University of Puerto Rico
Mayagüez Campus
Dean of Arts and Sciences

Annual Report 2024-2025

Submitted by:

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Contents

I. General Information of the Mathematic Department

a. Mission and Vision

The mission of the Department of Mathematical Sciences is to:

- To offer undergraduate and graduate programs of excellence in Mathematics (Pure and Applied), Statistics, Mathematics Education, and Computer Science.
- To promote research in the areas mentioned above.
- To promote interdepartmental and inter-university collaboration projects, both nationally and internationally.
- To promote teacher and student training projects to improve knowledge of mathematical sciences in Puerto Rico.
- Offer service courses to other academic programs of the RUM and advice in computing, statistics and mathematics to the community.

The vision of the Department of Mathematical Sciences consists of:

- To provide a high-quality education for all students.
- To promote the development of research and the wide dissemination of mathematics, statistics, education, computer science and other related areas.
- Maintain effective links that promote the development of the industry and the community in general.

b. Organizational Structure

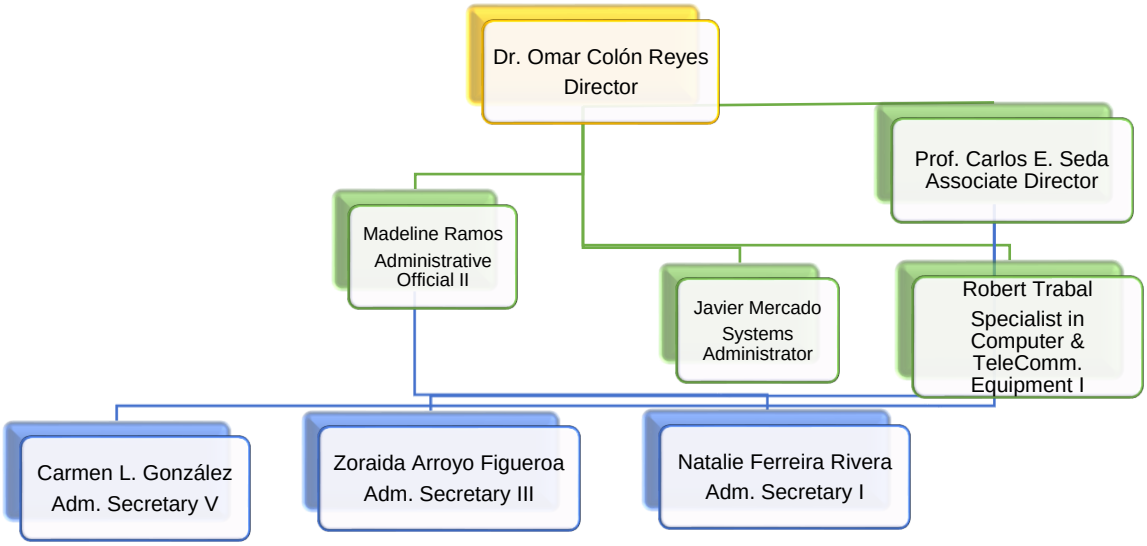
The Department of Mathematical Sciences offers a wide variety of study programs, both at the undergraduate and graduate levels. These programs are:

- Undergraduates: Bachelor's Degrees in Pure Mathematics, Computer Science and Mathematics Education.
- Graduates: Master's degrees in Applied Mathematics, Pure Mathematics, Computer Sciences, Mathematical Statistics, and Mathematics Teaching at Pre-University Level. PhD in Information and Computer Science and Engineering (CISE).

The Department of Mathematical Sciences has a staff of 36 professors in the specialties of Applied Mathematics, Computer Science, Mathematics Education, Pure Mathematics, Computer Sciences and Statistics. It also has 57 graduate students from different countries: Puerto Rico, Colombia, Honduras, El Salvador and Costa Rica.

1. Organizational Chart of the Mathematic Department

The math department administrative staff consists of a director, an associate director, an administrative officer, 3 secretaries, a systems coordinator and a user services technician.



II. Report on Initiatives, Activities, and Achievements in Accordance with the Strategic Plan and International Activity

a. Executive Summary

During the 2024–2025 academic year, the Department of Mathematics at the Mayagüez Campus continued to strengthen its educational, research, and service mission, while also facing important physical and academic transitions.

One of the most significant milestones of the year was the move to the Monzón Building, which now houses the Department's main offices and classrooms. Although the move represents a positive step toward modernizing the facilities, there are still needs related to furniture and equipment, the acquisition of which is a priority to ensure an optimal environment for academic and administrative work.

