Math Is Better Than the Brigadier's Girlfriend

Episode 15 | Everything is Everything

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Transcript

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Abstract

Statistics has the power to reveal hidden truths that escape conventional analysis. From estimating German tank production during World War II using serial numbers to determining optimal bombing altitudes through probability calculations, statistical thinking transforms how we understand complex problems. Ajay and Amit examine this transformation through the extraordinary life of C.R. Rao, the Indian statistician whose fundamental theorems became cornerstones of 20th century mathematics.

The conversation traces Rao's journey from a young migrant in Calcutta to a global mathematical giant, working within the remarkable ecosystem created by P.C. Mahalanobis at the Indian Statistical Institute. They explore how this institution, built without government funding in pre-independence India, produced world-class research that competed with Cambridge and other elite centers. The discussion reveals both the heights India achieved in mathematical statistics and the institutional challenges that prevented sustained excellence.

Through stories of wartime statistical analysis, the personalities behind India's statistical renaissance, and the shift from mathematical to computational statistics, this episode illuminates both individual genius and systemic patterns that shape scientific achievement.

Supplementary Resources

- **The Lady Tasting Tea** by David Salsburg (Book) [3]
- **Statistics and Truth** by C. Radhakrishna Rao (Book) [2]
- **The Theory of Moral Sentiments** by Adam Smith (Book) [4]
- **The Road to Serfdom** by Friedrich A. Hayek (Book) [1]

Contents

[00:00:00] Ajay Shah: And then suddenly you are dreaming algorithmically; you're thinking algorithmically. I mean, of course, we use mathematics to analyze those algorithms.

[00:00:08] Ajay Shah: But the unit of analysis stops being a mathematical estimator that can be written down in closed form; the estimator becomes an algorithm.

[00:00:18] Ajay Shah: And it opens up a whole set of possibilities for how we can design estimators.

[00:00:26] Amit Varma: I must tell, I must tell dear readers that that is the ghost of statisticians past who have worked at the ISI wailing to see the condition.

[00:00:37] Amit Varma: No, it's not. It's our cats fighting, and we have to go to the next chapter anyway. So give us a moment. We will sort out the kitten situation.

Introduction: The Brigadier's Girlfriend

[00:01:02] Amit Varma: Welcome to episode 14 of Everything is Everything. In our last episode, unlucky number 13, thank God we got past that, we spoke about Bruce Springsteen.

[00:01:10] Amit Varma: And to carry the musical theme forward, I'm wearing a shirt with the Beatles on it. John, Paul, George, Ringo.

[00:01:18] Amit Varma: I'm sorry, is my sense of humor a problem for you?

[00:01:20] Ajay Shah: I have a better problem for you.

[00:01:22] Amit Varma: Batao.

[00:01:23] Ajay Shah: Okay. Let us teleport back into the Second World War.

[00:01:30] Ajay Shah: Okay, late in the Second World War, there were remarkable developments in making tanks on the German side. Okay, there's the famous Tiger tank, but also some other remarkable heavy tanks were being made by the Germans.

[00:01:47] Ajay Shah: One of the greatest questions for the allies at that time was, are these just a few artisanal demo parts or are they being produced? Are they being produced on scale?

[00:02:00] Ajay Shah: How many are being produced a month? Okay? If thousands are being produced a month, then it's a whole new problem. And you know, the allies would have to go back to basics and rethink what they're going to do.

[00:02:13] Ajay Shah: So, one of the most important questions was that of estimation: how many of a certain tank are being made per month. How might you approach this?

[00:02:24] Amit Varma: Different ways to approach it, but I would say it's an information asymmetry problem and given that it's a war and there are spies, I'd say, let me get a mole inside the German camp, woh sab bata dega.

[00:02:35] Ajay Shah: So that's absolutely one line of attack. That's the humint line of attack. Okay, one of the great lessons of history is that authoritarian tyrants have obedient regimes that are full of people who hate them.

[00:02:47] Ajay Shah: So there is plenty of opportunity for obtaining humint from creating sources because there are plenty of people inside the government of an authoritarian who actually detest the authority. Okay?

[00:03:00] Ajay Shah: So that is indeed one line of attack and that's called humint. And then there is another line of attack that is called sigint, where you process signals and you intercept communications and so on.

[00:03:11] Ajay Shah: Now in this case, there was a different line of attack, which is every now and then in the battlefield, the allies would kill a German tank.

[00:03:22] Ajay Shah: And the Germans were very systematic. Every tank would have a serial number. Okay, the methodical German mind would assign incremental numerical serial numbers on every tank.

[00:03:34] Ajay Shah: And just imagine this would have been harder if they had randomized every number. But every engine had a nice serial number which were flowing incrementally.

[00:03:43] Ajay Shah: And this is called the German tank problem, that N number of tanks are being produced every month. Every month, some tanks are being killed.

[00:03:53] Ajay Shah: You get the serial numbers of the tanks that have been killed every month. So out of the stock of tanks, some tanks are killed every month.

[00:04:03] Ajay Shah: And our job is to estimate what is the grand total number of tanks that exist as of every month. And then you subtract them and you get the production of every month. Okay?

[00:04:12] Ajay Shah: So this is called the German tank problem, that a few sporadic killed numbers are observed and out of that, you have to estimate what is the grand total of the number of tanks that have ever been produced.

[00:04:22] Ajay Shah: And there is a cute piece of statistical thinking here. So imagine that tank number 26, 74, and 90 have been killed. So I killed the tank, my people went and verified the serial number, 24, 76, and 90.

[00:04:39] Ajay Shah: One simple approach is to say 90 is the highest number of what we have verified is a tank that has been killed. Therefore 90 tanks exist.

[00:04:49] Ajay Shah: Okay? And the sweet mathematical intuition is, no, there could well be more tanks and you just happened to kill Mr. 90. Maybe there's a 100, maybe there's a 110.

[00:05:00] Ajay Shah: So there is a max value which is above the 90. So you want to top up this number 90 with something. What would you do?

[00:05:09] Ajay Shah: And the sweet mathematical answer is take the distance between tank one and two, the 24 and the 70. Take the distance from 74 to 90, take the average of the inter-tank distance and add that back into 90.

[00:05:23] Ajay Shah: And that gives you an estimator of the top. It's a sweet, simple idea. And this is the field of statistics.

[00:05:29] Ajay Shah: This kind of reasoning, this kind of careful thinking and the development of these kinds of formulae that will solve complex estimation problems, this is what the statisticians do.

[00:05:40] Ajay Shah: Now, during the Second World War, this field was very nascent; very little knowledge of statistics existed. And it turned out that there was a conflict between the humint department.

[00:05:51] Ajay Shah: Okay, the people who created sources, who knew the girlfriend of some brigadier and managed to extract secrets out of the mighty German Wehrmacht.

[00:06:01] Ajay Shah: Those estimates were coming out like 1500 tanks produced per month. And the numerical calculations by the statisticians were producing an estimate like 200 a month.

