Dr. Athar Kharal – CV

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Personal Details

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Summary

- Presently teaching Applied Data Science at under-grad level and supervising 7 MS theses and 4 PhD thesis in Data Science at Center for Advanced Studies in Pure & Applied Mathematics (CASPAM), BZU, Pakistan.
- Served Pakistan Air Force Research & Development setups for 23 years and retired as Wing Commander.
- **Teaching Category 'A'** (highest being 'A') at NUST and received **Best Teaching Faculty Award**.
- PhD Mathematics (specialization: Fuzzy Logic) with **10 ½ years' practical experience of applying Data Science & AI** to aeronautical engineering, financial, healthcare, educational, aviation, and defense domains.
- Provided wide-ranging consultancy to industry/businesses in the areas of Data Analysis, Predictive Modelling, Discrete Event Simulation and Heuristic Optimization.
- Written 33 research papers (link here) with more than **1000 citations** (h10-index = 9, i10-index = 9) internationally (link here), in the areas of Deep Learning (Artificial Neural Networks), Fuzzy Logic, Optimization of Multi Criteria Decision Making (MCDM), Fuzzy Topologies and Soft Sets.
- Special expertise in using ICT in classroom environment, Curriculum Design using the methodology of Outcome Based Education (OBE), Theory and Practice of Semester System, Life Enhancement & Development Skills.

Skills & Tools

- **Mathematics & Statistics Software:** Maple, MATLAB (toolboxes of: Statistics & ML, ANN, Fuzzy Logic, Optimization), LaTeX, MuPad, Scientific Workplace 5.5
- **Data Science: R** (mlr3, tidyverse, ggplot), **Python** (pandas, scikit-learn), **SPSS** Modeler
- **AI & Deep Learning:** Keras, TensorFlow
- **Business Intelligence:** PowerBI, PowerQuery, FlexDashboards, Shiny Dashboards
- **Programming Languages:** Python, C++, Fortran
- **Distributed Computing:** Apache Spark (MLlib using sparklyr & PySpark), H2O Sparkling Water
- **Presentation of Work:** Markdown, Jupyter Notebook, Google CoLab, Databricks Spark Notebook, Binder
- **Databases:** PostgreSQL, MySQL, MongoDB
- **Cloud Computing:** RStudio Cloud, Azure ML Studio, Google Cloud Platform

Education

- PhD Mathematics 2013, BZU Pakistan • MSc Mathematics 1995, BZU Pakistan • BSc Mathematics, Statistics, Economics, 1993, BZU Pakistan

Certifications

- **Microsoft:**
  Microsoft Azure Fundamentals
  Bring the Power of Data to Every User in Your Organization
- **edX:**

Business and Data Analysis
Data Science and Machine Learning Essentials (DAT203x)
Introduction to Python for Data Science (DAT208x)
Analysing and Visualizing Data in Excel
Introduction to R for Data Science

Taught Courses

Grad Courses		Under-Grad Courses	
STAT-503	Discrete Event Simulation	CS-302	Theory of Automata and Languages
MATH-544	Advanced Engineering Mathematics	STAT-322	Applied Statistics using SPSS
STAT-521	Applied Statistics	MATH-321	Computer Programming (C++, Python)
STAT-431	Regression Analysis & Diagnostics	MATH-221	Numerical Methods using MATLAB
CS-563	Machine Learning Using R	MATH-222	Advanced Linear Algebra
CS-532	Data Science II (Python based)	MATH-101	Calculus I
MATH-533	Advanced Calculus	MATH-201	Calculus II
MATH-542	Practical Optimization (R based)	MATH-222	Differential Equations
STAT-541	Applied Survival Analysis using R	MATH-223	Engineering Mathematics
CS-845	Topological Data Analysis	MATH-233	Laplace Transforms for Engineering Problems
CS-524	Interpretable Machine Learning	STAT-302	Statistical Inference
		MATH-303	Business Mathematics

Theses Supervised

1. **MS:** Ayaz Hussain Bokhari, Prediction of Annual Rainfall in Sindh Province Using Machine Learning and Statistical Learning, Federal Urdu University, Karachi, Pakistan, January 2017
2. **MS:** Waqas Saleem, Comparison of ACO and GA Techniques to Generate Neural Network Based Bezier-PARSEC Parameterized Airfoil, School of Mechanical and Manufacturing Engineering, National University of Sciences and Technology (NUST), March 2016
3. **Under-grad:** Supervised 30 student projects concerning Machine Learning and Applied Statistics.