From an academic perspective, 741 sections of undergraduate and graduate courses were offered, serving an enrollment of approximately 8,894 students. Progress was made on the curriculum review, and a proposal was developed for the creation of a new Bachelor's Degree in Statistics to respond to the growing demand in this discipline and expand academic and professional opportunities for our students.

In the research area, faculty maintained an active participation through publications, conference presentations, and the securing of external funding. The Department continued to promote the integration of undergraduate and graduate students into research projects and specialized academic activities.

In terms of service, the Department collaborated with institutional and community initiatives, such as mathematical competitions, pre-university programs, and student mentoring. These activities strengthened ties with the community and reaffirmed the Department's commitment to comprehensive education.

Finally, administrative efforts aimed at improving internal processes, the use of educational technology, and staff professional development continued. New strategies were also identified for student recruitment and strengthening academic offerings.

In summary, the 2024–2025 academic year marked a period of transition, growth, and future projection for the Department of Mathematics, laying the foundation for academic innovations and infrastructure improvements that will benefit the entire university community.

b. Objective 1: Institutionalize a culture of strategic planning and assessment

To foster and institutionalize a culture of strategic planning and continuous assessment within the Department of Mathematics by strengthening key academic initiatives such as the Departmental Colloquium —which promotes professional development and inter-university collaboration—, the annual awarding of the Gauss Medal for academic excellence, and outreach activities that encourage mathematical culture in Puerto Rico, including the Pre-Calculus and Calculus Competency events and the COMATEQ International Competition. These initiatives serve as strategic pillars for aligning teaching, research, and community engagement with the institutional goals of the University of Puerto Rico at Mayagüez.

Encourage research among undergraduate and graduate students

Oral Presentations

- Ortiz, Reyes, “On the τ-divisor topology”, Luis Duran (CROEM student), ISEF PR, March 7, 2025. Qualified for ISEF in Ohio (to be presented, May 10-16, 2025)

- Ortiz, Reyes “On the Reduced τ_n- divisor graphs”, with Carmen Peña, in progress.

- Ortiz, Reyes “On the τ_5-divisor graph”, with Byron Patiño, in progress.

- Ortiz, Reyes “On the distribution and asymptotic behavior of τ_n-primes”, with Daniel Vasquez, in progress.

- Ortiz, Reyes “On the Macias Topology”, with Jhixon Macías, in progress.

- Ortiz, Reyes “On the classification of group of k-rotational permutations”, with Jose Calderon and Luis Medina, in progress.

- Colon Reyes, Omar, “A control theory for Monomial dynamical systems over finite fields”, with Dennis Quintano.

- Colon Reyes, Omar, “On acyclic subgraphs and transient length bounds”, with Bryan C. Busby.

- Colon Reyes, Omar, “Use of the Frobenius number to determine the transient of fixed-point dynamical systems over finite fields of characteristic 2”, with Mario Motiño, Arnaldo Vera, Eiver Rodríguez.

- Almodóvar, Israel, “A semi-supervised k-means directions algorithm for data in the sphere”, with graduate student Yeily P. Guzman. (first place awarded in Research Competition from the Engineering department UPR -Mayaguez)

DEPARTMENT ACTIVITIES

Date	Activity
July 27, 2024	Girls Math Club (GMCPR)
August 1, 2024	Academic Orientation – New Undergraduate Students
August 29, 2024	Girls Math Club (GMCPR)
August 30, 2024	Academic Orientation – New Graduate Students
September 26, 2024	Girls Math Club (GMCPR)
October 17, 2024	Girls Math Club (GMCPR)
October 17, 2024	Mathematics Professionals Panel – Pythagorum Association
October 24, 2024	Institutional Open House
November 1–24, 2024	Infomate
Nov. 12 -Dec. 6, 2024	BEBRAS PR Challenge
November 16, 2024	OMPR – Second Round (2023–2024 Cycle)
November 21, 2024	Girls Math Club (GMCPR)
November 26, 2024	Mathematics Professionals Panel – Pythagorum Association
December 6, 2024	NSF Workshop – Dr. Karen Ríos
December 6, 2024	International Dinner – Graduate Students and Faculty
December 7, 2024	Diagnostic Exam
January 13, 2025	Orientation – New Graduate Students (January)
February 1, 2025	Scratch Jam Workshop
February 6, 2025	Statistics Committee Meeting
February 10, 2025	Pythagorum Association – New Members Recruitment
February 12, 2025	ACM-W Movie Night
February 15, 2025	OMPR – Third Round (2023–2024 Cycle)
March 7–8, 2025	SIDIM 2025 – UPR Ponce
March 10, 2025	Programming Workshop (Git & GitHub)
March 14, 2025	Pre-Calculus and Calculus Competencies
March 29, 2025	OMPR Awards Ceremony – Mangual Coliseum, Special guest: Dr. Ada Monzón- Meteorologist
April 3, 2025	Curriculum Committee Meeting
April 7, 2025	ACM Programming Competition
April 8, 2025	Curriculum Committee Meeting

