V. (Seenu) Srinivasan Interview by Leigh McAlister, October 24, 2017, Houston Texas

Early Life

LEIGH MCALISTER: I am honored to be able to be part of this recognition of your contributions, Seenu. And I want you to know that all your other doctoral students wish they were here. I've talked with them, and we collectively, heartily endorse this decision by INFORMS. We are wondering how this all got started. Could you tell us about how you became such a wonderful dissertation advisor? What was it like when you were a little boy?

SEENU SRINIVASAN: Thank you so much. So my name is-- I'll give you my full name, which is normally not written down anywhere. It is Venkataraman Srinivasan. And I go, as you know, by the nickname Seenu. So people call me Seenu Srinivasan.

And I was born in a small town. The name of the town is Pudukkottai. It is in the southern part of India in the state of Tamil Nadu, and population, maybe about 45,000 or something like that. So my father was an attorney. And my mother was a homemaker.

And my father has had a huge influence on me, which is often the case, I think, with boys. But my mother, too, I will get to that. My father, in particular, is a highly organized person.

And in particular, had one particular thing-- he kept telling me this. Whatever you do, you need to do it perfectly. So I have changed it to excellently, because I think perfectly is just very difficult to do. And secondly, he's just extremely organized-- in his thinking and the way he does his things and so on. Both of those things have rubbed on to me in a big way.

My mother is just a very nice person to everybody and that has also rubbed on to me, I hope. So that's where we started. We are a large family. My parents had five boys and one daughter. And the youngest one, unfortunately, died in an accident. So the four of us are there.

And two of us are in the academe. And you know my older brother, you have met him, Professor Balachandran at Kellogg, Northwestern University. And my father was actually married before. And only when his first wife died, he married my mother. So there is a half-brother and a half-sister from that marriage, too. Those two have passed away.

So I grew up in this town, Pudukkottai, very sheltered and not particularly much of a world view or anything like that, not in the capital of the state or anything like that. So primary school and elementary school, secondary school, I went to a private school, but not particularly expensive. These are all quite inexpensive schools.

I was very good in math. And later on, when it got to high school, physics. Those are the two subjects that I really got interested in. And I would trace it back to a couple of teachers who were in the elementary school, particularly, I think. And they were just, you know, the kind of

questions they asked, the kind of questions I will ask them and how they will respond to it. So that was OK.

Another person who had a huge influence on me was my neighbor, the neighbor across the street. He would get his kids and me, I will just sort of join in. And he will give a series of problems, mathematical problems to solve. This is when, like, eight or 10 years old. And I think that just drilled me into sort of thinking about math problems well.

I didn't particularly like chemistry or biology, even though I did OK, well, in those courses. But that was not my favorite thing. It seemed to be, at least the way it was taught, more of a cramming exercise as opposed to really thinking deeply about it and then applying it somewhere else, which was true with both math and physics.

So when I finished my high school, I was really interested in going to an engineering college. Why engineering? Partly because it is physics and math, sort of just directly translates into engineering. It is also because there are only two types of careers in India at that time. This was back in 1960s I'm talking about. Only two careers which will give you a decent wage.

So one was engineering, another one was medicine, doctor. And of course, I didn't want to go the doctor route because of chemistry and biology. So clearly, I wanted to do engineering. I was number one in my high school. And so I was pretty confident that I will get in.

The state I come from is called Tamil Nadu. That is a state where people speak the language Tamil, which is an old language going back some 3,000 years. But the peculiarity about that language, because it is a Dravidian language, it is very different from the Indo-European type of languages.

And the impact of that is that if I leave my town and go 250 miles in any direction, I will be totally lost because the language is just now completely different. And so I applied only to the engineering colleges in my own state. There were, like, five or six colleges, but there was sort of a common admission to all of them. And the common admission turned out I was turned down to all engineering colleges.

LEIGH MCALISTER: That's not believable, Seenu.

SEENU SRINIVASAN: I know. I was just completely devastated. And it happened, I'm quite sure, because I was a Brahmin. Now we have this caste system in India. Brahmins are at the top, arguably, in some sense. But they were originally priests, really, more than anything else.

But they knew Sanskrit, which is a language which is close enough to the European languages, and hence English. So the people who were Brahmins became the administrative elite under the British Raj. And they are only like 5% of the population in my state.

So there was a lot of resentment against the Brahmins. See I was not even aware there was this much resentment when I was growing up. Anyway, I was just turned down, plain and simple.

Undergraduate Education at the IIT, Madras

And so my father said, why don't you do a B.Sc. in math or physics. I know that will not lead me very far because, eventually, I will not get a job, even though I can do the studying itself. So luckily for me, somebody told me that there is a new institution that is getting started in Chennai, which is old Madras, and that is a capital of my state.

And this is called the Indian Institute of Technology. This is the third such institution startup in India. There were already a couple of them. One in Kharagpur, another one in Bombay. And they said, if you take that entrance exam and you do extremely well, that will get into, because this is now a national college as opposed to the state college, which is where this discrimination was taking place in a big way.

So I did not follow my father's advice of doing a B.Sc. in physics or math. I just sat home. I just got the books for B.Sc. physics and B.Sc. math and B.Sc. chemistry, because I had to do those three subjects.

And sort of studied on my own. There's no tutor or anybody like that. I just studied on my own, took the exam. I did extremely well in the exam.

And so I got I admitted to this Indian Institute of Technology called IIT Madras. Madras is the state capital. It's also called Chennai-- is the current name for that.

I went into mechanical engineering partly because, again, there's physics and so on. It's sort of close enough to mechanical. And secondly, when I was growing up, there was a bicycle shop next to my house.

So I used to work there. And so I got interested in the machines, how they work, and how to repair something, and this kind of thing. So that was part of the reason I got started in it.

That's where my real mathematical training took place, at the IIT. You know, starting from calculus and then we were applying it. And some of the notion of models, mathematical models-- that is, it is not a perfect description of whatever it is that you are trying to do. It may capture say 90% or 80% or whatever. But that's good enough to sort of work with to get a decent result.