[00:06:12] Ajay Shah: So these two estimates were very far apart and it was a raging debate about which one is right. And after the war ended, when the allies went and did the postmortem inside the German production records, it turned out that basically the statisticians were right and the humint was wrong.

[00:06:30] Amit Varma: What is the moral of this story? I will tell you the moral of the story. The moral of the story is brigadiers lie to their girlfriends.

[00:06:38] Ajay Shah: Yeah, or that tanks don't lie.

Chapter 1: We Will Not Let Down CR Rao

[00:06:52] Amit Varma: So Ajay, 22nd August, a few days ago, a few days before we are recording, you were pretty upset. You said a hero of yours has died, C. R. Rao.

[00:07:01] Amit Varma: Tell me a little bit more about him because honestly, I've heard the name but I know absolutely nothing about the man. And hearing about the reverence you hold him in made me want to know more. So why not get to know more in front of everybody?

[00:07:14] Ajay Shah: C. R. Rao is one of the great figures of the 20th century. And let me tell his story. His story of course is deeply intertwined with P. C. Mahalanobis.

[00:07:25] Ajay Shah: C. R. Rao was born in 1920. As the name suggests, he was South Indian. He migrated to Calcutta and there he met Mahalanobis and became a student at the Indian Statistical Institute.

[00:07:41] Ajay Shah: At the ISI in the mid-40s, you have to understand what a unique moment that was in history. Mahalanobis had built this new organization, ISI.

[00:07:55] Ajay Shah: Mahalanobis was himself a very skilled physicist. He was fellow of the Royal Society. So while he never got a Nobel prize, he was a really good physicist.

[00:08:04] Ajay Shah: And he was one of the early pioneers who understood that there was something remarkable going on in the field of statistics and he was a pioneer in trying to wake up and create interest and curiosity and work on statistics in India.

[00:08:18] Ajay Shah: And C. R. Rao came into that world. As a young man, he came into the world of Mahalanobis and the Indian Statistical Institute, which was there in Calcutta at the time.

[00:08:30] Ajay Shah: And note, this is pre-independence. So there was like no government patronage, no government money. This was all activities bootstrapped by Mahalanobis, many times with his own personal money and so on.

[00:08:40] Ajay Shah: So these were remarkable people who were doing things without waiting for a government to give them money or tell them what to do. And while at Calcutta, C. R. Rao built some of the great propositions, some of the great theorems of statistics of the 20th century.

[00:09:02] Ajay Shah: So if you think of five or 10 of the greatest results, the greatest theorems, the greatest achievements of statistics of the 20th century, then two of them are by C. R. Rao.

[00:09:14] Ajay Shah: They're co-authored by C. R. Rao, even though they were done completely separately. So one of them is called the Cramér–Rao lower bound. It was independently discovered by both people.

[00:09:24] Ajay Shah: And I'll tell that story in a moment. And the other is called the Rao-Blackwell theorem. Once again, it was done separately. Their names were pasted together because they had independently discovered it.

[00:09:34] Ajay Shah: Just imagine, a young person all alone away from the mainstream of European science, living in Calcutta in the little magic created by Mahalanobis who built two of the five or 10 great achievements of the statistics of the 20th century, all by himself in India.

[00:10:02] Ajay Shah: And it is just so amazing that this work got done. Now, what were what were those results? Let me tell a personal story. As an undergraduate student at college, I didn't get any probability or statistics education.

[00:10:16] Ajay Shah: So then when I landed up to start a PhD, I was told that I had deficiencies. So I had to do makeup coursework. Remedial undergraduate coursework was required of me because I just had gaps in my background.

[00:10:30] Ajay Shah: Which which is a good way to approach it. You should recognize gaps in knowledge and we should overcome them. All gaps are overcomable.

[00:10:38] Ajay Shah: So I was placed in a fourth year undergraduate econometrics class taught by a great econometrician and a hero of mine, Dennis Igner.

[00:10:49] Ajay Shah: Now, I'd never taken probability or statistics before. So this was a fourth year undergraduate econometrics class. So in the first five lectures, he did a helicopter tour of all statistics.

[00:11:02] Ajay Shah: And for me, it was just a hurricane. I was swept away in the beauty and the grandeur. I cannot tell you how excited I was day after day learning all those things. And you know, of course, I would go back home and learn everything myself all over again.

[00:11:14] Ajay Shah: But in class, those were memorable moments. So Dennis started teaching the concept of an estimator and the concept of a more efficient estimator or a less efficient estimator.

[00:11:25] Ajay Shah: So take the German tank problem. You could say that I'll take the highest serial number of the tank and that's my estimator. And intuitively we can see that has a problem.

[00:11:35] Ajay Shah: You're likely to undercount the tanks. So you need to worry that there are some tanks that have been produced that have not yet been killed and so you need to add back something into that.

[00:11:44] Ajay Shah: Okay, this is the subject of designing, analyzing, and comparing estimators and coming up with better and better estimators. So the moment he started saying in class that here's one estimator, here's another estimator, and you can see we make it better, we make it better.

[00:11:59] Ajay Shah: And I put up my hand and I said that surely you can't keep going forever, that there will be a limit. There will be a theoretical limit on how good an estimator can get.

[00:12:10] Ajay Shah: And he said there was an Indian guy who asked that question and he got the answer. And that is the Cramér-Rao lower bound. So the Cramér-Rao lower bound proves what is the limit of how good an estimator can be when faced with a certain kind of data set.

[00:12:26] Ajay Shah: So just imagine how fundamental is that result that given a model, given a data set, you get an analytical derivation of the, it's like a possibility result. What best estimator can possibly exist?

[00:12:38] Ajay Shah: And the answer is the Cramér-Rao lower bound shows us the limit of what estimators can do. So you can run and run and build better and better estimators, but you can't cross the Cramér-Rao lower bound.

[00:12:48] Ajay Shah: So that's the first of his results and I'm narrating this to give you a flavor of how basic that result is. It's a fundamental result and he got it in 1943 all by himself in Calcutta, cut off from the European mainstream.

[00:13:02] Ajay Shah: And this is the greatness of what C. R. Rao represented. The second result, the Rao-Blackwell theorem is a technology for making a one step better estimator.

[00:13:12] Ajay Shah: Again, one of the fundamental theorems of 20th century statistics done by C. R. Rao. So this is the man C. R. Rao and he built many, many things in his life.

[00:13:24] Ajay Shah: Now I want to think about Ramanujan versus Anand. Okay, so these are two concepts of the limits of Indian genius, right? So there was something amazing in Ramanujan, there was something, there is something amazing in Vishwanathan Anand.

[00:13:40] Ajay Shah: Both of them are heroes to us and both of them contain deep insights on what is the journey of building knowledge, building expertise, building communities in India.

[00:13:51] Ajay Shah: In a fundamental way, Ramanujan was completely self-taught. He built himself in complete isolation. He had nothing. He just had some obscure 19th century school textbook.

[00:14:03] Ajay Shah: And out of that, he rebuilt magnificent edifices of knowledge all by himself. And then he wrote a letter to G. H. Hardy and he transported to Cambridge and everything else that happened to Ramanujan is a credit of Cambridge.