Date	Activity
April 12–13, 2025	OMPR – Fourth Round and Awards Ceremony (UPR Río Piedras)
April 23, 2025	Integration Bee – Room M-302
April 30, 2025	Arts & Sciences Honor Roll
May 1, 2025	Integration Bee – Physics Amphitheater (FB)
May 3, 2025	Eugene Francis Cup – Competition
May 9, 2025	2nd UPRM Regional Workshop on Computational Data Science
May 10, 2025	Gauss Medal Award – Winner: Denzel Montes Meléndez
June 11–16, 2025	Summer Camp for Talented Mathematics Students – CROEM, Mayagüez

COLLOQUIUM

As part of our department's commitment to academic enrichment and scholarly engagement, we hosted a series of research presentations throughout the 2024–2025 academic year. The Colloquium Series featured distinguished faculty, researchers, and professionals from UPR-Mayagüez and beyond. These talks provided a platform for the dissemination of current research, interdisciplinary dialogue, and the professional development of our students and faculty.

List of Presentations:

- **August 21, 2024**
  Mr. Junior Arauz Aguilar, UPR-Mayagüez
  Title: *Analysis of Results from the Second and Third Rounds of OMPR 2023–2024*
- **September 12, 2024**
  Dr. José Emilio Calderón, UPR-Mayagüez
  Title: *Characterization and Affine Equivalence of k-Rotation Symmetric Boolean Functions*
- **October 17, 2024**
  Dr. Wolfgang Rolke, UPR-Mayagüez
  Title: *Brief History of the Most Famous Formula in Statistics*
- **November 12, 2024**
  Dr. Angy C. Coronel, UPR-Mayagüez
  Title: *Number Sense in Puerto Rican Students*
- **November 14, 2024**
  Mr. Jhixon Macías, UPR-Mayagüez
  Title: *A Topological Proof of the Infinitude of Prime Numbers*

- **December 5, 2024**
  Dr. István Mező, UPR-Mayagüez
  Title: *Some Exotic Topological Spaces*
- **March 4, 2025**
  Dr. Marcelo Suárez, UPR-Mayagüez
  Title: *Materials Science and the Quest for the Philosopher's Stone: Some Outcomes*
- **March 6, 2025**
  Mr. Joseph Martínez, Telemundo
  Title: *Beyond Maps: How Applied Mathematics Is Fundamental in Meteorology*
- **March 11, 2025**
  Dr. Jhoana Romero, UPR-Mayagüez
  Title: *Dynamics of AMR Beyond a Single Bacterial Strain: Revealing the Existence of Multiple Equilibria and Immune System-Dependent Transitions*
- **March 25, 2025**
  Dr. Roberto Rivera, UPR-Mayagüez
  Title: *Estimating Counts Through an Average Rounded to the Nearest Non-negative Integer and Its Theoretical & Practical Effects*
- **March 27, 2025**
  Dr. Liliana Esquivel, UPR-Mayagüez
  Title: *A Riemann–Hilbert Approach to the Fractional NSL Equation on a Half-Line*
- **April 1, 2025**
  Dr. Israel Almodóvar, UPR-Mayagüez
  Title: *Incorporating Seasonality in Functional Magnetic Resonance Imaging to Assess Reliability*
- **April 10, 2025**
  Dr. Maytee Cruz, UPR-Cayey
  Title: *Metapopulation Model Framework for Puerto Rico Applied to COVID-19*
- **May 5, 2025**
  Dr. Maxim Laurențiu, University of Wisconsin–Madison
  Title: *Curvature, Asphericity, and Positivity in Complex Geometry*

ACHIEVEMENTS AND AWARDS

During the 2024–2025 academic year, the Department of Mathematics celebrated several noteworthy accomplishments. A formal proposal for the creation of a Bachelor's degree in Statistics was successfully developed, reflecting our commitment to academic growth and programmatic innovation. The Girls Math Club of Puerto Rico (GMCPR) experienced significant expansion, offering continuous mentorship and enrichment opportunities for young women interested in mathematics. The Puerto Rico Mathematical Olympiad (OMPR) continued to identify and recruit mathematically talented students from across the island, reinforcing our leadership in pre-university mathematics education.

In collaboration with Dr. Alcibiades Bustillo and undergraduate students, the department achieved exceptional national recognition by securing **First Place in the 2024 Research Posters Competition – Undergraduate Computing Track** at the **Great Minds in STEM**

(GMiS) Conference, as well as **First Place in the 2024 CAHSI Data Analytics Challenge**. These achievements highlight the department's dedication to excellence in research, student mentorship, and interdisciplinary collaboration.