In mechanical engineering, that's good enough. You don't need to be perfect by any chance. Because we have something called a factor of safety, we will apply the factor of safety, so that if something is missing in my calculation, the machine will not break down at least, that kind of thing.

So after five years, I graduated as a gold medalist in the program. This is the top student in the entire program that were graduating that year. And one thing I should mention, that out of 100 people who apply to this institution, only one person gets selected.

So it is a highly selective institution. And so they end up at the top of that institution, which is a fantastic thing. So it was, in a way, it was lucky that I was rejected to these other colleges,

because I would not have gone this route. The other thing that is interesting is, I sort of reflect back, how many other people like me were reverse discriminated and sort of didn't pursue whatever they could do because of what happened there? We don't know what happened. There is no statistics kept on this stuff.

From Production Planning to Carnegie-Mellon

So after graduation, I had two paths. Either I can continue with an M.Tech, which is a Master of Technology, or I can go to the world of work. So I thought-- I'm only at that time 22 years old, so you know, why not just figure out how this world of work is like?

So there was a company in Mumbai, in those days it called Bombay, called Larsen and Toubro. These are two Danish engineers who started this company in India. So I was assigned to production planning within that group.

And so one of my supervisors said, you know, there is this formula called economic order quantity. Why don't you use that? I said, where does that formula come from? So he said, you know, go look up a library. And there is a book on production planning, or industrial engineering. You'll find it.

So I read up on this stuff. And so I found it really interesting. I had not done such things in mechanical engineering itself. I also learned that this model, which is sort of a purchasing kind of model, that is, an order, purchase, it costs something, fixed amount. And then there is this inventory holding costs, and then you sort of balance those two costs, optimize it, to get this economic order quantity.

What on surface, looked like a completely different problem, which was, there were in this company, which is called a switchgear company-- you know, there are these power bars, and you have to connect those power bars through a heavy, strong conductor. So these are silver conductors. So, silver, obviously, the inventory holding costs are tremendous.

But there is a fixed cost which is not so much ordering cost. But it has to do with, when you set up the machine to make this thing, it costs something. So even though superficially it looked like a different problem, it is exactly the same problem mathematically. So I could sort of apply the same thing to do that thing.

So I thought I should study a little bit more. So I asked my manager there, hey, can I get a couple of years of leave of absence? And you know, I will go to the US, study an MS in industrial engineering or industrial administration or business administration. And then I'll come right back and take this job. So they said fine.

And initially I was admitted to some college. But this manager really knew quite a bit. So he said, you know, this Carnegie Mellon is a great school. Why don't you go there-- among the schools I was admitted to.

So I went to Carnegie Mellon, and I worked with Gerry Thompson, Gerald Thompson, who is also an INFORMS Fellow, fantastic advisor. So you talked about my working with doctoral students, it was very similar. I would sort of sit down next to him, and we will literally code things on the thing. And those days there was a teletype, so that it is like a tape which will sort of come out of the machine. You probably remember those.

LEIGH MCALISTER: Yes, I do.

SEENU SRINIVASAN: And then you had to sort of feed that tape back in. And then that's how the program loads on-- it used to be BASIC was the programming language. So that's what I was-- so he was my advisor, a fantastic person to work with.

And I will tell you a little later, then, exactly how I got into my dissertation topic. But I worked with Egon Balas, of course, the famous integer programmer. He was another professor of mine. So I graduated in a little less than three years. I got both my master's and PhD, even though I did not go in for the PhD.

And then by that time, it became clear, now that I have a PhD and I'm doing research, this place where I was working is not just going to fit at all. And even though there are good universities in India, they are not doing much research. It was mainly teaching type of institutions. So I thought this is the place to stay.

And I will also explain a little bit later how I got into marketing. So I had this work experience in production management. I have this thesis work in Operations Research with Gerry Thompson. And I have this new interest in marketing. So I actually did not know in which direction I am going. It could be any one of these three things.

University of Rochester and Marriage

So I joined the University of Rochester, and they allowed me to teach a course in network flows, which was an Operations Research PhD course; a course in production management, which is sort of related to my work experience, and a course in marketing, too. So it was just sort of a wonderful thing to do.

But the most important event during that time was in 1971-74, I was in the University of Rochester, is that I got married to Sita, my wife. That was just fantastic. I think that is absolutely the luckiest event that happened in my entire life, no doubt about it.

And it is also quite a chancy thing. So you may find this particularly interesting, coming from the United States. So we had quote, unquote "arranged marriages." Actually, the word "proposed marriage" is probably a little better term, because marriage is proposed to the boy and the girl, and they can decide to not go through it. So you know, either the boy can decline or the woman can decline, either way, either one of us.

So we did not know each other at all. And how do the parents ever figure out who to propose? They want to make sure that the socioeconomic background of the two people is similar, not too

high, not too low, but kind of similar to what they were. And secondly, the horoscopes have to match.

LEIGH MCALISTER: Horoscopes!

SEENU SRINIVASAN: That's it, right now. So my parents totally believed in it. I don't actually, at this time, at least. But it was a big deal. You know, maybe one in 10 matches will even work, this kind of thing, so horoscopes match.

So had I been born, say, 20 years earlier, I would not be able to even talk to my future wife. That's not even allowed. You can just, maybe, see. That's about it.

And in some parts of India, you can't even see the woman and you have to wait until the marriage date to actually see her, right? They'll cover her face. And then later on, take out the cover. So in my case, it was not quite so bad.

So I asked my father-in-law could I talk to her for at least half an hour. And he kindly agreed. And that was all. That was all. 30 minutes I had a conversation with my future wife. Can you believe that?

I mean, what is it she wanted to do, and she asked kind of similar things in terms of what my future holds and so on. And particularly, I was concerned about whether she is interested in coming to the US. Because it was quite clear that, given the research interest, I am probably going to stay in the US and not return to India. And she was OK with it.

And so that's how we got married. She had an MS in Economics in India. And then eventually, when she came to Rochester, did an MS in Education. She eventually became a kindergarten teacher. She's a great teacher, and the kids and the parents, particularly, want their kids to go to her as opposed to some other teacher.

