.D. students.

Bob, your truly outstanding academic, professional, and industrial accomplishments are very well-known. I would like to remark on your kind and unlimited assistance and guidance you offered to your students.

Upon completing my B.S. in Mathematics and Engineering Sciences at the University of Rhode Island (URI), I started working as a nuclear submarine engineer at General Dynamics (GD) in Groton, Connecticut. During my two successful years at GD, I was able to obtain my M.S. in Applied Mathematics from URI. I decided I wanted to try teaching so I went to my supervisor to submit my resignation and he said you are not resigning, you are going on an educational leave of absence. Up to now I am still on such status.

While teaching at URI, a Ph.D. was essential so I applied to neighboring universities to continue my graduate studies, one of which was UConn. Meeting Bob for the first time was an incredible and motivating experience. He said stop looking, you are coming to UConn because I will build the best statistics department in New England and you will be proud of attending such a university. I mentioned to him that I had three children and needed to keep my job. No problem — we will arrange for your three graduate courses per semester at UConn and you can continue teaching your four courses at URI. He was so inspiring in advising me that I couldn't respond to him. Commuting three times a week each round trip 120 miles did not enter the picture. Bob did not only recruit me from URI, but he also recruited the only statistician at the university, Dr. Harry Posten, a Virginia Tech graduate.

Everything went smoothly and the time came to defend my doctoral thesis, but I was told by the graduate school that I had not completed all the requirements. I needed university residence at UConn for at least one year. Here came Bob again; he asked the graduate school to waive the legal residency because I was teaching full time at a sister university, URI, and was exposed to the educational and academic culture of a university, a successful argument.

Upon completing my Ph.D. at UConn, Bob continued with his relentless and valuable assistance. He sent me as an Associate Professor at Virginia Tech, Department of Statistics, his alma mater. The Virginia Tech Statistics Department was one of the first departments in the United States, founded and led by a truly outstanding administrator, Dr. Boyd Harshburger.

After two successful years in Blacksburg, Virginia, I accepted a position at the UPenn Wharton School. My first week there was not very pleasant, when I started commuting one hour each way along the main line of Philadelphia. I submitted my resignation and decided to "retire" at a new academic institution in Tampa, Florida, the University of South Florida, which recently was selected to join the Association of American Universities (AAU), the top three percent of universities in the U.S. in recognition of research, innovation, etc.

Bob, your motivational strategies and guidance to students have been instrumental in mentoring and supervising my 80 doctoral students, and I will continue to emulate your style with my several current graduate students.

Bob, good luck on your future project as a fictional novel writer. You have the interdisciplinary experience and living in Blacksburg to be very successful.

Bob, thank you very much for your kind assistance and it has been a great pleasure knowing you.

4.3 Alan E. Gelfand

Alan Gelfand came to UConn in 1969 after getting his Ph.D. from Stanford University, and spent 33 years as a professor at UConn. In 2002, he moved to Duke University. He is a James B. Duke Distinguished Professor Emeritus of Statistical Science, Duke University. He is best known for his pioneering work in computational Bayesian inference (Gelfand and Smith, 1990), along with many other important contribitions that he made to the statistics field, such as spatial statistics and hierarchical modeling, during his tenure at UConn.

I first met Bob in February, 1969 when he was Department Chair and I came to Storrs to interview for an Assistant Professor position in the Department. At that time Bob was living in a camper van. And, apart from going off to dinner (at the old Altnaveigh Inn), he interviewed me, over a few beers, in the van. And, I recall that the van was parked in front of the Monteith Building, the original home for the Department.

Bob was very warm and genuine. I immediately felt comfortable with him and, within a few weeks, accepted an offer to join the Department. Surprisingly, when I arrived at UConn in late August of 1969, Bob was gone, off to Scripps in San Diego, Gottfried Noether the new chair.

We have kept in touch sporadically over the many years, primarily due to our common interest in problems involving environmental and ecological processes. He has always been a "feet on the ground" researcher/thinker, a virtue that I happily connect with. As a chair, Bob had a vision for the Department which recognized the need for a balance between theory and application. This balance persists to the present day.

5 Conclusion

The Department of Statistics at UConn, which Dr. Riffenburgh built from scratch over sixty years ago, has grown into a stronghold of statistics excellence. As of August 2023, the department consists of 22 tenured or tenure-track faculty members, two Assistant Professors in Residence, 13 affiliated faculty, and 6 adjunct faculty. A total of 218 students have graduated with a Ph.D. in Statistics, 483 with a M.Sc. in Statistics, and 99 with a M.Sc. in Biostatistics. The growth in the last 10 years is notable; for example, the number of Ph.D. graduates almost doubled that in 2013 (Dey et al., 2013). The department values both theory and practice equally, maintains strong interdisciplinary collaborations, supports faculty, and especially strives to help junior colleagues achieve their early-career goals. Recently, the department fully embraced data science, and is now offering B.Sc. majors in Statistical Data Science, and contributes multiple core courses to the interdepartmental B.A. majors in Applied Data Analysis. The department is also playing a major role in a university-wide M.Sc. Data Science program. Dr. Riffenburgh's visionary leadership

during the formative years of the department is of immeasurable significance to its success today.

Dr. Riffenburgh's career is truly remarkable and inspirational in a number of ways. His diverse endeavors and contributions in many fields has helped advance science in general, and has greatly elevated the role statistics in the eyes of many people outside of our field. By going into government and industry, Dr. Riffenburgh was able to extend the influence of statistical thinking well beyond the academic world. From medicine, to environmental research, agriculture, space exploration, and psychology, Dr. Riffenburgh's research is as relevant now as it has ever been. He did all that while acquiring many life-long friends among his colleagues, and while maintaining an incredible work-life balance and enjoying time with his family, and developing his diverse interests, skills, and hobbies.