Career Progression

- **Assistant Professor of Data Science**, Centre for Advanced Studies in Pure and Applied Mathematics (CASPAM), Bahauddin Zakariya University, Multan, PAKISTAN, Nov 2021 – till to-date
- **Controller of Examinations (Associate Professor)**, University of Wah, Pakistan 26 April 2021 – Nov 2021
- **Data Custodian (Wing Commander)**, Flying Training, Air University, Pakistan Air Force Academy, Nov 15 – Jul 20
- **Head Data Analytics & Mathematics Division (Squadron Leader)**, supervisor for Machine Learning projects, Aeronautical Engineering, National University of Sciences & Technology (NUST), Pakistan Air Force, Sept 2009 – Nov 2015
- **Projects Commander (Flight Lieutenant) in Scientific Computing**, Statistics, MATLAB and C++, Aeronautical Engineering, National University of Sciences & Technology (NUST), Pakistan Air Force, 2004-2009
- **Flight Lieutenant**, Aeronautical Engineering, National University of Sciences & Technology (NUST), Pakistan Air Force, 1999-2004

Miscellaneous/Secondary Duties

Incharge Computing Lab: Nov. 1998 - Jan 2000, Established a full-fledged Computing Lab as in-charge Computer Section of Pre-Trade Training School of Pakistan Air Force. Conducted several short courses on General Orientation of Computing, Computer Programming in C++ and Advanced Usage of MS Office.

Academic Coordinator: Jan 2002 - Nov 2003 and Dec 2009 - Feb 2011, Duties included arrangements and scheduling of classes, lectures, briefings, in-service training sessions and student counselling. Monitoring of course content coverage in semester, recording, consolidating and reporting of student feedback.

ISO Auditor and Coordinator: Quality Assurance System ISO-9001, Aug 2002 – Dec 2003 and Sep 2009 to present. Duties comprised complete checking of compliance of the institutional practices with the laid down quality assurance procedures of ISO-9001.

Research & Development Coordinator: Sep 2010 – Nov 2016, Arranging of research seminars and lectures. Collection and dissemination of information regarding R&D activities. Compilation of plagiarism reports, R&D proposals and research bibliometrics e.g. Citations, h-indices, i10-indices, impact factor, eigen factor etc.

Head of Data Analytics & Mathematics Division: Sep 2011 – Nov 2016, Monitoring of coverage of course contents, ensuring the difficulty level, impartiality and punctuality of examinations. Raising the annual efficiency reports of Mathematics and Computer Science faculty. Course revisions and synchronization with modern engineering and analytics curricula at NUST.

Incharge CAE Convocation Ceremony: Sep 2011 – Nov 2016, NUST holds convocation of CAE bi-annually as two courses pass out in a year. As ceremony incharge, looked after matters like preparation of venue, designing, printing and sending of invitation cards, commentary vetting etc.

Data Analysis Team Lead for PAF Institutions' Cadets: Nov 2016 – June 2017, Data acquisition from historical records starting from 1947 till date and then its analytics and predictive modelling was done; comprehensive report spanning over 300 pages was submitted. Chief of Air Force awarded **Professional Excellence Badge** for this work in April 2018.

Head Curriculum Design Committee: 2018-2019, State-of-the-art curriculum designing methodology namely Outcome Based Education (OBE) was applied by myself for design and implementation of curriculum of basic sciences for Aeronautical Engineering setup of Pakistan Air Force.