Graduate student Dennis Quintano was invited and awarded a scholarship to participate in the workshop: "Graduate workshop on Linear Algebra over Finite Fields & Application", to be held at ICERM at Brown University.

Congratulations to Dr. Luis F. Cáceres and his OMPR group (OM.PR) for the approval of their proposal submitted to citadel Securities. This proposal will support the OMPR summer Camp, where young people from public and private schools in Puerto Rico will be trained as part of our annual OMPR cycle.

This academic year, several students successfully completed their master's degrees in our department. These accomplishments reflect the dedication of our graduate students and the strength of our academic programs. We extend our congratulations to all graduates for their outstanding efforts and contributions to the mathematical community.

Master's Degrees Awarded

Mathematics Education

- Jazleydy Chavez
- Jeffreey Castro
- Julio Fontalvo
- Victor Reyes
- Marissa Álvarez – *In addition to being a dedicated university employee, Marissa successfully completed her Master's in Mathematics Education.*

Pure Mathematics

- Hassam Hayek
- Jhixon Macias

Applied Mathematics

- Carlos Díaz
- Patrick González

Scientific Computing

- Sebastián Jansasoy
- Edwin Lara

c. Objective 2: To lead higher education throughout Puerto Rico while guaranteeing the best education for our students

The Department of Mathematical Sciences supports the University's mission to lead higher education in Puerto Rico by fostering academic excellence, research innovation, and inclusive educational practices. We uphold rigorous academic standards in all our programs—Pure Mathematics, Applied Mathematics, Mathematics Education, and Scientific Computing—ensuring our students receive a comprehensive and forward-looking education. Through faculty research, interdisciplinary collaborations, and participation in national and international conferences, we help position the University as a center of intellectual leadership. Additionally, our commitment to quality teaching, academic advising, and community engagement—such as math outreach events, Olympiads, and teacher development—reinforces our role in shaping the future of mathematics education across Puerto Rico.

As part of our commitment to academic excellence and leadership in higher education across Puerto Rico, and in response to a request from the **Office of Academic Affairs,** the Department of Mathematical Sciences has developed a comprehensive **Action Plan for Low-Enrollment Programs** for the 2025–2026 academic year. This initiative seeks to address declining enrollment in key academic concentrations by implementing targeted strategies that promote the value, relevance, and career opportunities associated with mathematical education and theoretical mathematics.

Action Plan – Low-Enrollment Programs

Academic Year: 2025–2026
Department: Mathematical Sciences
College: College of Arts and Sciences

Introduction:
The Mathematics Education concentration is currently experiencing low enrollment, partly due to declining student interest in education careers and perceptions of limited economic prospects in the teaching profession. Despite this, the program plays a crucial role in preparing highly skilled mathematics educators for the Puerto Rican education system. This plan aims to revitalize interest in the program through initiatives that highlight the professional, social, and academic value of mathematics teaching, alongside the institution's commitment to excellence in educator training.

Initiative 1: "Voces que Enseñan: Profile of the Future Mathematics Educator"

- **Justification:**
  This initiative seeks to transform public perception of mathematics teaching by portraying it as an intellectually stimulating and socially impactful career.
- **Objectives:**
  1. Increase visibility of mathematics educators as agents of change.
  2. Promote the program in at least 15 schools using alumni success profiles.

3. Attract students with teaching vocations through interactive outreach.

- **Implementation Plan:**
  - Create and disseminate alumni success profiles (June–August 2025).
  - Organize school visits and interactive sessions (September–November 2025).
  - Launch social media campaigns with testimonials and key data (August–December 2025).

Initiative 2: "Programa Puente: Pre-University Mathematics Education Experience"

- **Justification:**
  Engaging high school students in real-world mathematics teaching experiences can help foster early interest in the profession.
- **Objectives:**
  1. Identify prospective mathematics education students in 10 schools.
  2. Implement a semester-long workshop with microteaching sessions.
  3. Facilitate observation opportunities at partner schools.
- **Implementation Plan:**
  - Sign agreements with public and private schools (July–August 2025).
  - Conduct introductory didactics workshops (September 2025 & February 2026).
  - Organize classroom observation sessions with cooperating teachers (November 2025 & April 2026).

Note: A proposal to revise the Mathematics Education program will be presented to the DMS faculty by December 2025. Implementation timelines are subject to the department's calendar and relevant committee evaluations.

