[SQUEAKING] [RUSTLING] [CLICKING]

VASILY STRELA: So today's class is introductory class. We'll talk about the class itself and about the program of the class. Then Jake will talk a little bit about the financial terms and ideas. And I'll talk about bond math a little bit.

So the class, because it is organized to introduce you to the applications of math in the real world, the class is split between a mathematical part, which will be taught by Peter, and application part, which will be taught by many people who come from industry. Maybe start with a little bit of introduction of myself and how it all comes together.

So I was at MIT a long time ago. I got my PhD from math department in '92. My advisor was Gil Strang. And my topic of my PhD had nothing to do with finance. It was actually applications where it was about wavelets and applications were in signal processing.

So after that, I was a math professor for a few years and did math research. But at some point, I decided to switch to the industry. And somehow I did like mathematical finance. So since then, I've been a quant working in mathematical finance, worked in many places for a long time. I was with Morgan Stanley, and right now, I run fixed-income quants at RBC. I very much appreciate having experience, both with academia and with industry. And that's what I would like to show you through the class.

So now a little bit more about the class. So as I said, there will be math part, and there will be finance part. The lectures will be intertwined, not necessarily one after another but more or less in equal proportion. In terms of prerequisites, I do think that you all have necessary mathematical prerequisites, which is linear algebra, some statistics, and probably some calculus and mathematical analysis. We don't require any prior knowledge of finance, even though if you have been doing some work or internships before, that certainly helps.

Here is the schedule, which we intend to keep, and please keep in mind that things may change and may shift, particularly with invited speakers. Peter will talk about the mathematical part here. I'll just introduce a few classes.

So in a week's time, Jeff Shen from BlackRock will talk about equity investing, in particular, quantitative equity investing. Then Stefan Andreev from Two Sigma will talk about principal component analysis and finance, which should go well together with what Peter will be talking about at the time.

Then Andrew Gustavsson from Mizuho will talk about linear rates, product swaps, bonds, and curve construction. Then James Sheppard from Quantile Technologies, which is now part of London Stock Exchange, will talk about optimization and compressing derivative portfolios.

Then a very interesting lecture by Tarek Mansoor and Luna Lopez from Kalshi. They'll talk about their company and how they started. They both are MIT alums and actually alums from the class, from a few years ago.

Then Ross Garon from Millennium will talk about investments and systematic investments. Andrew Lo from MIT will talk actually about applying some techniques from computational finance into biomedicine and biomedical portfolio. Oh, I missed both Jake and myself there, but Jake will talk about portfolio optimization, and I'll talk about Black-Scholes. And the last invited lecture will be by John Hull, who is legendary in derivatives space, but he will actually talk about machine learning, his newest interest.

With that, let me pass it on to Peter.

PETER: OK, thank you, Vasily. Let me just page back up to the schedule of lectures. Although, before that, let me give a brief self-introduction. I have a PhD degree in statistics, and this was a mathematical statistics program at UC Berkeley. And I was getting rather distracted with mathematical arguments and analysis and took a class at the business school at Berkeley, the Haas School, and that renewed my passion, basically, for studying finance and quantitative finance.

I taught in the statistics department at Harvard and then joined the Sloan School, where I pursued research on statistical modeling and finance. That led to interesting consulting projects where one client hired-- well, wanted to hire me to work on a trading program in international equities, and we ended up agreeing on becoming partners rather than deciding how much I should get paid for that.

And so I worked with hedge funds for a number of years. Ultimately had the great pleasure of working for IKOS, a hedge fund in Cyprus, which is in the eastern Mediterranean.

Following that, I came back to academics actually to help with this course, now, what? 11 years ago or 12 years ago, and had the great pleasure to work with Vasiliy and Jake on this class. And what I think is really important to highlight, is how the mathematics lectures are teaching you mathematics that's really quite practical and useful.

So I love mathematics, but I love, I guess, financial applications even more. And so we'll be stressing those tools that are useful in financial modeling.

I do think it's important to emphasize the stature of many of these guest lectures. And you're really going to be hearing from people who are the top in the field, like John Hull, many of you probably are familiar with his work, and Andrew Lo.