Academic Seminars Delivered

1. A History of Mathematics - I, II, III, Centre for Advanced Studies in Pure and Applied Mathematics (CASPAM), Bahauddin Zakariya University, Multan on 10,17 and 24 March, 1994.
2. A first introduction to the Philosophy of Mathematics, Centre for Advanced Studies in Pure and Applied Mathematics (CASPAM), Bahauddin Zakariya University, Multan on 14 November, 1995.
3. Relative Grading System at CAE, seminar given at NUST Conference on Grading Systems, EME Campus NUST, Rawalpindi, Oct., 2002.
4. Vector Spaces of Human Eye's Colour System, Centre for Advanced Studies in Pure and Applied Mathematics (CASPAM), Bahauddin Zakariya University, Multan on 15 Nov, 2004.
5. Fibonacci Numbers, Centre for Advanced Studies in Pure and Applied Mathematics (CASPAM), Bahauddin Zakariya University, Multan on 8 August 2005.
6. Use of Scientific Workplace for Academic and Research Communication, College of Aeronautical Engineering (NUST), 18 Dec 2009.
7. Anti-plagiarism at NUST and use of Turnitin® Anti-plagiarism Online Service at CAE, College of Aeronautical Engineering (NUST), 17 April 2010.
8. Data Science – the new frontier, PAF Academy Auditorium, 6 June 2011
9. Analysing Flight Safety Data for Optimum Flying Effort, PAF College of Flying Training 03 January 2012
10. Adaptive Neuro-Fuzzy Systems for AutoPilot Ventures, Air University, Islamabad, 11 April 2013
11. Data mining techniques for Software Defined Radios and their spectrum analysis, College of Aeronautical Engineering (NUST), Saeed Auditorium, 09 September 2015

12. Big Data, Streaming Data and IoT: a futuristic perspective for Pakistan Air Force, Academy Auditorium, Risalpur, January 2019
13. Take Care of Yourself *in* One Day Symposium at CASPAM on 3 March 2022

Short Courses Conducted

A number of short courses (duration varying between 1 to 3 weeks) have been conducted by me at various times. A partial list of the courses is given below:

1. Mathematics of Applied Fuzzy Sets
2. Knowledge Based Fuzzy Logic Controllers
3. Applied Statistics Using SPSS
4. An introduction to R computer language
5. Introduction to MATLAB usage and programming
6. Computer Algebra System: Maple
7. Writing of successful research papers in Science and Engineering
8. Structured Document Development in MS Word for power-user
9. Teaching of Engineering Mathematics in Multimedia Classroom: Tools and Techniques
10. LaTeX for Classroom Teaching of Science and Engineering
11. LaTeX for Research Paper Writing
12. Automated Exams and Solutions Development for Class Instructors
13. Implementing Fuzzy Logic Solutions using Fuzzy Logic toolbox of MATLAB
14. Advanced Usage of MS Excel: from pivot tables to macros and data models
15. MuPad programming and integration with MATLAB
16. Ant Colony Optimization: Theory and Implementation
17. Automated Knowledge Discovery Using Machine Intelligence Algorithms (RapidMiner & SPSS Modeler based)

Workshops/Seminars Attended

1. All Pakistan Mathematics Conference, Department of Mathematics, Government College Faisalabad, March 1996 Pakistan (attended and also presented a paper).
2. First Mathematics Conference at CASPAM, BZU Multan Pakistan, (presented paper and also participated as a member of the organizing committee).
3. 4th World Conference at Abdus Salam School of Mathematical Sciences, GCU, Lahore (attended and also presented a paper)
4. National Workshop on Mathematical Modelling and Information Technology for Health (December 30-31, 2011) at LUMS, Lahore (attended)
5. Workshop on Personality Development by National Institute of Psychology, Quaid-e-Azam University, Islamabad.

Professional Courses Attended

1. Optimization and simulation techniques for aviation, Islamabad
2. Strategic Human Resource Management (May 14-18, 2012), Professional Development Centre, National University of Sciences and Technology (NUST), Islamabad
3. Training Supervisors Course, USA
4. Senior Command and Staff Course, Air War College (AWC) Pakistan Air Force
5. MATLAB and Python for applied machine learning, Centre for Human Resource Development, Karachi
6. Junior Command and Staff Course II, Air War College (AWC) Pakistan Air Force
7. Junior Command and Staff Course I, Air War College (AWC) Pakistan Air Force

8. SQL for Data Analysis, PAF Software Development Centre Malir, Karachi
9. Basic Staff Course, Air War College (AWC) Pakistan Air Force
10. Effective Communication Skills (with distinction), College of Education, Pakistan Air Force
11. Basic Instructional Technique Training, Directorate of Studies, PAF Academy

