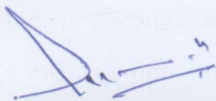


BS Computational Mathematics with Data Analytics

**Department of Mathematics
Faculty of Basic & Applied Sciences
August 2025**



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PAF Complex E-5 Islamabad

BS Computational Mathematics with Data Analytics

Title of the program

BS in Computational Mathematics with Data Analytics

Academic Department

Department of Mathematics, Faculty of Basic and Applied Sciences

Proposed Inception Term

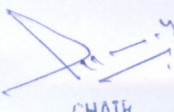
Fall 2025

Program Description

A bachelor's degree in Computational Mathematics with Data Analytics proposes offering a unique blend of traditional mathematical expertise and data analytical skills. The degree is designed to establish a comprehensive foundation in mathematical principles and techniques essential for quantitative analysis across various disciplines. This interdisciplinary program will be offered by the Department of Mathematics, in collaboration with the Faculty of Computing and Artificial Intelligence at AU.

In contrast to traditional data science programs, this degree emphasizes analytical processing of massive data through mathematical insights, enabling students to draw robust, data-driven conclusions. Graduates will be well-prepared to apply their skills to make informed decisions in data-intensive careers, standing out in a competitive job market. The curriculum emphasizes both classical and non-conventional mathematical tools, such as topology, geometry, graph theory, and game theory that are increasingly vital for managing and analyzing complex data sets.

Computational Mathematics and Data Analytics offers a great variety of academic career paths, ranging from teaching at all levels to research in mathematics and its adjacent fields, as well as all careers where Data analytics is valuable. It qualifies students for graduate study not only in Mathematics, but also in neighboring disciplines such as Engineering, Physics, Data Science, Economics, Finance, MBA programs, and many others. Mathematical thinking combined with modeling and programming skills is the key to employment in a variety of high-level strategic positions in which analytic thinking, problem solving, and quantitative skills are paramount, ranging from consultancy, public administration, information technology, and data security, to high-level management.


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Program Educational Aims

The program is designed with the goal in mind that its graduates are optimally qualified to continue graduate education in mathematics or in data science. At the same time, the program aims at developing key transferable skills for a future professional career, either indirectly via a graduate degree or by direct entry into the work force. This degree program is aimed at students who wish to build specialized expertise in data science, a high-demand field, while grounded in the rigorous framework of computational mathematics. Through a strong focus on mathematical modeling, students will learn to create and apply sophisticated models that address real-world problems across sectors, including applied sciences, engineering, finance, business, and industry.

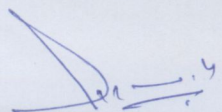
The detailed overarching program aims are:

- comprehensive basic education in the core field of computational mathematics
- Comprehensive skills in solving mathematical modeling problems and their implementation
- Basic education in data analytics and its application to modeling problems

Learning Outcomes

Graduates of this program will be able to:

1. Develop a strong foundation in computational mathematics and data analytics to pursue careers in business, industry, government, or academia. Graduates will possess the necessary mathematical, statistical, and computational knowledge to tackle complex problems and adapt to emerging technological trends in data-driven fields.
2. Identify, analyze, and formulate complex mathematical and data-driven problems through critical evaluation and logical reasoning. Graduates will be able to derive valid conclusions by leveraging mathematical models, algorithms, and statistical techniques to ensure accuracy, effectiveness, and efficiency in real-world applications.
3. Apply appropriate mathematical techniques and modern computational tools, including machine learning, statistical software, and programming frameworks, for modeling and analyzing large-scale data. Graduates will have hands-on experience with industry-standard tools and an understanding of their limitations and practical implications.
4. Communicate complex mathematical and data-driven insights effectively to technical and non-technical audiences. Graduates will be proficient in preparing comprehensive reports, presenting findings visually and orally, and conveying actionable insights using appropriate data visualization techniques and storytelling methods.
5. Integrate mathematical and analytical knowledge with other disciplines such as artificial intelligence, finance, healthcare, and engineering to develop innovative solutions. Graduates will



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have the ability to address real-world challenges through interdisciplinary approaches and contribute to advancements in various domains.

Projected Enrollment for the proposed program

It is anticipated that the enrollment for the proposed program is 30-35 students in the first year of the launch and an increased enrollment is expected afterwards.