[00:14:17] Ajay Shah: He was the creature of Cambridge. It is G. H. Hardy who, you know, delicately cultivated the genius of Ramanujan and took him from an astonishing child to one of the world's great mathematicians.

[00:14:31] Ajay Shah: It is the achievement of the Cambridge ecosystem. It is something weird about India that at those levels of deprivation and malnutrition that a Ramanujan character happened in India.

[00:14:41] Ajay Shah: It is something truly remarkable that there are people like Ramanujan in India. But for the rest, the shaping of Ramanujan and the translation of Ramanujan into greatness happened in Cambridge.

[00:14:52] Ajay Shah: That is not the case with Anand. To a substantial extent, Anand lived in India, worked in India, was built by the Indian ecosystem with all its flaws.

[00:15:03] Ajay Shah: The Indian ecosystem nurtured Anand, funded him, gave him impulses. He went abroad a lot. He lived in Spain, like many other world champions did.

[00:15:13] Ajay Shah: He hired seconds in Spain and so on. But there is a fundamental sense in which Anand is that second generation of the Indian ecosystem of chess that came after that first weak generation.

[00:15:25] Ajay Shah: So there is a substantial extent in which Anand was the product of an Indian ecosystem. And then Anand was that great person who helped nurture that third generation of the Indian ecosystem, where chess in India just exploded and it is all to a substantial extent the credit of Anand.

[00:15:45] Ajay Shah: Partly Anand as an inspiration, but also Anand at a hands-on level nurtured the talent and it took 20, 30 years and we are today at an explosive moment where, you know, in some sense, the teenagers in India are just the best in the world.

[00:15:59] Ajay Shah: Today India is ready to say at the teen level we are basically world number one. C. R. Rao to me is a little more of that Anand story and not the Ramanujan story.

[00:16:10] Ajay Shah: C. R. Rao came into an ecosystem built by Mahalanobis. He was not shipped off to Cambridge as a precocious child. He was not a precocious gifted person on the scale of Ramanujan.

[00:16:25] Ajay Shah: He did not write a letter to Mahalanobis saying, "I've proved some theorems and what do you think is going on¿' He came as a regular student to ISI and he exploded in the world created by Mahalanobis.

[00:16:36] Ajay Shah: So it is the achievement of Mahalanobis. And at the risk of offending Bengalis all over the world, I would like to claim that C. R. Rao is the greatest achievement of the Bengali Renaissance.

[00:16:48] Amit Varma: Okay, is that a reasonable proposition?

[00:16:50] Ajay Shah: That's a wonderful proposition. Why should I mind? The whole world is Bengali. I think there is some fantasy novel written by someone.

[00:16:56] Ajay Shah: I've forgotten whom in which Bengal colonizes the world, right?

[00:17:00] Amit Varma: So so it's like, you know, we will certainly claim him as one of our own if you sort of give us a chance. I want to point out for gentle readers here who might be watching this, that in episode eight, we discussed Ramanujan and Anand in great detail.

[00:17:13] Amit Varma: It's called when talent comes in clusters. So if you're wondering why we are going on about Anand and Ramanujan, it is because we spoke about it and that's kind of the reference point.

[00:17:21] Amit Varma: And speaking of Bengali Renaissance, you know, the American Statistical Association once said about C. R. Rao that Rao is a living legend whose work has influenced not just statistics, but has far reaching implications for fields as varied as economics, genetics, anthropology, geology, national planning, demography, biometry, and medicines.

[00:17:42] Amit Varma: And when I read this, I thought ki haan, here is a Renaissance man. And now it strikes me that nahi, here is a Bengal Renaissance man.

[00:17:48] Ajay Shah: So he is the greatest achievement of the Bengal Renaissance, that a young person, a migrant at age 20 or something, comes from Andhra Pradesh and gets transformed.

[00:18:00] Ajay Shah: And all the credit goes to Mahalanobis, all the credit goes to ISI and those people and that community. So, this is really one of the beautiful, inspiring stories.

[00:18:12] Ajay Shah: I want to say a couple of more things. I asked the great Indian mathematician Rajiva Karandikar that how did it become the Rao-Blackwell theorem?

[00:18:21] Ajay Shah: How did it become the Cramér-Rao lower bound? Because it is so easy for work to be done in India to get brushed aside. Okay, we see this even today in the age of the internet that when work is done in India, very often the global mainstream just ignores it.

[00:18:36] Ajay Shah: I've seen it happen many times and it has happened to me. So I've seen things that I have done which were ahead of the global mainstream, which basically have just been ignored and not cited.

[00:18:46] Ajay Shah: And then somebody else basically claims that it is their line of literature and the Indian side gets..

[00:18:52] Amit Varma: And as you pointed out in episode 10, it happened repeatedly to Arun Shourie who was practically decades ahead of the West in, you know, recognizing certain things.

[00:18:58] Ajay Shah: And Rajiva said to me that that was the decency of Ronald Fisher. Ronald Fisher understood that there's something great going on with Mahalanobis and ISI.

[00:19:07] Ajay Shah: Occasionally, he would visit ISI. He rapidly understood the importance of these results and he took to calling it Cramér-Rao lower bound.

[00:19:16] Ajay Shah: He knew what was going on in Cambridge. He knew what Rao was building. He understood these are two basically same results. It's again, the decency of the Royal Society that when Wallace wrote the letter saying, I want to present this, the people in the Royal society knew that Darwin had been nursing this for 20 years and they brought them together and so they both got the credit for having invented the theory of evolution together.

[00:19:37] Ajay Shah: Even though Wallace had just got it in a malaria fever dream a few weeks ago, while Darwin had been nursing this for 25 years.

[00:19:45] Ajay Shah: So this is the decency of Fisher that Fisher started calling it the Rao-Blackwell theorem. Fisher started calling it the Cramér-Rao lower bound. And suddenly for the whole world it became Rao's work.

[00:19:56] Ajay Shah: And so, I think that kind of decency is also very important because otherwise, in 1943, work happens in India, you'll just be brushed aside. There's no internet. I mean, nobody knows that you have done this work.

[00:20:07] Ajay Shah: Uh, so this is the amazing story of Mahalanobis, ISI, Rao, and that ferment, that intellectual creativity of that period, you can imagine just like an Anand phenomenon, it was created here.

[00:20:22] Ajay Shah: It gave the people in ISI immense confidence that we can be at the global frontier. You know, so having one C. R. Rao made a huge difference to a whole generation of statisticians because they understood that this is a game we can play and they had access to the people, they had access to the conversations with Mahalanobis and Rao and so on.

[00:20:44] Ajay Shah: And there was a period where ISI was world beating. ISI was a world class institution. There was a journal that was built out of ISI that was called Sankhya, which was respected as a world class journal all over the world.

[00:20:57] Ajay Shah: Libraries all over the world would get Sankhya. Okay, and this is a remarkable and happy story about what was possible in pre-independence India without any government funding.