So she's wonderful. But more than anything else, she's fantastically devoted to the family. And so every member of the family, and I hope likewise from me or to her. And so that that's the most important event that happened in Rochester.

Moving to Stanford and Current Activities

Then Professor David Montgomery, whom you know well, he was at Stanford at the time. And he said, you know, would you like to come by and give a seminar at Stanford? And so I agreed, and I gave a talk. And they made an offer.

So this is 1974, '74 I joined Stanford. Initially, I taught a course in Operations Research again, and then some courses in marketing, so partly in econometrics, the course that you took, for example. So that was what was going on.

And two years after that I got promoted to full professorship with tenure. So actually from my PhD graduation to getting a full professorship was exactly five years, which was a record, I think, at that time at the business school and continues to be, as I understand.

LEIGH MCALISTER: Yes. That was the first thing I was told about you.

SEENU SRINIVASAN: OK. Is that right? OK.

LEIGH MCALISTER: Yes.

SEENU SRINIVASAN: OK. So that was fantastic. And so I totally, you know, Stanford is a fantastic place in terms of the students that are there, the great atmosphere, sort of physically, and so on.

So I moved gradually into marketing. So initially I was in Operations Research and marketing and then gradually moved into marketing totally. I was a PhD director for the entire PhD program for three years, '82 to '85. I was also the chair of the marketing area many times during this entire period. I was also heading the executive program in strategic marketing management for a few years during that time.

So in 2010, I became emeritus. And you know, one thing I always wanted to do is to teach in India. It sort of goes back to the old days, despite my having been discriminated against and all that.

So I teach generally through March. My wife and I go to India. I teach a course at the Indian School of Business, which is in Hyderabad, and a school called Great Lakes Institute of Management in Chennai. That's the one that my-- the older brother you met-- he is a dean of and also the founder of that school.

So I teach in these two places. The remaining nine months I'm here doing some research, a little bit of consulting, a little bit of executive teaching. So that's what I have been doing during this time. That's sort of the big picture, at least.

LEIGH MCALISTER: I'd never heard that you came from a little town. And it makes me wonder if that didn't put you at a disadvantage when you got to Madras. Did you find you had to do a lot of catch up to stay up with your peers that you eventually left in the dust?

SEENU SRINIVASAN: I think my education itself, although it was strong in my view at that time, and I was number one and all that, it is not the same as the education that was happening at the big cities, for example. I think the better professors were there. And so that would have been better. So I had quite a bit of catching up to do, I think that's absolutely right.

Also catching up to do in terms of sort of broadening my view of the world. See I had a very narrow view of the world because coming from this small town. And it was quite important the fact that I was there. You know, particularly there was students from all over India, not only from my state. So of course, I'm hearing lots of these other languages and picking up some of

that, and made friends with many of them. And so that was a big, big widening and a learning experience for me.

PhD Students and Children

LEIGH MCALISTER: Very impressive. You neglected to mention, as you were going through the history, all the PhD students you've introduced to research. And I believe you have the most PhD student prizes of any-- certainly any professor in marketing, maybe in the world. Do you have that statistic off the top of your head?

SEENU SRINIVASAN: I think I do. So I have a total of about 14 PhD students, I think, I graduated during particularly-- if you include both Stanford and Rochester. And I think eight of them went on to win-- you are being the very first one, I think, you are the second one in that-- to win the best dissertation award or best paper based on a dissertation type of award.

Teaching PhD students has been a fantastic experience for me. I think in a number of ways. One is, I sort of mimic a little bit what Gerry Thompson, how I interacted with him. So initially, you know, I always liked a desk where the student can sit next to me as opposed to I am sitting across, so to speak. We can sort of work together, and take a look at each other's notes, that kind of thing.

And so you start off, initially, the student as an apprentice. So you sort of have this research project, and you sort of, go and do this for me. You know what questions do you have on it? Could we have done this in a different way?

So it's kind of more guiding. And then gradually, by the time they graduate, they're already my co-authors. So it is that level of thing. So that has been a great experience for me.

And the other thing I forgot to mention, let me also add, that I didn't talk about my kids. So Sita and I have two wonderful sons. Both of them are in the academe. So the first son, his name is Ramesh. You have met both of them. And Ramesh Srinivasan is a Professor of Information Studies at UCLA. So he is already an Associate Professor. He is coming up for a full professorship this year. And my younger son, Mahesh Srinivasan, is an Assistant Professor of Psychology, developmental psychology and cognitive science at University of California at Berkeley. So he is the one a little closer to me, but Ramesh is not too far either. Ramesh is married. We don't have any grandchildren yet. Mahesh has a girlfriend. So we are keeping our fingers crossed so it proceeds smoothly.

LEIGH MCALISTER: Yeah. I did get to meet them when they were little boys. But then I saw them again at your retirement party. You and Sita have done a wonderful job with them.

SEENU SRINIVASAN: Thank you.

LEIGH MCALISTER: They are fine young men. Congratulations.

SEENU SRINIVASAN: And more than anything else, the thing I like about them are they are fantastic human beings, I think. So they are kind to people. You know, that's why. I think they're great scholars, of course. But more importantly, I think good human beings.

Dissertation on Transportation Problems

So let me get to a little bit more about some of the things I kind of skipped a little bit, and then come back, about how I got started on my dissertation, and that line of work, which is very much in Operations Research itself. So I joined, as I said, Carnegie Mellon as an M.S. student. So in my first semester, I took a course from Gerry Thompson in Operations Research. So at the end of the term, there is a final exam.

And the final exam had a question in transportation problems. So transportation problem, you know, is that there are some factories with some capacities. And there are some markets which have demands. And then if you supply the material from this factory to that market, this is the unit cost. And you are trying to minimize the total cost. And so that's a canonical transportation problem.

So the question, and the dual variable; optimal dual variable tells you, if you increase, for example, the factory capacity by one unit, it gives you more possibilities. And therefore, the total cost will come down. How much the total cost will come down is basically what the dual variable tells us. So here, they asked us in the final exam, Professor-- Dr. Thompson, in terms of if we were to increase the factory capacity by one unit, how much the total cost will come down?