Career Options

As an interdisciplinary degree in data analytics with a strong mathematical background, a degree in Computational Mathematics and Data Analytics promises to open the doors for a wide range of career options. These include:

- **Financial Analysts** in various organizations of quantitative finance, financial engineering and insurance companies.
- **Operations Researchers**
- Mathematicians are frequently employed in Information Technology positions. Mathematical knowledge is essential for work in **information security and cryptography**.
- **Statisticians** are employed by large organizations and work in research and development divisions from academia to industry to analyze data from surveys and experiments.
- Education offers a wide field of employment ranging from secondary **school teachers to university professors**.
- **Mathematicians** pursue academic careers at research institutes or universities.
- **Data Analysts, Data Engineers, Risk Analyst, Forecast Analyst** in various sectors like, finance, medicine, business, Machine Learning Engineer.

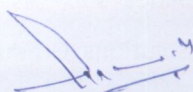
Similar Programs Offered Locally and Globally

Pakistan:

- BS Mathematics with Data Science (Comsats University)
- BS Mathematics with Data Science (CASE)
- BS Mathematics (Specialization in Data Science), University of Management and Technology

International:

- BS Mathematical Data Science (Plymouth University, USA)
- BS Mathematics, Big Data Analytics (Old Dominion University, Virginia USA)
- BS Mathematics Concentration in Data Analytics (The Citadel, South Carolina, USA)
- BS Mathematics, Modeling and Data Analytics (Constructor University, Germany)



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- BS in Computational Mathematics, Data Science Track (Embry-Riddle Aeronautical University, USA)
- BS in Computational Mathematics and Data Analytics (Universitat Autònoma de Barcelona, Spain)

Resources Required

- **Faculty:** Currently, no new faculty resources are required to teach courses in BS in Computational Mathematics and Data Analytics. The faculty of mathematics and the department of data science can serve to teach courses for the new degree. As enrollment increases, new faculty may be required in future to teach specialized courses.
- **Labs:** Computer lab slots are required to serve the needs of the new program and the existing programs in mathematics.
- **Classroom:** No additional classroom is required to serve the enrollment for the new program till 2 years. An additional classroom may be required later.

Eligibility Criteria

HSSC with Mathematics from any BISE with at least 50 % marks

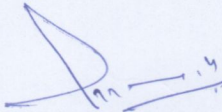
OR

An examination equivalent to the Intermediate with mathematics and having an Equivalent Certificate issued by the Inter Board Chairman Committee, Islamabad

HSSC without Mathematics / Pre-Medical may be allowed admission with condition to take one additional course of 4 credit hours.

Program Structure

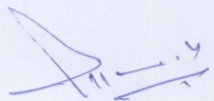
The BS program in Mathematics is based on four years of education after higher secondary school. In the first two years, students will be offered General Education courses, core courses of Mathematics and Data Analytics along with some interdisciplinary and allied courses. After two years, the students will take advanced courses from Computational Mathematics and Data Analytics. While designing the curriculum for this proposed program, the guidelines of Higher Education Commission (HEC) as per the UGE policy 2023 have been considered.


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Overview of BS Computational Mathematics and Data Analytics

S. No.	Domain		No. of Courses	No. of Credit Hours
1	General Education		15	35
2	Interdisciplinary Allied Courses		4	13
3	Major Courses	Core Mathematics	11	78
		Computational Mathematics	08	
		Data Analytics	07	
4	Internship			03
5	Capstone Project			06
			45	135

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General Education Courses

S. No.	Course Code	Course Title	Cr Hrs.	No. of Courses	Subcategory
1	IR 100	Introduction to International Relations	3-0-3	1	Arts & Humanities
2	PH 123	Introductory Mechanics	2-0-2	1	Natural Sciences
	PH 123L	Introductory Mechanics Lab	0-1-1		
3	BA 152	Introduction to Management	2-0-2	1	Social Sciences
4	EL 170	Functional English	3-0-3	1	Functional English
5	EL 271	Expository Writing	3-0-3	1	Expository Writing
6	HU 124	Islamic Studies and Ethics	2-0-2	1	Islamic Studies
7	HU 405	Ideology and Constitution of Pakistan	2-0-2	1	Ideology and Constitution of Pakistan
8	HU 115	Pakistan Studies	2-0-2	1	Pakistan Studies
9	CS 181	Applications of Information and Communication Technologies	2-0-2	1	Applications of Information and Communication Technologies (ICT)
	CS 181L	Applications of Information and Communication Technologies Lab	0-1-1		
10	MA 116	Single Variable Calculus	3-0-3	2	Quantitative Reasoning
11	MA 105	Multivariable Calculus	3-0-3		
12	BA 353	Entrepreneurship	2-0-2	1	Entrepreneurship
13	HU 411	Civics and Community Engagements	2-0-2	1	Civics and Community Engagement
14	FQ 100	Fehm-e-Quran I	0-1-1	1	Fehm-e-Quran
15	FQ 101	Fehm-e-Quran II	0-1-1	1	
	Total		31-4-35	15	