Program: Pure Mathematics

Introduction:
The Pure Mathematics concentration has experienced a decline in enrollment, likely due to perceptions of it being a highly theoretical field with limited practical applications, in addition to broader disruptions such as the COVID-19 pandemic and natural disasters. However, this program offers a strong foundation for careers in research, data science, graduate study, and emerging fields like artificial intelligence and network theory. This plan seeks to communicate the modern relevance and intellectual appeal of theoretical mathematics.

Initiative 1: "Pure Mathematics: The Science Behind the Future"

- **Justification:**
  This initiative aims to counter the belief that pure mathematics is impractical by showcasing its connections to fields such as technology, cryptography, and data analysis.

- **Objectives:**
    1. Present at least five real-world applications of pure mathematics through graphic materials and talks.
    2. Recruit high-performing students in standardized math assessments.
    3. Launch a pre-university seminar series for advanced students.
- **Implementation Plan:**
    - Produce infographics and videos on number theory, algebra, geometry, etc. (July–August 2025).
    - Organize monthly seminars with faculty participation (August–December 2025).
    - Connect with schools to identify students with strong math profiles (September–October 2025).

Initiative 2: "Advanced Problem Solving and Logic Workshop"

- **Justification:**
  Creative problem solving provides an ideal entry point into pure mathematics. This workshop is designed to excite students who enjoy logical thinking.
- **Objectives:**
    1. Host a competitive workshop on advanced mathematical problem solving.
    2. Identify and motivate students inclined toward mathematical research.
    3. Establish links with local and regional mathematics Olympiads.
- **Implementation Plan:**
    - Design the workshop and launch the call for participation (June–August 2025).
    - Offer weekly workshop sessions during the semester (September–December 2025).
    - Select top-performing students for academic mentorship (January–April 2026).

d. Objective 3: To increase and diversify the Institution’s sources of revenue

The Department of Mathematical Sciences continues to actively pursue external funding opportunities to supplement its annual budget and support its academic, research, and administrative initiatives. Our faculty’s involvement in short-, medium-, and long-term projects reflects our sustained commitment to excellence in all areas of our mission.

One notable achievement is the development, proofreading, and promotion of instructional materials authored by our faculty and used in core mathematics courses. These include:

- *MATE 3171: Text and Exercise Manual (Precalculus I)*
- *MATE 3172: Text and Exercise Manual (Precalculus II)*

- *MATE 3086: Textbook (Mathematical Reasoning)*

These publications not only alleviate the financial burden on students by reducing textbook costs, but also generate revenue for the department. These funds are reinvested directly into student-centered initiatives, instructional enhancements, and research activities, thereby creating a self-sustaining model of academic support.

Another key initiative is the **Institute of Mathematical Strengthening (INFOMATE)**, which continues to generate income through its offerings. INFOMATE provides essential preparatory resources for students preparing to take the Mathematics Diagnostic Exam, and its growing popularity underscores its value as an academic support tool.

All revenue generated through these initiatives is allocated to support impactful services in teaching, research, and the administrative infrastructure that enables both.

e. Objective 4: To implement efficient and expedient competitive creative endeavors

The Department of Mathematical Sciences has continued to implement strategic initiatives aimed at increasing administrative efficiency and supporting the university's "paperless" policy. These efforts enhance both academic operations and student services:

- **Digitization of Processes:** Ongoing digitization of departmental files has streamlined operations, including more efficient electronic processing of approvals for the Mathematics Diagnostic Exam and the Institute of Mathematical Strengthening (INFOMATE).
- **Website Revamp:** The department's official website (math.uprm.edu) has been redesigned to improve speed, usability, and accessibility. The updated platform better serves students, faculty, and the broader community.
- **INFOMATE Accessibility:** Server infrastructure has been upgraded and digital content updated to ensure that the Institute for Mathematical Strengthening (INFOMATE) remains fully accessible online. This initiative has significantly broadened its impact, providing remote access to preparatory materials for Precalculus to all UPRM students and the general public.
- **Online Mathematics Diagnostic Test:** Improvements to server performance and data management have also enhanced the delivery of the online Mathematics Diagnostic Test. This makes the test more accessible to incoming students, particularly those who score 604 or below on the College Board PAA exam.
- **Adoption of Adobe Sign:** The department has adopted the Adobe Sign platform for the streamlined and efficient processing of administrative and academic documents that require multi-level signatures across departments and academic deanships.
- **Support for Online Teaching Certification:** Faculty and teaching assistants are encouraged to obtain the Online Teaching Certification offered by DECEP (Division of Continuing Education and Professional Studies). This strengthens the

department's capacity for high-quality distance education and supports efforts to pursue external funding through online course offerings.