Now I got an answer, and some others had a different answer. So there are two different answers students are getting in the class. After we left the exam, we were comparing our answers.

And that cannot be. Because if you are starting with an optimum solution and you're going to a new optimum solution, so the difference in cost-- the difference cannot be any-- there's only one number. So if I get a four and another one gets a six, that cannot be true.

So I was trying to dig in to figure out why is that happening, and you know, who is right, and why are we getting these two things. It turns out to be something called dual degeneracy. Dual degeneracy, which is that there is something called a basis for a transportation problem, which is a network, actually-- and then if it is off the basis, the cell, the cost of that cell, cost going from factory I to market J minus the dual variable for factory I and minus the dual variable for factory J is usually greater than 0. Because that is why they are not in the basis, because it's too costly, so to speak.

But you can have exactly equal to zero. And if it is exactly equal to zero, that's an example of dual degeneracy. And that was what was happening in this particular problem.

And then, so there were two different bases that some student had. One basis and the other one had a different basis, and that's where the answers were coming. And then, even though somebody got this answer, that answer is valid only over a zero range. That is, in other words, you could increase it by zero, but you cannot really increase it any material way.

So I went to Dr. Thompson and said, you know, this problem is interesting. That's exactly what is going on. And so even though I went in to do only a master's program, he said, you know, you should really be in the PhD program.

So he then petitioned the department. And the other professors also sort of chimed in, I think. And so after the first semester, I switched to the doctoral program. And then I worked with him on this thing.

So the topic I chose eventually, which is very much linked to this particular exam problem, is about parametric programming for transportation problems. In other words, we have solved the transportation problem. You have the optimal solution. Suppose the factory capacity were to be increased continuously from whatever it is now, either up or down? How does the optimum solution change?

So you sort of have a trajectory of optimum solutions as they change. As you are changing this factory capacity either up or down, you can tell which direction you want to go. And similarly, you can talk about the market demand. You can talk about the costs. These are the various parameters of the problem.

And as parameters of the problem change, how does the optimum solution change? That's the basic question that we are doing. So I wrote a thesis called *An Operator Theory of Parametric Programming for Transportation Problems*, with, I think, *Management Science Applications* or something, is the title of the dissertation.

And it turns out there are these so-called operators by which you change a particular thing continuously up or down. There are something called area operators. So you are not changing just one row, but you are changing a bunch of rows together at a particular rate. Then what happens?

It turns out this problem has a lot of applications. So I'll give you a couple of examples. One example is something called a two criteria, dual criteria optimization problem. So you have minimization of cost. You can also minimize the time, average time it takes you to get the goods from the factories to markets. So that's a second variable.

So instead of the cell having a cost, you also have a time. If you shipped from factory I to market J, that is a time. So you can minimize the average time of shipping this good also.

So that turns out to be nothing but a quote, unquote "area operator." So you could sort of solve that problem that way. So that's an example.

There's another problem which has to do with cash management, which one would not think of it as a transportation problem, but as a transshipment problem in the sense that you have multiple time periods. If I put my money in a bank deposit, for example, in a three month thing, three months from now that money will come in. So it's transportation from this source to that source, that kind of thing. And that is another example.

And the other thing, I think, where Dr. Thompson taught me, really, is that it is not sufficient to have these theories. You have to actually have a code which works. I mean, that's how it started from the beginning itself. And so at that time, this is back-- I'm talking about 1971, we had the fastest code for solving the transportation problem. So we had two papers, Dr. Thompson and I, in the Journal of the Association for Computing Machinery, which is where we eventually published these two papers.

So this whole dissertation area and its applications sort of consumed a lot of my research time in those early years. I don't know whether it is because of my coming to Stanford, because it's now physically distant so much from Pittsburgh, which is where Carnegie Mellon is, or is it my move to marketing, I gradually shifted away from Operations Research, particularly transportation problems. But the applied math orientation and mathematical model, that stayed and stays to this date. That orientation is still there.

LINMAP

So what happened when I was at Carnegie, that is, another very interesting and lucky thing happened to me. You have met Allan Shocker?

LEIGH MCALISTER: Yes.

SEENU SRINIVASAN: So Allan Shocker was a PhD student, fellow PhD student. He was in marketing. I am in Operations Research, and we are roommates.

And so he will ask me, you know, I have been thinking of this marketing problem. You are the Operations Researcher. So you should be able to solve this problem, can you not? Something like that-- I said, what kind of problem?

So he said, think of it like this, just to simplify the example. Suppose there are two dimensions, two attributes of a product. Like say, memory and speed, or something like that, for example. And so maybe that's not the greatest example, but two attributes of a product.

And each respondent, each consumer, has an ideal point in that two dimensional space. Ideal point being, that -- if there are two products which are not exactly on the ideal product, ideal point of that consumer, that consumer will choose that product which happens to be closer to his ideal point. So whichever is closer, that he will choose.

And so if you have a two dimensional map where the ideal points are all over the place depending on what each of the consumers want, and you have currently some products positioned in that space, there are already some brands in the market, what would be the best new product that you can come up with? As you can imagine, this looks like an Operations Research problem. It's kind of a little bit of an integer programming problem where the consumer chooses this product or that product. But at the same time, it's mixed integer program, because you're searching over the space to find the optimal product.

But I went to him and said, you know, this is actually not the right problem to work on. We should first figure out, because if you say the customer chooses the closest one, you are kind of initially assuming that both these dimensions are equally important. Maybe that is not such a good assumption. And in fact, for most people, there are some people this may be more important. For some other people, that may be more important.

So we needed to figure out what weights they attach to these dimensions, and then we had to also, of course, determine these ideal points. So we change the problem from an optimal identification of a new product, at least initially, to one of estimating the parameters of a consumer's preferences. So in this case, an ideal point and the weights they attach to these multiple dimensions.

And if you think about it, and you can sort of, we said, you know, if the person has to choose between this product and that product, and if he tells you that I prefer this product to that, a to b, that tells you that the distance to a is smaller than the distance to b. It's a weighted distance. And that gives you a mathematical inequality, not an equation, but an inequality. So if we ask a series of such paired comparisons to the respondent, then basically I can figure out what his ideal point is and what his weights attaching to these dimensions are. That's the origin of LINMAP, which you have used in your dissertation.