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Interdisciplinary Allied Courses

S. No.	Course Code	Course Title	Cr Hrs.
1	MA 488	Scientific Writing and Research Methods	3-0-3
2	CS 114	Introduction to Programming	2-0-2
	CS 114L	Introduction to Programming Lab	0-1-1
3	CS 218	Advanced Programming	2-0-2
	CS 218L	Advanced Programming Lab	0-1-1
4	CS 130	Database Systems	3-0-3
	CS 130 L	Database Systems Lab	0-1-1
	Total		10-3-13

Internship

S. No.	Course Code	Course Title	Cr Hrs.
1	MA 490	Internship	3-0-3

Capstone Project

S. No.	Course Code	Course Title	Cr Hrs.
1	MA 498	Final Year Project-I	3-0-3
2	MA 499	Final Year Project-II	3-0-3

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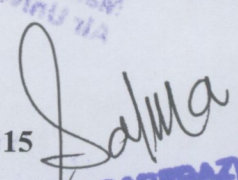
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List of Major courses

Category	Sub-Category	Course Code	Course Title	Cr Hrs.
Mathematics	Core Mathematics	MA-201	Linear Algebra	3-0-3 ✓
		MA-209	Complex Analysis	3-0-3 ✓
		MA-215	Ordinary Differential Equations	3-0-3 ✓
		MA-312	Partial Differential Equations	3-0-3 ✓
		MA-216	Discrete Structures	3-0-3 ✓
		MA-361	Real Analysis	3-0-3 ✓
		MA 333	Mathematical Statistics-I	3-0-3 ✓
		MA 436	Mathematical Statistics-II	3-0-3 ✓
		MA-373	Set Topology	3-0-3 ✓
		MA 478	Graph Theory	3-0-3 ✓
		MA 473	Abstract Algebra	3-0-3 ✓
	Computational Mathematics	MA 440	Modeling and Simulation	2-0-2 ✓
		MA 440L	Modeling and Simulation Lab	0-1-1 ✓
		MA-342	Fundamentals of Optimization	3-0-3 ✓
		MA 338	Applied Statistics	2-0-2 ✓
		MA 338L	Applied Statistics Lab	0-1-1 ✓
		MA-221	Numerical Analysis and Computation	2-0-2 ✓
		MA 221L	Numerical Analysis and Computation Lab	0-1-1 ✓
		MA 316	Applied Matrix Analysis	3-0-3 ✓
		MA 343	Tensor Computation for Data Analysis	2-0-2 ✓
		MA 343L	Tensor Computation for Data Analysis Lab	0-1-1 ✓
Data Analytics	Data Science	CS 332	Design and Analysis of Algorithms	3-0-3 ✓
		DS210	Introduction to Data Science	2-0-2 ✓
		DS 210L	Introduction to Data Science Lab	0-1-1 ✓
		AI 233	Machine Learning	2-0-2 ✓
		AI 233L	Machine Learning Lab	0-1-1 ✓
		DS 455	Deep Learning	2-0-2 ✓
		DS 455L	Deep Learning Lab	0-1-1 ✓
		CS 217	Applied Data Structures	2-0-2 ✓
		CS 217L	Applied Data Structures Lab	0-1-1 ✓
Electives		MA xxx	Elective I	x-x-3
		MA xxx	Elective II	x-x-3
		DS-xxx	Elective III	x-x-3
		DS-xxx	Elective IV	x-x-3
		Total		78


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List of Electives (Computational Mathematics)

S. No.	Category	Course Code	Course Title	Cr Hrs.
1	Computational Mathematics	MA 446	Temporal Data Analysis	3-0-3
2		MA 442	Topological Data Analysis	3-0-3
3		MA 455	Financial Data Analysis	3-0-3
4		MA 482	Stochastic Processes	3-0-3
5		MA 438	Experimental Design	3-0-3
6		MA426	Numerical Optimization	3-0-3
7		MA 475	Game Theory	3-0-3
8		MA 429	Numerical Solutions of PDEs	2-0-2
		MA 429L	Numerical Solutions of PDEs Lab	0-1-1
9		MA434	Fundamentals of Finite Element Method	3-0-3
10		MA 476	Cryptography	3-0-3
11		MA 473	Information Coding Theory	3-0-3
12		MA 428	Numerical Solutions of ODEs	2-0-2
		MA 428L	Numerical Solutions of ODEs Lab	0-1-1
13		MA-345	Fundamental of Operations Research	3-0-3
14		MA 473	Fuzzy Sets and Uncertainty Modeling	3-0-3
15	MA 445	Monte Carlo Simulations	3-0-3	
16	MA 484	Stochastic Calculus with Applications to Non-Linear Filtering	3-0-3	