[00:21:07] Ajay Shah: So when anybody says, you know, build more public sector universities, I consider myself skeptical that there are fundamental management problems. What you need is a Mahalanobis.

[00:21:16] Ajay Shah: What you need is that eccentric, confident, crazy, creative person. What you don't need is a government bureaucracy. What you need is more individuals like Mahalanobis who will create isolated centers of excellence rather than big bureaucracies.

[00:21:32] Ajay Shah: So I feel that we should look back at that ISI with wonder and think about what has happened. I have a small personal story that connects to C. R. Rao.

[00:21:43] Ajay Shah: My good friend and colleague, Saurish Das, who is at the Chennai Mathematical Institute, is our collaborator. One of the fun things in my life is a programming language called Julia.

[00:21:59] Ajay Shah: I want to shout out to everybody watching this. Dear reader, if you care about computer programming, if you care about high performance, please take interest in Julia.

[00:22:10] Ajay Shah: A co-author of Julia is my good friend Viral Shah and Julia is really one of the great achievements in modern computer programming.

[00:22:20] Ajay Shah: And it allows us to write high quality code, clean code, understandable code, which is at the global frontier of performance. So it's a remarkable package of sanity and cleanliness and the ultimate in performance.

[00:22:35] Amit Varma: As another Julia would say, the hills are alive with the sound of coding. You've promised us a Unix episode. There's been popular demand for that. Now you have to do something about Julia as well, but continue with your story.

[00:22:45] Ajay Shah: Yeah. So we at XKDR Forum and Chennai Mathematical Institute and a bunch of other collaborators are building foundational statistics packages for Julia because we think Julia is of transformative importance for doing statistics, for doing data analysis, for doing data science.

[00:23:04] Ajay Shah: And it's going very well. There's a lot of amazing work going on. I think today this is the global frontier of how to do data science.

[00:23:13] Ajay Shah: In that, Saurish Das is building a beautiful package. First, I want to describe it generically. The principle, the philosophy is that you want a consistent API for a wide variety of different statistical estimators.

[00:23:27] Ajay Shah: So there is a linear regression, there is a Bayesian regression, there is a random forest, there are many, many kinds of models. You should not have to go crazy learning many, many different packages.

[00:23:39] Ajay Shah: You should get one single calling convention whereby you call the function and you say what kind of package, sorry, what kind of estimator you want to do and you get a uniform API for doing a wide variety of estimators.

[00:23:53] Ajay Shah: And in this, we also want to be uncompromisingly Bayesian, that for every single estimator, you want to be frequentist, you want to be Bayesian, it's one single API.

[00:24:02] Ajay Shah: There is no distance. We are trying to remove the stretch that is required to do Bayesian computation. Okay? So this is the beautiful package Saurish Das is the leader of this work.

[00:24:13] Ajay Shah: And then came the question, what are we going to call it? Okay, so many ideas, many names were bandied about. And then one day Saurish came to me and said that I have an idea which is a commitment device.

[00:24:23] Ajay Shah: I said, what? He said, I want to call this package C. R. Rao.jl. I said, huh? Tell me more. He said that this is my way to kick myself that I will do this well. Wow.

[00:24:37] Ajay Shah: We love C. R. Rao. We respect C. R. Rao. And this is our way of promising ourselves that we will do this right.

[00:24:48] Amit Varma: We should we should have called the show C. R. Rao. Everything is C. R. Rao. So you would also have put more effort in. What is this? What kind of shirt are you wearing? Untucked and all that, but no, no, what a fantastic thought.

[00:24:58] Ajay Shah: So that's how Saurish chose the name C. R. Rao. It was just a promise to ourselves that we will not let him down and we will build this into a really good package.

[00:25:09] Ajay Shah: Uh, last tiny story of that, we got an email from C. R. Rao's daughter that somehow she became aware that we had built this package. And she said that she showed it to him and he smiled.

[00:25:22] Ajay Shah: Okay, so that is the closest that I ever came to the greatness that is C. R. Rao and we were very happy and we were very proud.

[00:25:30] Ajay Shah: I want to close off with a bit of a sad story that I described so many things to you. I said in 1943 C. R. Rao as a student was building, you know, global frontiers, mathematics in India, in an institution, the Indian Statistical Institute built by Mahalanobis with basically no government funding and so on.

[00:25:51] Ajay Shah: What an amazing start. In many ways, it was a seed capital to do something remarkable. And it didn't quite pan out like that.

[00:25:59] Ajay Shah: That, you know, in some way, that should have been the beginning of something truly remarkable. It didn't quite pan out that way. So, I feel we in India should think a lot about why that amazing initial condition didn't work out.

[00:26:11] Ajay Shah: It takes us to fundamental questions around the management of institutions that there is something going wrong with the Indian public sector research organization or educational institution where these management methods have problems.

[00:26:29] Ajay Shah: So whether it's IITs or the IISC, etc. There's something about the modern Indian public sector, state-funded organization that is just incompatible with quality and excellence.

[00:26:44] Ajay Shah: We are not able to recreate what Mahalanobis and C. R. Rao were doing at that age. In the field of statistics, something strange happened. Okay. So at the beginning, Mahalanobis, C. R. Rao, etc were at the absolute global frontier.

[00:26:59] Ajay Shah: And the frontier at that time is a field that today is called mathematical statistics. It was about proving theorems about estimators. It was about setting up a mathematical toolbox on analyzing estimators and designing estimators and developing new estimators.

[00:27:14] Ajay Shah: And it was high mathematics, it was very complex mathematics and in the 40s and 50s, people in India were top of the game. Okay. Now what happened was that by the 70s, the game started changing.

[00:27:27] Ajay Shah: Okay, so there was a series of people in the 70s and the 80s, famously in 1979, Bradley Efron developed what is called the bootstrap.

[00:27:37] Ajay Shah: And there was a whole bunch of other innovations in a field that today is called computational statistics where the strategy became that an estimator doesn't have to be a closed-form mathematical formula. An estimator can be an algorithm.

[00:27:51] Ajay Shah: And then suddenly you are dreaming algorithmically; you're thinking algorithmically. I mean of course we use mathematics to analyze those algorithms.

[00:27:59] Ajay Shah: But the unit of analysis stops being a mathematical estimator that can be written down in closed form. But the estimator becomes an algorithm.

[00:28:09] Ajay Shah: And it opens up a whole set of possibilities for how we can design estimators.

[00:28:17] Amit Varma: I must tell, I must tell dear readers that is the ghost of statisticians past who have worked at the ISI wailing to see the condition.

[00:28:28] Amit Varma: No, it's not. It's our cats fighting, and we have to go to the next chapter anyway. So give us a moment. We will sort out the kitten situation.

[00:28:40] Ajay Shah: So there was this development of a great field which is now called computational statistics where the unit of analysis is an algorithm and not a theorem. It required computer science to be fused with statistics.

[00:28:53] Ajay Shah: And in a fundamental way, India just missed the boat. The entire statistics community in India was wedded to the old ways. We keep on doing mathematical statistics. We keep on doing theorem proving.