LEIGH MCALISTER: Yes, I have. And I appreciate it. And many people have.

SEENU SRINIVASAN: Many people have. That's right. So it stands for Linear Programming Techniques for Multi-Dimensional Attribute Preferences, LINMAP.

So that's how the LINMAP method started. We published two papers, as you know, in *Psychometrica*, which was a good avenue, because you are sort of looking at psychological phenomena, but using mathematical methods to get at them. So that's how we got started on that.

Conjoint Analysis

And then we said, now that we have done this problem, we can go back to the original problem you've told me. And we published a paper in Management Science. So that's what started my path from Operations Research. You can still see this is a mathematical model of a consumer. Of course, a consumer is more complicated than that model, we understand fully.

But if we get a random sample of consumers from the relevant market, estimate their parameters, like what I just said, and you know where the products are currently positioned in the space, you can then identify what the next new product should be. So people, instead of building a product and then seeing whether people will buy it, you can sort of try to find the best product that you can manufacture, and then go with it.

And that's what eventually moved into this topic of conjoint analysis. And the biggest influence of that was Paul Green. Professor Paul Green was a professor, as you know, at University of Pennsylvania. And he had heard of my work in linear programming methods. He was applying

something else that came from Bell Labs, something called MONONOVA, monotone analysis of variance. He was using that.

And he said, you know, you are coming at it from this way. I'm coming at it from this way. But there is a broader problem we are working on. So we might want to sort of collaborate and come up with an overview of this thing, because this seems to be centrally important to marketing people. So we should do something on it.

And so I was more than happy. You know, he's a very senior professor, chaired professor, probably the best man at that time known for market research. So it was a really wonderful thing to interact with him.

There was an area known as conjoint measurement that existed before. But that was kind of, what are the set of axioms that you have to come up with, so that, for example, an additive preference model holds. But marketing people are more pragmatic.

They say, let's assume the additive model is true. Let's then calibrate the parameters of that model. And then we can test the predictive validity of it. So it's not instead of saying is it axiomatically exactly correct. Is it 90% correct or 80% correct? We can examine through predictive analytics. So we renamed the topic as conjoint analysis.

So this was how the term conjoint analysis, which is now commonly used in marketing. That term came in that paper that we wrote in 1978 in the *Journal of Consumer Research* at that time. And then we wrote another paper subsequently. And each of these papers are cited more than 3,000 times now and have had a huge impact on the field.

LEIGH MCALISTER: And on practice, as I understand it.

SEENU SRINIVASAN: Yeah, on practice-- so more than 18,000 commercial applications of conjoint analysis takes place each year all over the world. Of course, other methods have come about. So it's actually a portfolio of methods, if you want to think of it. So depending on the context you are working on, you'd choose a particular problem.

So as I'm working in this area, you will see the following things. I am coming from Operations Research moving into marketing. Number two, I am becoming more applied. So instead of being theoretical, I'm becoming more applied. And so that trend continues from that time onward. Here I'm talking about 1971, et cetera.

So when we left the doctoral program together, interestingly, we had this work done, this LINMAP work. It was neither his dissertation nor my dissertation. And I had done my dissertation, as I told you, in transportation problems. And he had done something in organizational self-development or something like that. So eventually it became central to both of our work.

Marketing Applications of the Transportation Problem

I continued to work in conjoint for a long time. I continue even to this date. So I'll give you a couple of other important studies. So one is what is called brand equity. This is a big deal in marketing.

So what does the brand add to the product? So that's one way to think about it. And so it turned out, because I had this training in Operations Research, transportation problems, curiously, this problem, these two problems merged.

So if you think of consumers as the rows of that matrix, instead of factories, and companies which sell these brands as the columns of that matrix, and you know how much each of these brands are selling, how many units the sales of each of these units are, and each consumer, just to make it simpler, let's say, buys one product. And the cost, it is the preference that the customer has for this product, which you can determine using the conjoint or a multi-attribute preference model.

So if you just sort of say, what would be the maximum preferences that these consumers can get from the market from the products that are being supplied, that's a transportation problem. But that will not necessarily give the same market shares that is currently in the market. And it turns out the dual variable for each of those markets is actually nothing but the brand equity. Well, what an interesting thing, that something which is a completely different domain, and some dual variable of a transportation problem happen to the brand equity. So that was a paper we did.

LEIGH MCALISTER: But don't you think that's the magic of Management Science?

SEENU SRINIVASAN: Yeah, that is the magic of Management Science. So, a number of things in that-- first of all, models are portable, so to speak. They can translate. They can go from one area to another area to another area. That is nice. And it's also the fun of mathematics, I think.

So you know, when I saw the result, my god, I said. How could this be? And I guess, partly because I knew the area, I could sort of spot it quicker.

So I talked about the transportation problem earlier in terms of finding non-degenerate shadow prices, as opposed to possibly degenerate shadow prices. It turns out you can determine all the non-degenerate shadow prices in one fell swoop in another algorithm. And it turns out that is nothing but-- if you take the whole, all the nodes of that network, which are the factories and the markets-- and if you sort of leave out the degenerate cells in the basis, the network sort of goes into some sub-networks. And if you solve the shortest path problem between these various sub-networks, which is a completely different network problem. Then that, together with the original thing gives you all the non-degenerate shadow prices. Examples like that.

You know, mathematics is extremely beautiful. At the same time, solves in Operations Research as well as in marketing, solves some really interesting problems. So I continue to work in conjoint that way.

Consulting's Links to Research

And this also brings up another thing, which is the practice. What is-- you pointed out how practically it is being used. So one of the ways I have picked up that, is when you are doing your consulting work, you understand what you have done, where it works and where it doesn't work, and what are the problems with it? What are the real problems that these companies are facing? And how this model fits or not fit. That is the other thing that you have to do in order to solve the problem they do.