- **Computer Lab Upgrades:** As part of our commitment to enhancing the technological resources available to students, the department completed a full renovation of its computer laboratories. New, high-performance computers were installed to support instruction, research, and software-based coursework, providing students with access to modern tools that meet current academic and professional standards.

f. Objective 5: To strengthen research and competitive creative endeavors

The Department of Mathematical Sciences continues to advance a robust research agenda through funded proposals, scholarly publications, national and international conference participation, and the mentorship of student research projects. These efforts reflect the department's commitment to academic excellence and creative inquiry.

Funded Proposals

Dr. Edwin Flórez

1. *Development of Automated Fluid Delivery System to Advance Neuroscience*, PR-INBRE Pilot Project ($50,000/year, 2 years)
2. *Small Instrumentation Awards for PUIs*, PR-INBRE ($30,000, March 2024)
3. *CDS-Exchange Curriculum Development Fellow*, CDS Exchange Fellowship ($1,000, December 2024)

Dr. Omar Colón & Dr. Luis Cáceres

1. *Épsilon Fund, PROTASM* – Puerto Rico Opportunities for Mathematically Talented Students, American Mathematical Society ($5,500, 2024-2025)
2. *Tensor Grant – Girls Math Club in Puerto Rico*, Mathematical Association of America ($6,000, 2024)
3. *UPRM Chancellor Funds* – Co-requisite Support ($80,000, 2024)
4. *CRRSAA Funds* – Math Tutorial Lab ($100,000, 2024–2025)

Submitted Proposals

Dr. Xuerong Yong

- *Matrices with Exactly One Positive Eigenvalue*, submitted to *Linear Algebra and Its Applications* (April 2025)

Dr. Liliana Esquivel

- *LEAPS-MPS: Fractional Dispersion and Stochasticity: A Complex Analysis Approach to Boundary Value Problems and Integrated STEM Training*
- *NSF 25-535: Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences*

Dr. Edwin Flórez

- *Exploring Chatbots for Mathematical Competition Problem Generation*, Microsoft Accelerate Foundation Models Research (Nov. 2024)
- *Using Chatbots to Generate Challenges in Math & CS Competitions*, Google-CAHSI IRP (Jan. 2024)
- *CDS Exchange Fellowship Program: Computational and Data Science Curriculum Materials*
- *Flower Patch System for Honeybee Experiments* (under revision)

Peer-reviewed Publications (Accepted)

Dr. Luis Cáceres

- Book Chapter: *Metodología de enseñanza en espiral*, XIII CIEMAC, Universidad de la Rioja (2024)
- *Analyzing Proficiency and Growth: A Study of Math Competitions in Elementary Students in Puerto Rico*
- *Mathematics Competition by Teams (COMATEQ): An International Opportunity*, INTE Proceedings (2024)

Invited Talks and Presentations

Dr. Arturo Portnoy

- *Music and Mathematics: A Deep and Multifaceted Relationship*, UPR-Río Piedras (Aug. 2024)
- Plenary Talk: *The Mathematics of Music and Art*, SIDIM XL, UPR-Ponce (Mar. 2025)

Dr. Jose Emilio Calderón

- *k-Rotational Boolean Functions*, UPRM (Sept. 2024)
- *Boolean Functions and Symmetry*, UPNFM-Honduras (Mar. 2025)

Dr. Edwin Flórez

- *Computational Thinking and AI in Puerto Rico*, OiPR
- *WebWork as a Pedagogical Tool*, SIDIM (Mar. 2025)

Dr. Liliana Esquivel

- *A Riemann-Hilbert Approach to the Fractional NLS Equation*, UPR-Río Piedras

Dr. Alcibiades Bustillo

- *Teaching and Learning of Calculus*, MAA MathFest (Aug. 2024)

Dr. Angy Coronel

- *Numerical Sense in Puerto Rican Students*, DCM Colloquium (Nov. 2024)
- *Origami Workshop*, Girls Math Club (Oct. 2024)

Dr. Karen Ríos

- *Differential Equations & Mathematical Biology Workshop*, Miami (Nov. 2024)
- *NSF CDS Exchange Symposium*, Clark University (May 2025)

Dr. Jhoana Romero Leiton

- *Mathematical Modeling of AMR in Livestock*, BIOMATH 2025, Bulgaria (June 2025)

Student Presentations Under Faculty Supervision

Dr. Arturo Portnoy

- *Another Proof of Pearson's Theorem*, José A. Ortega, SIDIM XL (Mar. 2025)

Dr. Reyes Ortiz

- *t-Divisor Topology*, Luis Durán (CROEM), ISEF PR & ISEF Ohio (Mar. 2025)