[00:29:04] Ajay Shah: Today we are in a data science revolution, which in a way represents the flowering of these computational statistics techniques. But the Indian statistics community didn't turn on the dime and reinvent themselves and that's just a pity.

[00:29:19] Amit Varma: We missed the boat on algorithms, and what I am worried about is that you and I will miss the boat on the YouTube algorithm. Ki bhai, kuch karo. Let us at least, if we can't go Viral Shah, let us at least go viral as it were, right?

[00:29:32] Amit Varma: So, yeah, that's it's actually a pretty moving story of not just a man, but an entire ecosystem which almost seems lost.

[00:29:41] Ajay Shah: Yes.

Chapter 2: The Unusual Mind of Abraham Wald

[00:29:49] Ajay Shah: So Amit, we talked about the German tank problem. Do you have fun problems on your mind?

[00:29:52] Amit Varma: Yes, yes. Why should we talk? See, we equity has to be there. You have spoken about German tanks. Now we must speak about British planes.

[00:30:00] Ajay Shah: Okay, let's do that.

[00:30:02] Amit Varma: To set the record straight. So I want to tell you the story and this is such a famous story. You obviously know it and many of our gentle readers may also know it. Now, Abraham Wald was also kind of like a Renaissance man, did well in various fields, decision theory, sequential analysis, statistics, blah, blah, blah.

[00:30:18] Amit Varma: And circa 1942, if I remember correctly, he was drafted into something called the Strategic Research Group. Right? The Strategic Research group was in fact headed by a gentleman called something Wallace who was one of his students.

[00:30:30] Amit Varma: And Wallace at one point described it, not without exaggeration as we know today looking back in hindsight, as the greatest group of living statisticians ever assembled. It was such a remarkable group, there was such intelligence in the room that at one point somebody quipped that Milton Friedman is the fourth smartest person in the room.

[00:30:47] Amit Varma: Can you imagine? So, and Abraham Wald would have been the first smartest person. And despite this, let me tell you, he didn't have security clearance by the way. So, he would work on problems which he didn't have security clearance to actually see for himself.

[00:31:00] Amit Varma: So there was a joke that a secretary would stand by his side and every time he finished writing a sheet of paper, the secretary would quickly take the sheet away and then he'd begin work on the next sheet. So that was how the joke went. So there was an interesting problem that came to them about British aeroplanes.

[00:31:14] Amit Varma: That analysis needed to be done. A lot of British aeroplanes were coming back wounded as it were. You anthropomorphized tanks earlier by saying tanks were killed. So these were wounded aeroplanes, were kind of coming back.

[00:31:26] Amit Varma: And one had to analyze these wounded aeroplanes to see how they could be made stronger. And one way of doing this was just seeing the bullet holes in different parts of the plane. Right?

[00:31:36] Amit Varma: So, a simple sort of a table that looked at that saw that the engine had fewer holes than the fuselage, right?

[00:31:46] Amit Varma: And so, a conclusion that many drew from there is that, hey look, you know, all the bullet holes are in the fuselage, that's a problem, let's make it stronger. Wald said, no.

[00:31:56] Amit Varma: Wait a minute. That's not how you think about it. Ask the fundamental question, where are the missing bullets? Right? Once again. Where are the missing bullets? And his theory was this, that assume that all parts of a plane are going to get struck more or less equally, right?

[00:32:10] Amit Varma: The part with the fewer bullets is the part which is most vulnerable that needs to be fixed because that is what is going down. Where are the missing bullets? The missing bullets are in the planes that went down. So it is the engine that you need to protect and you need to kind of cover up for that.

[00:32:26] Amit Varma: Which is a counter intuitive, you know, sort of way of thinking about it. But you stats came up with that and it reminds me of something another great sports person came up with intuitively where, you know, Ricky Ponting, the great Australian batsman was once asked about his journey towards becoming a great batsman.

[00:32:43] Amit Varma: And he said, look, most batsmen have a map of the fielders in their head. I had a map of the gaps. So, that's that's sort of you had a German tank story. I I call you and I raise you with a British airplane story.

[00:32:58] Ajay Shah: Yeah. It's a great story. The technical phrase is survivorship bias, that when you see the data set, you are seeing the survivors. There are many units of observation that died along the way and you don't get to see them.

[00:33:09] Ajay Shah: So, it's always important to think more clearly about the source of the data rather than blindly using the data.

[00:33:15] Amit Varma: So, you used a phrase, I'll interrupt you before you go on to your story and tell you this interesting problem, and I wrote a column based on this once as well about illustrating survivorship bias. But at its heart, it's a scam. It's a great Indian scam, right?

[00:33:28] Amit Varma: So let us say that on a given day, I write to a thousand people who I know are like to bet on cricket and I tell them that look, everything is fixed. And bettors often believe in conspiracy theories. Everything is fixed.

[00:33:42] Amit Varma: I will tell you the result of the next India- Sri Lanka match. And they say, okay, tell us. And I'll say you don't have to pay me anything, I'll just tell you for free. I tell 500 of them India is going to win. I tell 500 of them Sri Lanka is going to win, right? Let's say Sri Lanka wins.

[00:33:55] Amit Varma: So 500 of them know I got it right. I do the same thing again. I tell 250 of them India is going to win, 250 of them Sri Lanka is going to win. Let's say India wins. 250 think I'm right. By the time I bring that number down to, you know, 10 or 12 or whatever, they believe me completely. I've got four, five, six right in a row.

[00:34:12] Amit Varma: They're willing to pay their money. And actually what happened was all of these were arbitrary random strategies. And it just so happens that that one particular strategy which led to 12 correct answers in a row, they will think it's a great strategy and that survivorship bias at play.

[00:34:26] Amit Varma: And when you think about mutual funds, this is why you can't just look at a mutual fund or a hedge fund and look at like a five, six year record, because if you say have a family of mutual funds, you you can just randomly make them do different things and by sheer dumb luck one will come out on top.

[00:34:41] Amit Varma: But it doesn't mean that that is a correct strategy. Perhaps it just got lucky. So, sorry, illustration of survivorship bias.

[00:34:46] Ajay Shah: Absolutely. Survivorship bias is is a lovely idea. Also, I would love to sell to everybody doing data analysis and data science that these are examples where you are encouraged to think more deeply.

[00:34:58] Ajay Shah: So, for too many people, statistics has become a mechanical process where you throw some data into some software package and you get some answers. And always and always, it is important to preserve fundamental intuition and insight and common sense.

[00:35:13] Ajay Shah: So, you need to always understand the problem and too many people in India are trying to turn this into a mechanical affair. Let me uh raise you with another simple story, but yet a beautiful and insightful story, which is related to the planes.

Chapter 3: How Many Lives Does It Take to Kill a Factory?

[00:35:38] Ajay Shah: Okay. So, the planes were going from the island of the UK to the continent and trying to kill facilities like uh oil refinery or a tank production factory.