For example, the main thing we learned is that there is a whole bunch of problems which are not five or six attribute problems, but they are like 10 or 15 attribute problems. So if you think of a smartphone, for example, there are lots of features of it. And some of them may be not really valuable. Some of them are much more valuable. And you need to somehow determine the preferences for all those parameters.

And one thing we all learned in marketing you know is very valid, is that there is a tremendous amount of heterogeneity in any market. So assuming the average of the market or even segments of the market is not good enough. So that's where we would take a large sample of consumers and we'd measure for each one of these people.

So how do you find the preference parameters when the number of attributes is large? So the standard conjoint models don't work. And I was working with Gordon Wyner, Dr. Gordon Wyner, who is at that time, with MARC, Marketing and Research Counsellors, which is in Dallas, Texas. And we came up with another method called CASEMAP, Computer Aided Self-Explication of Multi-Attribute Preferences, to attack these kind of problems.

So there is this little bit of pragmatism in it. So in a sense, it's not quite, of course, so elegant as the earlier models. But on the other hand, it solves the real problem. The elegant models will not solve the real problem. You know that, and so, you know, sometimes you have to do this. Sometimes you have to do that, depending on what it is.

And it also led to another problem in conjoint, which I am also quite excited about. This was work with Elie Ofek, whom you know, at Harvard now. Another doctoral student, also went on to win a doctoral dissertation award.

It's to answer the question, if I have a product and I can improve one of the aspects of the product by some amount, how much is a market willing to pay for it? You see, we can find out how much consumers prefer, but that's not the same as how much the other people are willing to pay for it. And we figured out eventually, through mathematics, that it can be written in the following way. There is a market share currently for this product.

Now suppose I improve that attribute by this much, but don't increase my price. What's going to happen? The product is better, and therefore, the market share will increase. How much can I increase my price, then, so that the market share goes back to where it was? That turns out to be what the market is willing to pay for it.

And this has been used now many times in litigation. So if one company sues another company, saying that you have violated my-- you have infringed on my patent, and so there are two parts to these trials. One is, in fact, has the patent been infringed? And second, if in fact there was an infringement, what is the damages that the infringing company has to pay to the other one? So there, this kind of calculations turn out to be useful.

So lots of very, very interesting problems and I continue to work in conjoint. So that's where I think my time in the post-retirement, arguably, time is working on sort of other algorithms for conjoint analysis and as well as what can be applications thereof.

Teaching's Links to Research

LEIGH MCALISTER: I have heard that you taught a course at Stanford, maybe jointly with the engineering school, on designing new products?

SEENU SRINIVASAN: Yes.

LEIGH MCALISTER: And that at Stanford, across the university, the students bid on classes they want to take. And yours, teaching them these techniques you're describing to us now, yours was the one that the students bid their most points for.

SEENU SRINIVASAN: Yeah, so this course was called IDMM, Integrated Design for Marketability and Manufacturing. My old work experience was in manufacturing, and marketing is my new interest. And there is a professor by the name William Lovejoy, Bill Lovejoy. He's now at Michigan in operations management. And there was a professor by the name David Beach in the mechanical engineering department at Stanford. And he has a machine shop.

So he said, you know, we three should collaborate. So you are the marketing person. You know how to understand consumers and how to market a product. I know how to manufacture a product. And he knows how to design a product.

So we should teach a course jointly together, where we took, I think, 10 teams. Each team has two MBAs and two engineers. And at the end, this is a two quarter course. At the beginning of the first quarter, we say, what is a product category we are all going to work on this year?

So this may be water filters, for example. So you know, you are going to go on a camping trip. And you want to get water which will not hurt you-- bacteria, viruses, and so forth. And how could you do that?

And we say, here are two products in the market already. Your job, each of your team's job, is to come up with a new product that has to work. It's not sufficient to have a picture. It has to work and could be manufactured inexpensively. So there's the manufacturing part. And the market wants it, so that's the marketing part.

So we do conjoint analysis. Each student, both the MBAs and engineers go to the lathes and milling machines and so on. There's my old mechanical engineering. And it really was fun. I

went back and worked on lathes myself, too. So that was great. So that course was a highly popular course.

And you know, it's interesting. That brings up another thing, actually. That sometimes teaching a course can lead to research. As opposed to, usually, you think that research helps teaching and research helps consulting and all that. But teaching can actually help you develop research.

So this was actually an eye opener for all three of us. Because we learned that, instead of saying that you find the optimal product by the way that we originally said, Alan Shocker and I did, that we find out that it explains maybe about 50, 60% of the variation in preferences correctly. It doesn't explain all of it. Similarly, from a manufacturing point of view, if you say that the cost of a product, the cost of manufacturing a product is a function of the attributes of the product, it also explains why only about 50, 60% of it. So you are not going to get the real optimum product by doing this.

So what we have to do, we came up with a result of us teaching this course, is to say, you know, you do both of these things. That gives you a lot of good ideas. And then use your design hat, which also tells you that you should think out of the box -- you will not be sort of affected and constrained by the current products in the market.

And come up with a series of products. So in this case, let's say 10 products. Let's sort of get those 10 products, it could be, even, prototypes. And then test it out, literally test it out on consumers in terms of their preferences. And now that you have a prototype, you know how to exactly manufacture it, and therefore, you know how much exactly it will cost.

So then you put them together. Now you have a better chance of getting an optimum product. So that came out in the *Journal of Marketing Research*. And I think we have, like, three or four papers that came out of teaching that course, actually, which is quite interesting. So that is one line of work.

Maybe-- should I tell you a little bit about a couple of other lines of work?

LEIGH MCALISTER: Please do.

SEENU SRINIVASAN: OK. So another one, which also links to this teaching to research link, as opposed to the research to teaching-- so I was on sabbatical from 1978 to '79 in Europe, in Brussels and Leuven, which is the Dutch part of Belgium, Flemish part of Belgium. So I was teaching-- you know, normally, I don't teach this course. But they were supporting me, so they said can you teach a course in advanced marketing. I normally don't teach that course, so I started teaching it, of course.

And then one of the topics in that is sales force compensation plans. So if you have a sales force, how should you incentivize them? And there was a series of papers before by John Farley, whom you know very well, and Chuck Weinberg and others. Saying, that if you think of-- let's say that a salesperson has multiple products to sell, the same salesperson is selling these multiple products, there is a gross margin that the company gets by selling each of these products.