Dr. Edwin Flórez

- *Numerical Simulation of PR Earthquake 2020*, Daniel Melo, SIDIM
- *Robotic Systems for Nectar Collection*, SIDIM
- *N-Queens Problem Solutions*, Julian Soto, GMiS 2024
- *Spotify AI Song Recommendations*, Emilia Couret, GMiS 2024

Dr. Alcibiades Bustillo

- *Adversarial AI Attacks*, Alondra Soto, GMiS 2024, Fort Worth, TX

Publications Under Review

Dr. Reyes Ortiz

- *The Macias Topology on Integral Domains II*, submitted to *Topology and its Applications*

Dr. Jose Emilio Calderón

- *Monomial Dihedral Symmetric Boolean Functions*, *Discrete Mathematics Journal* (Apr. 2025)

Dr. Liliana Esquivel

- *Well-posedness for KdV-Burgers Equation*

Dr. Alcibiades Bustillo

- *Digital Technologies and Calculus*, submitted to *IJME-ST* (Apr. 2025)

Dr. Angy Coronel

- *Knowledge for Teaching Mathematical Functions*, CAMACYC (under revision)

Dr. Paul Castillo

- *LDG Methods for Nonlinear Schrödinger Equation*

Publications Accepted for 2024–2025

Dr. Israel Almodovar

- *Quantifying the burden of cancer in Puerto Rico's oldest residents*, Cancer Epidemiology, volume 97, August 2025,102838
- *Ergosterol peroxide disrupts triple negative breast cancer mitochondrial function and inhibits tumor growth and metastasis,* International Journal of Molecular Sciences: int. J. Mol. Sci, 2025,26 (10), 4588

Dr. Arturo Portnoy

- Book: *Calculus to Analysis – An Introductory Transition*, Synthesis Lectures, Springer (2025) Link

Dr. Edwin Flórez

- *Statistical Analysis of Social Factors*, Ad-Gnosis, Vol. 13 (Nov. 2024)
- *Survey on Digital Twin Networks*, Springer LNNS, Vol. 1094 (Aug. 2024)

Dr. Angy Coronel (et al.)

- *BEBRAS PR 2023 Tasks and Solutions*, published by OiPR (2024)

Dr. István Mező

- *Inverse of Jackson's q-Exponential Function*, Adv. Operator Theory 9 (2024)
- *Stirling Numbers & Diophantine Equations*, Int. J. of Number Theory 21 (2024)
- *Definite Integrals and Gamma Functions*, *The Ramanujan Journal* 67 (2025)

Dr. Jhoana P. Romero

- "*Mathematical Modelling of the First HIV/ZIKV Co-Infection cases in Colombia and Brazil"*, Journal: Bulletin of Mathematical Biology, link: https://doi.org/10.1007/s11538-025-01429-x
- "*Mixed Cost Function and State Constrains Optimal Control Problems*", Journal: Applied Math, link: https://doi.org/10.3390/appliedmath5020046
- *Deterministic, stochastic and fractional mathematical approaches applied to AMR*, published in: Mathematical Biosciences and Engineering, Link: https://aimspress.com/article/doi/10.3934/mbe.2025015
- *Dynamics of AMR beyond a single bacterial strain: Revealing the existence of multiple equilibria and immune system-dependent transitions*, published in: Chaos, solutions and fractals, link: https://www.sciencedirect.com/science/article/pii/S0960077924014644?dgcid=author
- *Exploring Zika's dynamics: A scoping review journey from epidemic to equations through mathematical modelling*, published in: Infectious disease modeling, link: https://www.sciencedirect.com/science/article/pii/S2468042724001489?via%3Dihub

Dr. Luis F. Cáceres

- *Strengthening logical thinking through cooperative strategies for primary level students with mathematical talent*, junto a Natalia Alcala, accepted at: **17th annual International Conference on Education and New Learning Technologies, Palma (Spain) - 30 June - 2nd July 2025**
- *Kangaroo mathematics competition: a successful international cooperation activity*, with Dr. Omar Colon was accepted in: **17th annual International Conference on Education and New Learning Technologies, Palma (Spain) - 30 June - 2nd July 2025.**

Dr. Liliana Esquivel

- *Profile cut-off phenomenon for the ergodic Feller root process,* Journal: Stochastic Processes and their Applications

Dr. Edgar Acuña

- *The Treatment of Missing values and its Effect on Classifier Accuracy* pubished with Caroline Rodriguez in: Banks, D., McMorris, F.R., Arabie, P., Gaul, W. (eds) Classification, Clustering, and Data Mining Applications. Studies in Classification, Data Analysis, and Knowledge Organization. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-17103-1_60