[00:35:54] Ajay Shah: And uh they were getting shot up by German fighters and the ground-based flak, the 88 mm artillery gun.

[00:36:05] Ajay Shah: And uh they would either get shot down or they would struggle to limp back. By the way, one of the most beautiful phrases in the English language, coming back on a wing and a prayer. Okay, that is a phrase that is used all the time. Well, this is where it originated.

[00:36:20] Ajay Shah: It is literally a British or an American plane high above the European continent with its engines shot out. So, it's just a wing. It's trying to glide back home.

[00:36:32] Amit Varma: Wow.

[00:36:33] Ajay Shah: And you're just praying that you'll reach in time. So that's the source of the phrase a wing and a prayer. Okay. So now in that, imagine that we are given a problem that there is a tank factory and we want to kill it. So you've got to be scientific about it.

[00:36:48] Ajay Shah: You don't just throw bombs from high up and hope for the best. Okay? So there is always a bomb damage analysis that is done afterwards. You have a spotter plane, you have local intelligence, you have the brigadier's girlfriend, you got to find out whether the plant actually got destroyed.

[00:37:04] Ajay Shah: And at the time of World War II, the imprecision of bombs falling under the force of gravity was horrendous. Okay, there circular error probability is like 1 km, 5 km. You would throw thousands of bombs and you would not be sure you have hit one factory correctly.

[00:37:21] Ajay Shah: So you needed to figure out probabilities of what is the chance of the bomb hitting? Now, in that, there were anti aircraft guns from the ground and there were German fighters that were at the ground who were shooting at the craft.

[00:37:36] Ajay Shah: So, for the fighters, it was terrifying to go low and they wanted to fly high. So they wanted to be at 20,000 feet. So you're out of range of the anti aircraft guns. So you fly, you drop your bombs and you come back home.

[00:37:52] Ajay Shah: Okay? And that sounds superficially like a good idea because, you know, the anti aircraft guns don't get you. The the Luftwaffe had low capabilities by 1943 to actually scramble fighter planes and attack the bombers that were flying high above.

[00:38:08] Ajay Shah: Now that is where statistics comes in. Okay, so you start calculating that I send one bomber flying at 20,000 feet and it drops some bombs. And what's the hit rate? There is a miniscule hit rate. There's very high imprecision.

[00:38:22] Ajay Shah: So very few bombs get through. Okay? Or I fly at 6,000 feet. I run the gauntlet of all the anti aircraft guns. There is some rate at which this one is dying, there is some rate at which that one is dying. But I ask what is the rate at which the factory is getting killed?

[00:38:39] Ajay Shah: Okay? And the brutal answer turns out that you have to fly at 6,000 ft. because while the chances of getting killed by the anti-aircraft guns are higher, you need a smaller multiplication factor to overcome the imprecision of the bombs.

[00:38:56] Amit Varma: So the question you're really asking is how many lives is a factory worth?

[00:38:59] Ajay Shah: Correct. So, how many lives does it take to kill a factory? Not the subjective fear of a pilot going to 6,000 feet or 20,000 feet. And so there is this remarkable moment in history where the young Robert McNamara, one of the early quantitative thinkers, the statistician of this project, Curtis Lame, the head of bomber command, they first went back to a room full of the pilots and said, you have to fly at 6,000 feet and not 20,000 feet.

[00:39:31] Ajay Shah: And the pilots were in uproar that it is death to fly at 6,000 feet. You have not seen the anti aircraft guns. You have not seen the flag. It is terrifying to go there. Why the hell would you ever ask us to do it? And Curtis and Robert McNamara said, "We love you more than life itself, but we want fewer of you to die."

[00:39:50] Ajay Shah: And the way to do it is to go at 6,000 because we are counting how many of you die per unit factory killed.

[00:39:58] Amit Varma: Incredible. What a story. And and and you know what a tragic sort of uh and I you raised me, so I will just fold you because I don't want to I don't want to play the next hand that I'm forced to play, but I'll just fold it, which is that Abraham Wald died in an air crash.

[00:40:12] Amit Varma: He died in fact in an Air India crash in 1950. And this again brings us a full circle back to the ISI. Because he died in India. He had just given a talk at the ISI in Calcutta. He was going to I think the Indian Statistical Congress in Bangalore that January and plane crashed, he and his wife died. He was 48 years old.

[00:40:32] Amit Varma: So, you know, great uh great loss, great tragedy and you know, if there was a reunion of the uh you know, the group he was part of, Milton Friedman would now be the third smartest man in the room, but not in a way he would have liked.

[00:40:45] Amit Varma: Though I I feel like Mr. Friedman and I myself being a Friedman fan is going to dispute that fourth smartest, third smartest thing.

Chapter 4: Professor Mahalanobis

[00:41:00] Ajay Shah: So Amit, I talked a lot about C.R. Rao and I know you've deeply analyzed P.C. Mahalanobis, your fellow Bengali. Tell us more about Mahalanobis.

[00:41:11] Amit Varma: All Bengali geniuses are belong to me dada. So, here's the scene. A lot of the dope that I got on Mahalanobis, which I'll be talking about right now, came came to me via this excellent book called Planning Democracy by Nikhil Menon.

[00:41:24] Amit Varma: And I have, you know, had him on The Seen and the Unseen as well. Excellent book. And, you know, there I found as you said earlier that studied physics first and then when he was on a ship back to India, you know, he was given volumes and volumes of a statistical magazine called Biometrica.

[00:41:42] Amit Varma: And he lost himself in those magazines. He got so fascinated that he was just enraptured by them. And by the time he landed in India, statistics was his love. Right? So he actually taught physics in presidency college. That's where he was hired for a while, but in those days, he would go on to found the Indian Statistical Institute and kind of do all of that.

[00:42:00] Amit Varma: And and a very unusual kind of man even for the age. And Nikhil in his book has this excellent you know, description of him. He writes, "Tall, prominently nosed, stern of gaze, vast of brow with hair severely parted and slick flat by coconut oil, Mahalanobis looked the part of a serious man.

[00:42:18] Amit Varma: He was born into a family that belonged to Bengal's landed elite and his early milieu was that of intellectual inquiry and religious reform in turn of the century Calcutta. He grew up to be a prim workaholic seemingly immune to frivolity and usually found day and night stooping over his calculations.

[00:42:34] Amit Varma: As a friend of nearly half a century corroborated, he had no time for small talk and little capacity to compromise with unreason. These are the friends' words. And even a smile, tight lipped and partial to the right cheek, could seem a grudging concession.

[00:42:47] Amit Varma: Mahalanobis appeared to make a virtue of withholding expressions of affection, believing it his duty to conceal it except to pets, which included dogs, cats, and cows. Now I know not of your fondness for dogs and cows, but the rest of this seems to fit you Ajay Shah. Let me note.

[00:43:03] Ajay Shah: And cows also.

[00:43:05] Amit Varma: Cows also. There you go. All of the all of this sort of fits you. And the interesting thing about Mahalanobis is that around this time, he sort of was one of the early pioneers of randomized sample surveys.