Distinctions and Awards

1. Pakistan Air Force **Professional Excellence Badge** (PEB) for consolidation and analysis of large-scale educational data
2. **Best Faculty Award**, College of Aeronautical Engineering, National University of Sciences and Technology (NUST)
3. Pakistan Air Force **Letter of Appreciation** for abridgement and translation of book namely "PAF Compass"
4. **Chief of Air Force Commendation Certificate** August 2017 for Data Driven Decision (D3) initiative at College of Flying Training, Pakistan Air Force Academy
5. Pakistan Air Force **Letter of Appreciation** for writing History of PAF Academy using advanced features of MS Word and MS Publisher
6. Pakistan Air Force **Letter of Appreciation** for contributing original working papers for betterment of organizational setup
7. **Chief of Air Force Commendation Certificate** August 2002 for implementing Neural Network to control blanking plate assembly
8. PhD Scholarship from Higher Education Commission of Pakistan, for throughout first division academic careers.
9. Top Ten Students of B.Sc. at Bahauddin Zakariya University 1994.
10. Top Ten Students of F.Sc. at Board of Intermediate and Secondary Education Multan, Pakistan 1991

Resume of Supervised Engineering and Data Science Projects (Selected list)

1. Development of an Artificial Neural Network to Estimate Nozzle Guide Vane Exit Area of Aircraft Engine (ATAR 09c) Test Bed

A custom neural network was developed using MATLAB, for a precision critical but ill posed problem. The neural net replaced a faulty computer assembly at Mirage Rebuilt Factory of Pakistan Air Force at Kamra. Additional work was done by interfacing the neural output with industrial machines. The project was adjudged by the faculty of College of Aeronautical Engineering (NUST) to be the best and was awarded **Best Project Gold Medal**. Results of this project were also presented as research paper at a conference [1]. (NUST/CAE/AE/WAQAS_PMA733027)

2. Neuro Computation Based Inverse Problem of Airfoil Geometry Determination

Determining the geometry of an aerodynamic object which satisfies pre-stated distribution of the forces of lift and drag at different angles of attack is the inverse problem in CFD. This project developed a neural net for this problem for NACA airfoil series. Resulting geometries have been cross checked using a total Navier Stokes solver and very accurate results have been found. The project was graded as **2nd best** by the faculty of CAE. (NUST/CAE/AE/SAMEER)

3. Development of Neuro-Fuzzy Inference System for Pressure Distribution (Cp) Around an Airfoil

A neuro-fuzzy inference system was developed to estimate the wind pressure round an aerodynamic object. The system required extremely small time for its computation whereas the same computation using Navier-Stokes equations required 4 to 5 computing hours. Our developed system produced 64 fuzzy rules as well.

Study of these rules for further analytical extension in CFD is now underway. The work was graded as the **2nd best** by the faculty. (NUST/CAE/AE/NAUMAN_985517)

4. Simulation and Parameter Sensitivity Analysis of an Air Defense System

Mathematical model has been developed and simulated on computer using statistical software SPSS. The model is moderately complicated as it takes the direction of aircraft, wind speed and visibility into account. Data of one million encounters/interceptions has been simulated to carry out statistical analysis. Monte-Carlo techniques have been used extensively for simulations. (NUST/CAE/AE/Umair_985535)

5. Target Identification Using Neural Networks

This project is the first phase of a full-fledged target identification system to be mounted on a drone. The project successfully achieved its goals of development of a neural net to identify objects and then its integration with hardware. Work may further be extended in other aspects like miniaturization of apparatus and real time processing. (NUST/CAE/AvE/Akhtar)

6. A Fuzzy Inference Engine in C++

A multipurpose Fuzzy Logic based inference engine has been developed. Written in C++ it can be embedded in other applications, for example in a PIC microcontroller to fabricate a neuro-fuzzy chip. This engine has already been used by another project to find the pressure distribution around airfoils. (NUST/CAE/AE/Kashif_985514)

Data Science (Organization Level) Projects (selected list)

1. Data dashboards for executive decision making at Flying Training, Pakistan Air Force (Nov'15 – Jul'19)
2. Development and implementation of Data Collection, Cleaning and Storage policy at Flying Training facility of Pakistan Air Force
3. Predictive model development for variable geometry determination Micro Air Vehicles' aerofoils. (Jan '12 – Mar '13)
4. Aviation Churn model for prediction of suspensions from flying training (Apr '17 – Sep '17)
5. Personnel segmentation for branch allocation after suspension from flying training (Nov'17 – Jan'18)