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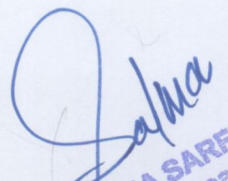
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List of Electives (Computational Mathematics)

S. No.	Category	Course Code	Course Title	Cr Hrs.
1	Computational Mathematics	MA-345	Fundamental of Operations Research	3-0-3
2		MA 428	Numerical Solutions of ODEs	2-0-2
		MA 428L	Numerical Solutions of ODEs Lab	0-1-1
3		MA 429	Numerical Solutions of PDEs	2-0-2
		MA 429L	Numerical Solutions of PDEs Lab	0-1-1
4		MA 434	Fundamentals of Finite Element Method	3-0-3
5		MA 438	Experimental Design	3-0-3
6		MA 439	Financial Data Analysis	3-0-3
7		MA 445	Monte Carlo Simulations	3-0-3
8		MA 446 ✓	Numerical Optimization	3-0-3
9		MA 470 ✓	Information Coding Theory	3-0-3
10		MA 476	Cryptography	3-0-3
11		MA 477	Game Theory	3-0-3
12		MA 479 ✓	Fuzzy Sets and Uncertainty Modeling	3-0-3
13		MA 484	Stochastic Calculus with Applications to Non-Linear Filtering	3-0-3
14		MA 485 ✓	Stochastic Processes	3-0-3
15		MA 486 ✓	Temporal Data Analysis	3-0-3
16		MA 487 ✓	Topological Data Analysis	3-0-3

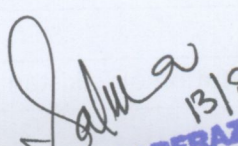

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List of Electives (Data Analytics)

1	Data Analytics	DS 301	Knowledge Representation and Reasoning	2-0-2	✓
		DS 301L	Knowledge Representation and Reasoning Lab	0-1-1	✓
2		DS 312	Data Mining	2-0-2	✓
		DS 312L	Data Mining Lab	0-1-1	✓
3		DS 350	Digital Image Processing	2-0-2	
		DS 350L	Digital Image Processing Lab	0-1-1	
4		DS 351	Natural Language Processing	2-0-2	
		DS 351L	Natural Language Processing Lab	0-1-1	
5		DS 354	Platforms and Architecture for Data Science	2-0-2	
		DS 354L	Platforms and Architecture for Data Science Lab	0-1-1	
6		DS 360	Data Visualization	2-0-2	✓
		DS 360L	Data Visualization Lab	0-1-1	✓
7		DS 470	Speech Processing	2-0-2	
		DS 470L	Speech Processing Lab	0-1-1	
8		CS 426	Parallel and Distributed Computing	2-0-2	
		CS 426L	Parallel and Distributed Computing Lab	0-1-1	
9		DS 320	Big Data Analytics	2-0-2	✓
		DS 320L	Big Data Analytics Lab	0-1-1	✓
10		IT 352	Virtual Systems and Services	2-0-2	✓
		IT 352L	Virtual Systems and Services Lab	0-1-1	✓
11		DS 451	Text Mining	2-0-2	✓
		DS 451L	Text Mining Lab	0-1-1	✓
12		AI 435	Reinforcement Learning	3-0-3	✓


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BSCMDA-Scheme of Studies

Fall 2025

1 st Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA 100	Foundational Mathematics		4-0-4*	Non Credit
MA 216	Discrete Structures		3-0-3	Major 1
IR 100	Introduction to International Relations		3-0-3	GE-AH
HU 124	Islamic Studies & Ethics		2-0-2	GE
CS 181	Applications of Information and Communication Technologies		2-0-2	GE-ICT
CS 181L	Applications of Information and Communication Technologies-Lab		0-1-1	
BA 152	Introduction to Management		2-0-2	GE-SS
HU 115	Pakistan Studies		2-0-2	GE
HU 411	Civics and Community Engagements		2-0-2	GE
FQ 100	Fehm-e-Quran I		0-1-1	GE
Total			16-2-18	