[00:43:17] Amit Varma: So in 1944, there was this sort of fascinating real world experiment where Mahalanobis' innovation, the random sample survey, which, you know, he and his colleagues had sort of pioneered in a sense at the ISI, was pitted against traditional methods of counting.

[00:43:32] Amit Varma: And I'll read this out from Nikhil's book also. It's fascinating. He writes, "A science, the science of random sample surveys for which the professor and the institute were among the earliest crusaders was yet to gain widespread acceptance anywhere in the world.

[00:43:46] Amit Varma: There were calls to abandon it and return to traditional plot-to- plot enumeration. In 1944, the Bengal government decided to settle this dispute over technique by commissioning both methods in a competition.

[00:43:57] Amit Varma: The idea was to run them simultaneously and then compare their results against the official jute sales figures.“ This was about jute basically, against the official jute sales figures to determine the more accurate reading.

[00:44:09] Amit Varma: It was a moment of sweet vindication for the institute and the science of sampling. The cumbersome enumeration or counting carried out by the government turned out to be off the mark by 16.6%, while the institute's more sophisticated sample survey erred only by 0.3%.

[00:44:25] Amit Varma: Even more conclusively, the sample survey cost only a 10th of the enumeration. End quote. So, obviously at this point he kind of becomes you know much better known, much more credible. And the question is how does this then affect him?

[00:44:39] Amit Varma: You know, remarkable success, clearly a great genius. And uh you know, at one point Nikhil writes in his book, quote, “An urbane savant, Mahalanobis was once described as, quote unquote, a physicist by training, statistician by intellect, and planner by conviction.“

[00:44:56] Amit Varma: He was also much more. He was also much more, versed in ancient Sanskrit texts, possessing of a discerning ear for Bengali poetry and a dabbler in architecture. In short, he was a proud polymath although of uneven talents, despite his high estimation of his own abilities.

[00:45:11] Amit Varma: Even an admiring younger colleague conceded, and now these are the colleague's words, “He thought he knew best in practically every matter.“ colleague's words ends. Mahalanobis was often referred to in Indian academic and government circles as the professor and it wasn't a moniker he was shy about.

[00:45:25] Amit Varma: And it wasn't a moniker he was shy about employing while signing correspondence. End quote. And, you know, the the the story goes on. I will now quote the new third smartest man in the world Milton Friedman, talking about Mahalanobis and Friedman says this of Mahalanobis.

[00:45:41] Amit Varma: Mahalanobis began as a mathematician and is a very able one. Able mathematicians are usually recognized for their ability at a relatively early age. Realizing their own ability as they do and working in a field of absolutes tends, in my opinion, to make them dangerous when they apply themselves to economic planning.

[00:45:58] Amit Varma: They produce specific and detailed plans in which they have confidence without perhaps realizing that economic planning is not the absolute science that mathematics is. End quote. And he himself could not stand economist, you know, he was much more thinking of the world in terms of physics.

[00:46:15] Amit Varma: He respected physicist more, but he was also perhaps searching for those certainties while economists have to recognize the messy complexities of the real world. Hannah Arendt said about Mahalanobis, "He must be nearly 70," and this was obviously late in Mahalanobis's years.

[00:46:32] Amit Varma: He must be nearly 70, immensely vigorous, alert, and intelligent, but also domineering, vain, and bigoted. A Bengali aristocrat who in moving towards a stalinist type authoritarianism has completely bypassed democratic liberal notions, never in any doubt who would plan and who would be planned for or against.

[00:46:50] Amit Varma: Right? And there is another, you know, I know you hate surveillance and the surveillance state and all that and there's another excerpt from Nikhil's book about you know, what the kind of benevolent autocrat Mahalanobis was. And Nikhil writes, you know, while attracting students from across the country to enroll in the institute's year-long program in statistics, the only one of its kind in India, the professor found little time to teach.

[00:47:11] Amit Varma: This did not, however, soften the harsh glare of an overbearing administrator. Students and staff were expected to record their daily activities in a diary and an attendance register was used to record entry and egress. End quote.

[00:47:25] Amit Varma: And again the mathematical mind everything must be precise. I must know everything, but he would have loved Adhaar and you know, modern tools of uh surveillance. So, just contrasting sides.

[00:47:36] Amit Varma: The man who is a genius, but in a sense has also trapped by his own genius into a hubris and an arrogance that doesn't serve him so well uh you know going down the line.

[00:47:47] Ajay Shah: Yeah. This is a recurring theme. The certainty of science and engineering leaves many very successful people in those fields unprepared for the complexities of the real world, the social sciences, the humanities are just filled with the unknowable.

[00:48:07] Ajay Shah: Whereas when you are doing one controlled system, it could be a mathematical model, it could be some engineering, you could be building one piece of software, you have much more control. So the mind gets used to that level of control. So I feel the phrase high modernism is the description of this idea.

[00:48:25] Ajay Shah: Two-part idea that the scientists and the engineers know what to do and that the scientists and the engineers have a special claim upon truth. When they argue for X and they ask for the coercive power to force everybody else to go their way.

[00:48:42] Ajay Shah: And if there is one great thing we have learned through the 20th century, it is that high modernism works pretty badly.

Chapter 5: The Sadhus and the Planning Commission

[00:48:56] Amit Varma: So I want to ask you, have you ever heard of the Bharat Sadhu Samaj?

[00:48:59] Ajay Shah: Never, in my whole life.

[00:49:00] Amit Varma: Okay. So the Bharat Sadhu Samaj was an organization set up in the mid 50s. I think 1956. And what is the purpose for setting them up? The purpose for setting them up is that India had too many sadhus. It was estimated that there are some 75 lakh sadhus in India.

[00:49:14] Amit Varma: And the thinking was that many of these sadhus are frauds and charlatans and all that. Some would even say all, but never mind. Many are frauds and charlatans. How do you identify a genuine sadhu? Obviously the government has to do it.

[00:49:25] Amit Varma: So in 1956, a Sadhu registration bill was brought about and the idea was that if you want to be known as a sadhu, you have to apply to the government. You will get a license to practice as a sadhu and thereby join the Bharat Sadhu Samaj and only then can you qualify as a sadhu.

[00:49:40] Ajay Shah: Was there a certification examination? Was there a UID?

[00:49:43] Amit Varma: I'm not aware of those details but I mean obviously sadhus don't need to be certified today. So something happened. But here's an interesting thing, all right? Once a Bharat Sadhu Samaj was formed, not farmed, you could farm them, with licensed and certificated sadhus, you know with their documentation in triplicate and all of that.

[00:50:03] Amit Varma: Uh they all gathered all these sadhus and Rajendra Prasad, our honorable president gave a speech to them. And here is what he said. "You need hardly be told that there is an intimate relationship between the world we live in and Parlok, the world we strive for.

[00:50:19] Amit Varma: It is not possible to achieve anything in the other world without setting things in order in this world. Our scriptures do not enjoy indifference towards this world." End quote. And I want to ask you why did he say this? What is the subject of what he is talking about?