And the result was that you should give exactly the same percent of the gross margin as the commission to the salesperson across products. If you do that, what the salesperson will do in his or her own self-interest of maximizing his commissions, will also maximize the pie for you, the company. So that's the result that they got. So I'm teaching that course, and I have not taught this material before at all, because that's not the area I normally work in.

So I am preparing for it the previous evening, diligently. I am not sure this result is correct. So I couldn't quite solve what the right answer to this question was. So I went to class, this is in Belgium, and so at first I very faithfully presented the current John Farley, Chuck Weinberg work in a way that looks correct. And I told them that, you know, I have some suspicion this is not quite correct.

And the reason why it may not be correct is because these models are assuming that the salesperson has a fixed time that he can spend on selling these products, then this result is true. But if you offer different commissions or higher commissions, you can incent the person so that he will work even harder. That is, he or she is willing to trade off some of his or her leisure for work because the compensation is higher, and so they're willing to trade off. So you have to take that into account, too. And then if you take that into account, it's not clear anymore whether the result is true or not.

So I have a paper in *Management Science* that came out of that. And an interesting result, and you know, this is another thing coming out of teaching and research. That you get managers to think intuitively, and often how they think intuitively is the right answer can turn out to be the wrong answer, and why is that so? Then they really have learned something. So I'll give you an example.

So the salesperson is selling two products, A and B. Let's say, just to make it extremely simple, that the gross margin is exactly the same on both products. But the first product is such that if the sales person were to double his time that he sells that product, the unit sales will go up by 50%. So the elasticity is 0.5, so to speak.

Whereas if the salesperson were to sell the second product doubled his time that he allocates to that product, the sales goes up only by 25%. OK? So the second product is in some sense a harder product to sell. The first one is somewhat easier to sell. So that's why by adding more time, we are able to sell more.

So I asked these managers, and I continued to have other questions similar to this. So you are the manager. You can decide how much commission to pay for this one or this one. So where would you pay a higher commission?

So many people will come and say, you know what? The first product is selling itself pretty well, anyway. The second product is also mine. The same company is selling both of these products. So you should really give a higher incentive to the second product so that the sales person will sell that product more, and thus I'll have both of my products selling well.

I tell them that, actually, the opposite is true. And why is the opposite true? Because you have to think of the salesperson as a resource that you have got. So their time is really valuable to you.

So what you want to do is to sort of maximize the value that you get out of that person. And that means that if he puts more time in terms of selling that first product, you make more money at the end of the day. So the second product we understand is not selling well. But that is actually optimal for your company in terms of the total profits you make.

So this is the kind of insight sometimes you can get from mathematical models which are counterintuitive initially, but then when you explain the reason for it, managers get it. And then that kind of has a lasting impact on them. So that's another example of our teaching, my struggling with the teaching of a class led to important research.

And we continue to work in this area. You know Amiya Basu, and Rajiv Lal, and Jagmohan Raju. And so we did a series of papers using the so-called agency theory to salesforce compensation. So that's another area I worked on.

Other Marketing Applications

And another area I worked on is market structuring. Which is, you have market segmentation, that is, consumers are not alike. So we can divide them into different segments.

But also market structuring in the sense that there are different brands in the market, but some brands compete with each other closely, but not with other brands. For example, decaffeinated coffee, if you have a sale on it, that affects other decaffeinated products and not so much caffeinated products, for example. So that's the structure of the market.

So I knew there are these two areas in marketing. And people have contributed research in the areas. There should be some connection between these two things. But it was not clear what that connection was.

So I was attending a seminar by Rajiv Grover, who is now the Dean of University of Memphis Business School. So I said, you know, this work that you're doing on latent class analysis seems to be kind of the trick to sort of pull these two areas together. So we worked on a problem and we showed that the latent classes that come out of a latent class network, so if you have a switching matrix, a brand switching matrix, of all of the people who bought brand I last time, what fraction of people buy one, two, three, n, that kind of a matrix, you can sort of do a latent class decomposition of that matrix. And that latent classes tell you the structure of the market as well as the segments of the market. So in other words, these are kind of the dual sides of the same analysis.

So that was something that came up with that. And then with Gary Russell and Randy Bucklin, we did a couple of other papers, which are, again, very interesting. So there is cross price elasticities, which economists worry about. And marketers worry a lot about brand switching probabilities.

And again these seem to be completely two different streams, or way of thinking. But if you think about it, there should be some relationship between these two. If there's a lot of switching between two brands, that must also mean that the elasticity between these two brands should be high. We showed a mathematical relationship as to how these two things are related. So those are some of the other areas I have worked on. So I will wrap up this way, but I will allow you to ask some more questions.

Career Perspective

So research is fun. That, I think, is one of the most important things. And you know, one of the things you try to impart to doctoral students is the fun aspect of it. It is, of course, you have all this journal review process. It can be tedious, and you get rejected, your paper. Now that is kind of difficult and all that. But the research process is fun.

An academic career is wonderful, absolutely wonderful. You are essentially your own boss. And you know, you have to coordinate, of course, with the school in terms of courses, how they'll be taught, and so on. And you can set your own time and so forth.

And you continue to learn all the time. That, to me, is one of the greatest delights of this thing. You know, you're innately curious, most of us are. And so you are continuing to learn the entire process, research wise, teaching wise, when you're working with companies, all of this thing is continuously learning.

I say, I already mentioned teaching, research, and consulting kind of go together. There is interaction every way. Consulting affects the research because there are problems you identify in the thing. And all those three parts of-- all the three way parts of it are true.

Theory is very helpful. Some of my work is in theoretical models, such as the sales force compensation models. The empirical work, all the data analysis, like in LINMAP and so forth is very important. And applied work is important. Each of them have a place in terms of solving real problem.

So as you move from Operations Research, sort of the theory side of it, to marketing, which is an applied discipline, you see that, you realize that all these three things have to be there together. Not everybody has to do every one of them. I understand that. But as a group, as a profession, marketing profession, operations, manufacturing, for example, that kind of collaboration is extremely important. I think that is another one.

