

Experience of an M.Math Interview at Indian Statistical Institute

by Pijush Pratim Sarmah - Thursday, July 25, 2019

<https://gonitsora.com/experience-of-an-m-math-interview-at-indian-statistical-institute/>

Getting into ISI was a dream. I appeared for ISI B.Math exam twice but couldn't make it and appeared for M.Math in 2019, I attempted 18 questions in the objective part and fully solved 5 questions from the subjective part in the written exam held on 5th May 2019. My name was shortlisted for interview that was scheduled to be held on 20th may at 3:30 pm.

On the day of interview, I reached ISI at 1 pm, had my lunch there, took a walk around the Campus and walked into the Stat-Math unit at 2:30pm. The person sitting in the office asked me to produce my original documents for verification and wait in the lobby. My turn came at 3:15 as I was asked to enter room S18 where interviews were taking place.

There were 5 professors in the interview panel. Later, (after checking ISI Bangalore website), I came to know their names: Ramesh Sreekantan (P1), Parthanil Roy (P2), Yogeswaran D (P3), Manish Kumar (P4) and Mathew Joseph (P5).

Below is a transcript of the interview from my memory.

P2: Hi!

I: Hi Sir.

P1: Please have a seat and tell us about yourself.

I: I am Pijush Pratim Sarmah and I am completing my Bachelor of Science this year from Tezpur University.

P2: Which college?

I: There are no colleges under Tezpur University. My program is 5-year Integrated M.Sc in Mathematics.

P5: You are allowed to leave after 3 years?

I: Yes Sir.

P2: Fine, other than ISI what entrances have you appeared for?

I: I qualified IIT JAM with AIR 242 and passed the written exam of TIFR but couldn't pass the interviews.

P1: What are your interests in Mathematics?

I: Real Analysis and Linear Algebra.

P5: Please go to the board and take a piece of chalk.

****I do as they command****

P5: Suppose A is a 3×2 real matrix and B is a 2×3 real matrix. What will be the determinant of the product matrix AB ?

I: The determinant will be 0 .

P5: How?

I: We know that $\text{rank}(AB) \leq \text{rank}(A)$ and $\text{rank}(A)$ is at most 2. So AB is a 3×3 matrix whose rank is less than 3. Hence, it is not invertible and its determinant is 0.

P3: Can you show that $\text{rank}(AB) \leq \min\{\text{rank}(A), \text{rank}(B)\}$?

** I showed this using the fact that column space of AB is a subspace of column space of A and row space of AB is a subspace of row space of B **

P2: Okay, good. If A is a real symmetric matrix, can we compare the ranks of A and A^2 ?

Now, this is a question that I solved just the night before my day of interview, so I showed that $\text{rank}(A) = \text{rank}(A^2)$. My confidence grew and I knew that I could do very well from there.

P3: Your solution is correct. Do you know that real symmetric matrices have a beautiful property?

I: Yes, Sir. Real Symmetric matrices are diagonalizable.

P3: Good. Now using the fact that real symmetric matrices are diagonalizable, can you show that $\text{rank}(A) = \text{rank}(A^2)$ when A is a real symmetric matrix?

I: There are many useful properties of diagonalizable matrices. Where should I start?

P5: Just use the definition of diagonalizable matrices.

I started solving the problem and got stuck in a step where I needed to use the fact that if D is a Diagonal matrix then $\text{rank}(D) = \text{rank}(D^2)$, but I hesitated to say that

P2: Yes, you are in the right direction. What can you say about ranks of D and D^2 ?

P1: What is the rank of a diagonal matrix?

I: It is precisely the number of non-zero diagonal entries. -- (The moment I said that, all my confusion

disappeared and I proceeded with my explanation)-- Now, since, D^2 is obtained by squaring the diagonal entries of D , rank of D and D^2 are equal and so are the ranks of A and A^2 .

P2: Correct! Lets move onto Analysis. Suppose $f: \mathbb{R} \rightarrow \mathbb{R}$ is continuous and $\{x_n\}$ be a Cauchy sequence in \mathbb{R} . Will $\{f(x_n)\}$ be a Cauchy sequence?

I: Since \mathbb{R} is complete, $\{x_n\}$ converges to some point, say x . By sequential criteria of continuity, $\{f(x_n)\}$ converges to $f(x)$. Therefore, $\{f(x_n)\}$ is a Cauchy sequence.

P2: Very good. Now, if we restrict the domain of the function to $(0, +\infty)$, will the same result hold?

I: No. If we consider the function $f(x)=1/x$ which is continuous on the given domain and the Cauchy sequence $\{x_n\}=\{1/n\}$ in the domain, then $\{f(x_n)\}=n$, which is unbounded and hence not a Cauchy sequence.

P2: Under what condition does a continuous function maps Cauchy sequences to Cauchy sequences?

I: When the function is uniformly continuous.

P5: If a function is continuous on \mathbb{R} , can you impose some condition on the function which will make the function uniformly continuous?

I: If limit of the function at $+\infty$ and $-\infty$ exists in \mathbb{R} .

P1: Okay, then it has to be bounded. Does there exist any real-valued function which is continuous and bounded on \mathbb{R} but not uniformly continuous?

I: $\sin(x^2)$.

P2: How will you show that?

I: I can give two sequences such that the limit of the sequence obtained by subtracting the corresponding terms of the sequences is zero but the limit of the sequence obtained by subtracting the corresponding terms of the image sequences is non-zero.

P3: Okay. You have the idea. You don't need to do it further.

**After this, asked me a few questions about my life at Tezpur University and said that the interview was over. From their encouraging response throughout the interview, which lasted for 25-30 minutes, I was quite sure that I would get in. And I did get in.

I would like to thank Prof. Anjan Kumar Chakrabarty (IIT-Ghy), Kuldeep Sarma (Research Scholar, Tezpur University) and Sourav Koner (M.Sc, Tezpur University) for guiding me in my preparation and making this possible for me.**

PDF generated from <https://gonitsora.com/experience-of-an-m-math-interview-at-indian-statistical-institute/>.

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.