[00:50:34] Ajay Shah: Do tell.

[00:50:34] Amit Varma: It is planning. He wanted their support for the five year plans because he said that you want to be good in that world, you got to be good in this world, five year plan will get you there. So that is the story of the Bharat Sadhu Samaj which I learned from Nikhil's book again, Planning Democracy.

[00:50:47] Ajay Shah: So everyone should buy it.

Chapter 6: Chintaman Deshmukh, the Sanskari Romantic

[00:50:56] Ajay Shah: Amit, have you visited the ISI? Tell us more about the ISI.

[00:50:59] Amit Varma: I have had nothing to do with the ISI, but I do have more stories, right? I had once done an episode with Sam Subramani on narrative non-fiction and he'd written a great book called a dominant character on the scientist JBS Haldane. Now JBS Haldane in the mid 50s when he was in his 60s had come to work at ISI.

[00:51:18] Amit Varma: And there he had the following words to say about Mahalanobis who was traveling all the time. The journeyings of our director define a novel random vector. Right? So that is, you know, Haldane talking about Mahalanobis in statistical terms. I I have no idea what that phrase means, but I'm sure you do.

[00:51:36] Amit Varma: And I also talk about Haldane coming to India uh to describe a great example of show don't tell, right? The writing principle show don't tell is just don't tell something in straight words, show it with something. And there's a great example of this in Haldane where he was asked that boss, you've lived all your life in England in your 60s or whatever you've come to India, why do you want to, you know, why have you shifted?

[00:51:55] Amit Varma: And he could have said that I want to live a simple life unconstrained by convention or whatever. He could have said one of those things. Instead he said, I don't want to wear socks anymore. And that's such a beautiful sentiment because everybody immediately gets a vibe.

[00:52:09] Amit Varma: Nobody likes wearing socks, I mean unless they're kind of kinky and you know, they wear it on their heads while doing unspeakable things. Look up autoerotic asphyxiation. But his gig was I just want to chill. And his way of saying this was I don't want to wear socks anymore.

[00:52:23] Amit Varma: And you see pictures of him in the rest of his life, he's like in Banyan and Dhoti and pajama and all of that, but never a sock in sight. So fantastic story about Haldane. And my final ISI connection and a suitably sanskari way to end the show is circa 1944 around the time you know Mahalanobis proved that the random sample surveys work against the government of Bengal.

[00:52:47] Amit Varma: Now I don't know if there was a positive link or whatever, but a gentleman who was high up in the government called Chintaman Deshmukh, later to be a finance minister, C D Deshmukh, Chintaman Deshmukh approved a certain flow of funds to ISI, practically guaranteeing that it would survive and it would remain for a few more years at least.

[00:53:05] Amit Varma: And he also seems to be a sort of a renaissance man. And again Nikhil in his excellent book writes of him, a diminutive man with a chiseled face Deshmukh was a suave cerebral product of elite Bombay and Cambridge education who ranked first in the Indian Civil Service.

[00:53:21] Amit Varma: He was a rooted cosmopolitan combining anglicized sophistication with Brahmanical learning. A figure known for reciting Vedic shlokas for pleasure, translating Kalidasa's Meghaduta from Sanskrit and quoting scripture to buttress economic policy commitment to the classical Rand D. End quote.

[00:53:39] Amit Varma: And I just got randomly interested in this person because I never heard of him before. So, uh I I had heard that, you know, he had after he was widowed tragically in the early 50s, he had married this lady called Durgabai Deshmukh. Right?

[00:53:53] Amit Varma: And Durgabai Deshmukh had herself had a child marriage at the age of eight. And then when she turned 14 and the marriage wasn't consummated yet, she told her father, I'm not going to do this. She spoke to the guy, the guy was liberal enough and let her go and all of that. And she was a feisty outspoken woman.

[00:54:07] Amit Varma: And she eventually married Chintaman Deshmukh in the 50s and, you know, lived happily ever after and all of that. And people were aghast at the marriage because he was urbane, sophisticated. She was outspoken, you know, will say whatever comes into her head.

[00:54:20] Amit Varma: And I tried hard to look for her autobiography Chintaman and I. and it is not available on Kindle, it's not available anywhere. However, however, I found a free copy of it on the net which I will link from the show notes. And I love the opening words of that book.

[00:54:34] Amit Varma: These are the opening words, "Chintaman took me to a eucalyptus tree in his garden and inscribed two Sanskrit shlokas on its bark. It was a proposal of marriage. I accepted and he kissed me."

[00:54:47] Ajay Shah: So this is sort of my final story of the day, which shows that even people who care about statistics and math have hearts. When men were men and inscribed Sanskrit shlokas into barks of trees.

[00:55:02] Amit Varma: Have you ever done that?

[00:55:02] Ajay Shah: No. No such luck.

Chapter 7: Amit's Recco

[00:55:09] Ajay Shah: Amit, tell us your recommendations for today.

[00:55:12] Amit Varma: So I want to turn to my right, because I'm always turning to the right, and point to a set of three books here, The Great Mental models. You know, these are brought out by Farnam Street, uh Shane Parrish is one of the co-authors. Shane Parrish of the excellent knowledge project podcast.

[00:55:26] Amit Varma: And these are brilliant books because you know, one of we get educated in a sense, but one of the things that our formal education doesn't teach many of us is how do you think about the world? And these three books give you those mental models.

[00:55:40] Amit Varma: Like the volume one has them in a very general sense, and you have physics and chemistry, then you have math. So you're getting all the mental models, the tools with which you can crock different aspects of the world. I mean when you and I say everything is everything, right?

[00:55:52] Amit Varma: Everything is related to everything else, but where are the tools with which you will find those commonalities and where are those frames through which you will find meaning in everything that you see? So this three volume set which was gifted to me a long time back by a good friend of mine, Gautam John when I went to Bangalore, just a treasure.

[00:56:10] Amit Varma: Everybody must have it. And I think the Kindle copies are really cheap. So I would recommend them for everyone.

Chapter 8: Ajay's Recco

[00:56:21] Ajay Shah: So Ajay, what recommendation are you leaving us with this week? Even if you have never done any statistics, I recommend the book, The lady tasting tea by David Salzburg. It is it takes us into the early years of thinking about statistics and Fisher and the others and asking very simple questions around a lady tasting tea.

[00:56:42] Ajay Shah: So it's a fun book.

[00:56:44] Amit Varma: Like where is the?

[00:56:45] Ajay Shah: Well, the lady claimed that whether you put the tea in the milk or the milk in the tea, it matters. And Fisher set out to establish whether she actually knew it or she didn't.

[00:56:58] Amit Varma: So a blind test would sort that out right?

[00:57:00] Ajay Shah: Yeah, but how do you develop concepts of testing, blind testing, the mathematics of these things?

[00:57:05] Amit Varma: Brilliant. I'm going to rush out and buy that book right now. And in the meantime, gentle readers, thank you for sticking with us for so long. Ajay and I had a great time. I hope you had a great time. And we'll see you next week.

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