2 nd Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA 116	Single Variable Calculus		3-0-3	GE – QR – 1
MA 201	Linear Algebra		3-0-3	Major – 2
PH 123	Introductory Mechanics		2-0-2	GE-NS
PH 123L	Introductory Mechanics Lab		0-1-1	
CS 114	Introduction to Programming		2-0-2	IAC – 1
CS 114L	Introduction to Programming Lab		0-1-1	
BA 353	Entrepreneurship		2-0-2	GE
FQ 101	Fehm-e-Quran II	FQ 100	0-1-1	GE
HU 405	Ideology and Constitution of Pakistan		2-0-2	GE
Total			14-3-17	

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3 rd Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA 105	Multivariable Calculus	MA 116	3-0-3	GE – QR – 2 ✓
MA 209	Complex Analysis		3-0-3	Major – 3 ✓
MA 215	Ordinary Differential Equations		3-0-3	Major – 4 ✓
CS 218	Advanced Programming		2-0-2	IAC – 2 ✓
CS 218L	Advanced Programming Lab		0-1-1	
DS 210	Introduction to Data Science		2-0-2	Major – 5 ✓
DS 210L	Introduction to Data Science-L		0-1-1	
EL 170	Functional English		3-0-3	GE
Total			16-2-18	

4 th Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA 221	Numerical Analysis and Computation		2-0-2	Major – 6
MA 221L	Numerical Analysis and Computation-Lab		0-1-1	
MA 333	Mathematical Statistics-I		3-0-3	Major – 7
MA 342	Fundamentals of Optimization		3-0-3	Major – 8
MA 361	Real Analysis		3-0-3	Major – 9
MA373	Set Topology		3-0-3	Major – 10
EL 271	Expository Writing	EL 170	3-0-3	GE
Total			17-1-18	

Gen Edu : 33
Major : 30

Internship				
	Course Title	Pre-req.	Cr. Hr.	Domain
MA 490	Internship (6-8 weeks)		03	Internship

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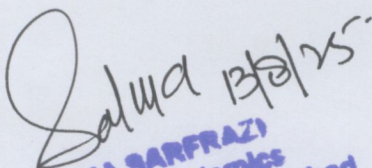
5 th Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA 473	Abstract Algebra		3-0-3	Major – 11
MA 316	Applied Matrix Analysis		3-0-3	Major – 12
MA 436	Mathematical Statistics-II		3-0-3	Major – 13
CS 130	Database Systems		3-0-3	IAC – 3
CS 130L	Database Systems-Lab		0-1-1	
CS 217	Applied Data Structures		2-0-2	Major – 14
CS 217L	Applied Data Structures Lab		0-1-1	
Total			14-2-16	

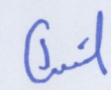
6 th Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA 312	Partial Differential Equations	MA 215	3-0-3	Major – 15
CS 332	Design and Analysis of Algorithms		3-0-3	Major – 16
MA 338	Applied Statistics		2-0-2	Major – 17
MA 338L	Applied Statistics Lab		0-1-1	
MA 343	Tensor Computation for Data Analysis		2-0-2	Major – 18
MA 343L	Tensor Computation for Data Analysis Lab		0-1-1	
MA 488	Scientific Writing and Research Methods		3-0-3	IAC – 4
Total			13-2-15	

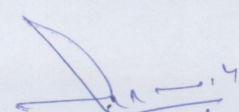
7 th Semester				
Course Code	Course Title	Pre-req.	Cr. Hr.	Domain
MA xxx	Elective-I		x-x-3	Major – 19
DS xxx	Elective - II		x-x-3	Major – 20
MA 440	Modeling and Simulation		2-0-2	Major – 21
MA 440L	Modeling and Simulation Lab		0-1-1	
AI 233	Machine Learning		2-0-2	Major – 22
AI 233L	Machine Learning -Lab		0-1-1	
MA 498	Final Year Project-I		3-0-3	Capstone Project
Total			x-x-15	

8 th Semester				
Course Code	Course Title	Prerequisite	Cr. Hr.	Domain
MA 478	Graph Theory		3-0-3	Major – 23
DS 455	Deep Learning		2-0-2	Major – 24
DS 455L	Deep Learning Lab		0-1-1	
MA 4xx	Elective – III		x-x-3	Major – 25
DS xxx	Elective – IV		x-x-3	Major – 26
MA 499	Final Year Project-II	MA 498	3-0-3	Capstone Project
Total			x-x-15	

Total Credit Hours-BS Mathematics	135
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