Jhixon Macias

- *A generalization of the Zariouh's property (gaz) through local spectral theory*, was accepted in: Math Journal, Ecuador, link; https://www.revistas.espol.edu.ec/index.php/matematica/article/view/1239

Research Projects

Dr. Jose Emilio Calderón

- *G-invariant Boolean Functions*, with researchers from UPRRP, UPRM, and UPRA

Dr. Edwin Flórez

- *PR-INBRE Honeybee Project*, UPRRP collaboration, NIH funding
- *AI in Streaming Platforms*, CAHSI REU with student Emilia Couret
- *Social Factors in UPR Student Performance*, UPRRP collaboration

Dr. Paul Castillo

- *LDG Methods for PDEs* – Free matrix implementation

Dr. Flor Narciso

- *AI for Emergency Medical Diagnostics*, undergraduate research, MATE 4990
- *Educational Innovation with AI*, MATE 4990, Computer Science and Industrial Engineering

g. Objective 6: To impact our Puerto Rican society

The department actively contributes to Puerto Rican society by identifying and nurturing mathematical talent through a variety of outreach and academic initiatives:

- Continued promotion and recruitment of gifted students via the **Puerto Rico Math Olympiad (OMPR)** and research-oriented activities.
- Organization of national and international competitions such as **Bebras PR** (focused on computational thinking), **Scratch Jam**, and **team selection for the International Olympiad in Informatics (IOI)**.
- Faculty service as **judges for mathematics fairs** coordinated by the Puerto Rico Department of Education (DEPR).
- Launch of a **co-requisite support course for MATE 3173**, aimed at enabling students without the MATE 3171 prerequisite to succeed in calculus-level mathematics.

These actions exemplify the department's outreach mission and its commitment to broadening access to mathematical education and cultivating future leaders in STEM fields.

h. Objective 7: To strengthen school spirit, pride, and identity

The Department of Mathematical Sciences is committed to fostering a vibrant academic community and strengthening the identity and pride of our students and faculty through a series of impactful activities:

- **Representation of Puerto Rico in the International Artificial Intelligence Olympiad (IAIO)**
  - **Date/Location:** September 8–12, 2024, Riyadh, Saudi Arabia
  - **Purpose:** Served as team leader and represented the University of Puerto Rico at Mayagüez (RUM) in this international academic competition.
  - **Impact:** Marked Puerto Rico's debut in IAIO, positioning RUM as a regional leader in artificial intelligence education.
- **Organization and Mentorship for Puerto Rico's Participation in the Ibero-American Olympiad in Informatics (OII)**
  - **Date:** June 22–23, 2024 (virtual format)

  - **Purpose:** Training and supervising K–12 students selected by OiPR to compete at the Ibero-American level.
  - **Impact:** Strengthened RUM's role as a center for early-stage computer science education and talent development.
- **Academic Participation in the LEVEL UP Workshop (Computing Research Association)**
  - **Date/Location:** August 7–8, 2024, Washington, D.C.
  - **Purpose:** Engaged in national discussions on inclusive teaching strategies in computer science education.
  - **Impact:** Facilitated knowledge transfer to the department's curriculum, enhancing course design with an inclusive and modern perspective.
- **Design and Management of a Digital Validation System for Departmental Textbooks**
  - **Date:** From July 2023 to present
  - **Purpose:** Provide students with secure, personalized, and digital access to institutional textbooks.
  - **Impact:** Optimized departmental resources and improved the student experience by streamlining textbook access.
- **Lecture Notes by Dr. Istvan Mezo for the Algebraic Topology Course (MATE 6551)**
  - Dr. Mezo authored a comprehensive 75-page lecture note for the Algebraic Topology course. These notes introduce modern topics in topology and algebraic homology, essential for students interested in research in this area. Moreover, these notes will serve as a valuable resource for future instructors of this course in our department.
- **Faculty Participation in National and International Academic Events and Competitions:**

  - 15th International Congress on Mathematical Education (ICME), Sydney, Australia, July 2–17, 2024
  - MAA Math Fest 2024, August 6–10, 2024
  - 39th Ibero-American Mathematics Olympiad, Tarija, Bolivia, September 19–25, 2024
  - 26th Central American and Caribbean Mathematics Olympiad, Comayagua, Honduras, October 12–17, 2024
  - 32nd Kangaroo Without Borders Meeting, Santos, Brazil, October 19–28, 2024
  - Conference for Teachers in Costa Rica promoting the department's graduate program, March 22–27, 2025
  - Kangaroo Math Meeting, Valencia, Spain, May 29–June 1, 2025

These initiatives collectively reflect the department's dedication to enhancing school spirit, fostering pride in academic excellence, and reinforcing the identity of our community within and beyond the university.