We have had a delightful conversation with Dr. Riffenburgh, and in writing this paper we came to be even more impressed with his accomplishments. As statisticians, in general, and as faculty members at UConn Statistics, in particular, we feel that we owe him a great deal. We hope that our readers will be as inspired by him as we were.

A Riffenburgh's Professional History

The following information is a copy from Dr. Riffenburgh's website https://robertriffenburgh.com, provided here for completeness and ease of referencing.

A.1 Experience Timeline By Decade (approximate)

2020s

Professor, Department of Mathematics and Statistics, San Diego State University.
Writing fiction in semi-retirement.

1990s, 2000s, 2010s

Chief of Biostatistics, Naval Medical Center San Diego.
Dept of Mathematics and Statistics, San Diego State University.

1980s

Head of Operations Research, NATO's Centre for Maritime Research and Experimentation, La Spezia, Italy.
Head of Naval Operations Research, NATO's SACEUR, The Hague, The Netherlands.

1970s

Director, Undersea Aqueduct Project, NOSC, San Diego.
Director, Biomedical Project, NOSC, San Diego.
Research Group Line Manager, NOSC, San Diego.
Statistician, NAVFAC Brawdy, Wales, UK.

1960s

Professor and Head, Statistics Department, University of Connecticut.
CEO, General Systems Analysis Company.
Post-doctoral studies, University of California San Diego.
Post-doctoral studies, Harvard University.
Systems Analyst, Lab for Electronics Inc, Monterey.

1950s

Assistant Professor of Mathematics, University of Hawaii.
Assistant Professor of Mathematics, Virginia Tech.

Graduate school: MS College of Wm & Mary; PhD Virginia Tech.

1940s

High school and college (incl first courses in statistics).

A.2 Types of Experience, Several Years Each

Technical

Statistician, general; biostatistician, medical; operations research analyst (industry, military); systems analyst (systems simulation); oceanometrician (quant. oceanogr.).

Teaching

Statistics (Professor: grad and undergrad); Mathematics (Asst Professor: undergrad).

Consulting Topics

Statistics in Medicine (all medical fields); Oceanography (physical, biological); Business and Economics; Education.

Administrative

University Department Head, founding (UConn); Project Director (U.S. Government);
Line Manager (U.S. Government);
Small Business CEO (own company).

A.3 Employment

1968-date Professor (Adjunct), San Diego State Univ: 2006-date, Dept Mathematics and Statistics (part-time); 1978–82 and 1990–94, Dept Information & Decision Systems; Professor, 1971–74 Dept Natural Science; 1968–69 Dept Mathematical Sciences.
Taught various classes; served on graduate committees; published research

1991–2019 Chief of Biostatistics, Clinical Investigation Dept, Naval Medical Center San Diego.
Evaluated scientific merit and planned experimental design of research protocols in medical and animal experiments; analyzed research data; conducted own research; prepared protocol critiques and participated in meetings of Institutional Review Board (IRB) and Institutional Animal Care and Use Committee (IACUC); gave lectures on medical statistics; supervised biostatistics intern.

1986–90 Head, Operations Research NATO A-5 (US O-6), NATO's Centre for Maritime Research & Experimentation, La Spezia, Italy.
Headed naval operations research for Supreme Allied Commander Atlantic.

1982–86 Leader, Naval Operations Analysis NATO A-5 (US O-6), NATO's SHAPE Technical Centre, The Hague, Holland.
Headed naval operations research for Supreme Allied Commander Europe.

1977–82 Mathematical Statistician GS-15, Project Leader/Line Mgr, Naval Ocean Systems Center, San Diego.
Led or consulted on projects, including oceanometrics, marine animal research, system optimization; managed groups, including planning, funding, budgets, personnel, reporting.

1974–77 Scientist, Naval Facility, Brawdy, Wales, UK.
Performed statistics and quality control in test and evaluation of Navy systems.

1971–73 (seconded part-time to Naval Hospital San Diego as Biostatistician).
Designed/analyzed medical studies & animal experiments for research staff/residents.

1970–74 Oceanometrician and Head, Biomedical Program, GS-15, Naval Undersea Center, San Diego.

Led studies on Fleet problems, including oceanography, shipboard epidemiology, dolphin behavior, protection against sharks, et al. Secured funding, supervised technical personnel.

1963–70 President & CEO, General Systems Analysis Company, Storrs CT.
Organized and administered company, securing business, hiring and supervising scientific personnel, managing budget, and consulting with many corporations (IBM, General Foods, Emhart Manufacturing, Continental Insurance, et al).

1962–70 Professor and (founding) Head, Statistics Dept, Univ of Connecticut, Storrs.
Planned, launched, & built department, including MS & PhD curriculum development, budgeting, hiring faculty, securing students, obtaining student support, obtaining research support, teaching undergraduate and graduate statistics classes, consulting with faculty (medicine, oceanography, agriculture, biology, psychology, business, et al); obtained, funded, and administered NIH Biostatistics Training Program.

1961–62 Systems Analyst, Laboratory for Electronics Inc, Monterey CA.
Developed probabilistic model for path conjunction among rockets and satellites.

1957–61 Mathematical Statistician GS-12, US Bureau Commercial Fisheries (part-time), Honolulu HI.
Designed/analyzed studies in biological/physical oceanography; developed new statistical methods for oceanometric analysis.

1957–61 Assistant Professor of Mathematics, University of Hawaii, Honolulu HI.
Taught undergraduate & graduate mathematics & statistics; did research in theoretical statistics; consulted on faculty studies in biology, medicine, economics, et al.

1955–57 Assistant Professor of Mathematics, Virginia Tech, Blacksburg VA.
Taught undergraduate mathematics.

Acknowledgement

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