And actually, I had the pleasure of teaching Tariq and Luana in statistics classes, one of which was this. And what they've done is created a new futures exchange, which is rather impressive. When you look at the history of the Commodity Futures Trading Commission, there may be, I don't know, 50 or so futures exchanges that have come and gone, maybe the most important, the Chicago Mercantile Exchange. But here, were two students who basically create an exchange where you bet on discrete events, whether things will or will not occur. And anyway, it's great to have them join the class.

Well, let's see. With the different statistics or math lectures, you can see the range of topics. And these are all lectures that introduce you to these topics without much background. So I think it provides an excellent introduction to the different topics.

We will also be using the language R in our studio for illustrations. And I think most students here probably are Python experts. I am not a Python expert, so I use R. But let me just tab over to a slide showing this.

Let's see. Using R, one of the reasons for using R is that it gives you immediate access to state-of-the-art statistical methods that get developed. But in addition to that, it facilitates the downloading and collection of financial data from the internet or from other sources that you might have access to. But one can see issues like nonlinear volatility models, regime modeling those are packages that are quite useful and powerful.

In terms of sources of financial data, everyone, I'm sure, looks at the financial markets a bit. And any data that's available on Yahoo, is importable into R. Also, the Federal Reserve Economic Database has all-- well, around 80,000 different time series of different rates.

So let's see. We distributed, in the Canvas site. this R notebook, FM Intro 1, which basically uses the RStudio Cloud to collect data and display it. And so this year, we have an alternative to asking students to install R desktop on their machines. But just to sign up to this RStudio Cloud, and you can, basically with a simple login, create simple files which we give you and display different time series.

So this FM Intro 1 R program, basically, will collect and display data. And you don't need to know anything, except to maybe update the dates for starting and ending data collection.

And so one can look at the S&P 500 index, the VIX index, perhaps one of the more important indexes in equity markets is the VIX index, sort of, a fear gauge. And it turns out that the fear gauge tends to spike when the market drops. And so there are interesting relationships between these that actually get formalized with option pricing theory.

And let's see. Just for interest, here's the time series for Bitcoin. The beginning of this time series is about when our class began. And if you were fortunate to be at MIT at that time, an alum of MIT gave all the incoming students, I think, $100 in Bitcoin.

And many years later, some of them still had their Bitcoin keys and could cash in. Some were very regretful that they somehow lost their Bitcoin keys. But it's really an interesting market. I was a complete skeptic back here. [LAUGHS] And I guess I'm still a complete skeptic. But that being said, there's obviously a great potential there.

Here's the time series graph of NVIDIA. Curiously, in last year's notes, we displayed NVIDIA. And since then, [CHUCKLES] it's risen rather dramatically. A really interesting topic for analysis is the creation of bubbles in financial markets, and can you detect a bubble and when it might burst, very challenging.

Let's see. One last point to illustrate was, the crude oil futures contract. It's one of the more popular futures contracts traded. And what's rather striking, is that in 2020, the price of this contract went negative, significantly. And this was an event that the brokers, important brokers, didn't program in that possibility into their systems. And so when the system became updated on this day when the price was significantly negative, those who held, say, thousands of contracts of the contract actually owed money to the exchange for their negative position.

Anyway, the financial markets offer these cases where surprising, seemingly impossible events can occur, such as negative interest rates. When I was studying finance, the thought of negative interest rates was just considered an impossibility.

So with that, let's see, I just want to highlight RStudio. Cloud allows you just to log in with just a username and password. And it's free. And then you can create R programs, and it should display the RStudio running from the cloud.

And so here is a directory in this cloud project which has an RMD for R Markdown file, which is displayed in the top left. And that simple program creates that HTML file. So analyses are very easy to illustrate with RStudio. And I hope to share with you various R programs that you can use to replicate studies we do in our lectures.

All right, let's see. Finally, we distributed assignment 0 today, which is asking everyone to fill out a simple survey of where you come from, what your interests are, and to submit, perhaps, a resume or CV if you have that accessible. So we can get to know all of you.