What else can I say? I think it has been fun working with doctoral students who are like you. I have learned from the doctoral students just as much as they have learned from me. You know, sometimes people will come up with a topic which is something I don't know anything about. And so that is my introduction to that area.

So that's fun. Sort of work on this area together. So you teach me about that, and then I can guide you also along the way, because I generally know about the area. So guidance and co-authors--

co-authors is just a tremendous thing. Because I think you are influencing those people as well as they are influencing you in terms of the ways of thinking. And so that's another thing important.

And also as you have seen in my lifetime overall, there is luck and chance has a huge impact on life. You know, may be the rejection in the Indian colleges which was very devastating to me at that time. Turned out to be a good thing that I got into IIT Madras.

That one mathematical problem in my exam turned out to open a completely full line of research there. Having a roommate like Alan Shocker got me into marketing. 30 minute meeting with my future wife changed my entire life, things like that. So who knows? So chance has a large place. So I'm thankful that Lady Luck has been good to me overall, I think.

Current Research While Semi-Retired

LEIGH MCALISTER: What I hear from golfers and so forth, the more you practice, the luckier you get. I think it's not an accident that you've had luck, Seenu. It seems to me you always had your nose into mathematics and management science. And you said, you're working on new ideas even though you've retired. You can't stop the machine.

SEENU SRINIVASAN: Yeah.

LEIGH MCALISTER: Can you give us any overview of--

SEENU SRINIVASAN: An example, actually, which I think you will find interesting. Because you said you are teaching basic marketing now.

LEIGH MCALISTER: Yes.

SEENU SRINIVASAN: So you might be one to tell me something about this. This work is not written up yet. I've got good ideas. I've written much of it, but not tried to publish it yet.

You know, there is this four P's of marketing. One of the first things that a marketing student learns-- product, price, promotion, and place. Product, price-- promotion is advertising, marketing communication, more generally, and place in terms of distribution, so a very basic thing. These are the four elements of the marketing mix everybody talks about. You can add on a couple of things to it, but that's the central thing.

Marketers have typically not talked about what is the sequence in which these decisions are to be made, or do we have to do them simultaneously? So the impression I have been left with, and you should correct me on this, the impression I've been left with is that, when you develop a marketing plan, all these four elements are to be there. And you sort of simultaneously, in that sense, you have to have a simultaneous thing.

What I think I can show mathematically now is that product and price come first, and then, for a particular reason. So you have to make some assumptions, such as you have a market. You already know what market you are going to serve. And you have a set of consumers, not

necessarily homogeneous, heterogeneous consumers. And there is a model BASES, you probably know the company, right?

They have currently-- they have made forecasts for something like 200,000 products all over the world. Can you believe that? And the forecasts are pretty good. In 9 out of 10 times, the actual sales is within plus or minus 20% of the forecast sales. For a new product, that is actually pretty impressive statistic. It costs about $100,000 a shot in order to do these kind of studies.

So if we take that kind of a model, you can show mathematically that product and price are to be determined simultaneously. You can't sort of decide one without the other. You have to decide them simultaneously.

And they are not affected, that's the other interesting part, they are not affected by how much advertising you are going to do or how much distribution you're going to do. But the reverse is not true. So it is the asymmetrical relationship within them.

But if you decide-- so you need to know what product and price are in order to determine how much advertising to do or how much distribution to do, for example. Advertising and distribution have to be determined simultaneously, too. So this is sort of a very fundamental thing in marketing. Again, this is not typically my area at all.

But when I'm teaching this course, then I realized this stuff is coming in the process. You know, why are you leaving out those two pieces? Because in conjoint typically, we are focusing on product and price. But we are leaving, almost like an afterthought, to take care of promotion and place. So why is that a legitimate thing to do conceptually?

So that's a paper that I'm doing. I'm doing another work on the thing about-- I talked about how much the market is willing to pay if you have to improve an attribute. It turns out there is a simpler way of determining that than what we had done in that earlier paper. And it is somewhat more intuitive. But under what conditions that is true, and what is a small attribute improvement over which this result can be true? So there's another example of a research paper I am working on.

LEIGH MCALISTER: Incredible, more productive in retirement than the rest of us at the peak of our career.

SEENU SRINIVASAN: Not true, but that's true. But you know, one thing I forgot to mention I should really say, I think I did say, about both my kids I said, I think. They are good researchers. But more importantly, they are good human beings.

Concluding Remarks

So you know, if someone were to say at the end of my life that here was somebody who contributed in an important way to the conjoint analysis area, more generally to multi-attribute preference models, and sort of understanding consumers so that products are not shoved at them, but you try to find out the product that they would like, and we are sort of selling that to them,

some work in my transportation problems and Operations Research, as a good advisor to doctoral students and sort of developing the next group of scholars in marketing, a dedicated teacher, and overall a good human being, to my family, to my friends, and colleagues, and to the profession at large, and to society at large -- that would be plenty for me to rest easy.

LEIGH MCALISTER: Well, you should rest easy then, Seenu. Because I bring with me tidings from all of your doctoral students, from all of your co-authors. I checked in with them when I told them I had this opportunity. And each one sends deep personal regard and thanks for the training, the technical training, the taste in problems, and the wonderful example you set for us for being a contributing academic.

I remember once at Stanford you were saying, "I know how to let blood in seminars. I just choose not to do it. " And that is not the case with all scholars. There are some-- I heard one person say: "It's the pulley system. I go up as you go down." I've never seen you behave in that way. You just set a wonderful example for all of us, and we are eternally grateful.

SEENU SRINIVASAN: Thank you so very much. And thank you for coming all the way from-- you had a busy schedule, teaching schedule. And you know, you must have woken up pretty early this morning.

LEIGH MCALISTER: I woke up very early. I would have gone to India for you, Seenu. You couldn't get to a side of the world that I wouldn't have treasured the opportunity.

SEENU SRINIVASAN: And I want to thank Irv for setting this thing up. I really appreciate the opportunity for doing this thing. Irv, thank you.