

FERMAT RESEARCH & DEVELOPMENT AGENDA

2023-2028





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Executive Summary

In honor of one of the most brilliant and productive mathematicians of his time, Pierre de Fermat, who contributed to the differential and integral calculus, number theory, and analytical geometry, the FERMAT Research and Development Agenda was formulated.

The Foundational and Expanded Research on Mathematical Application and Theory (FERMAT) R&D Agenda of the Department of Mathematics aims to develop new mathematical theories and extend existing theories in the different fields of Mathematics. The application of the developed formulas, techniques, and concepts in Mathematics to other fields such as in Agriculture, Biology, Education, Culture, Arts, Medicine, Health, Engineering, Finance and Management is also aimed to establish.

The program will focus on five priority areas: (1) theory building, (2) modeling, optimization, and application, (3) statistics and computing, (4) ethnomathematics, gender sensitive resilience, and mathematics education, and (5) institutional and program based. The program is also in consonance with the sustainable development goals (SDGs) and university research and development agenda.



Research Priorities & Agenda

Priority Area 1: Theory Building

Objectives:

- 1.1. Develop new mathematical theories and extend existing theories in the different fields of Mathematics in a more comprehensive and nuanced way.
- 1.2. Develop new mathematical methods or tools for building and testing theories, such as computer simulations and programs.

Priority Area 2: Modeling, Optimization, and Application

Objectives:

- 2.1. Apply mathematical modeling strategies to wide range of fields such as agriculture, climatology, biology, engineering, and medicine.
- 2.2. Develop and apply optimization algorithms that are tailored to specific application domains, such as transportation, business and finance, or production.
- 2.3. Effectively applied various mathematical theories and methods.

Priority Area 3: Statistics and Computing

Objectives:

- 3.1. Develop and apply statistical methods and computational programs to analyze complex data sets, such as climatology, environmental monitoring, healthcare, or financial markets.
- 3.2. Develop data visualization and communication applications and dashboards, to help stakeholders understand and interpret large data sets.

Priority Area 4: Ethnomathematics, Gender Sensitive Resilience, and Mathematics Education

Objectives:

- 4.1. Investigate the role of cultural background in shaping the development of mathematical concepts and problem-solving strategies.
- 4.2. Explore the ways in which gender norms and expectations influence the development of resiliency among teachers and students.
- 4.3. Examine the effectiveness of intervention programs and teaching strategies.

Priority Area 5: Institutional and Program-based

Objectives:

- 5.1. Conduct tracer studies and employability assessment of the BS Mathematics graduates.
- 5.2. Conduct and utilize data-driven research and analysis to inform and continuously improve the BS Mathematics curriculum and other related programs.
- 5.3. Develop and continuously improve high-quality instructional materials that support the effective teaching and learning of mathematics at all levels.



Consonance of the FERMAT R&D Agenda to the Sustainable Development Goals (SDGs) and the Current PSAU R&D Agenda (2021-2025)

SDG	FERMAT	PSAU				
4 EDUCATION	Theory Building	Learners and Learning Innovations*	Theory Building*			
2 ZERO SIGOD HEALTH SIGOD HEALTH AND WILL BEING -MV	Modeling, Optimization, and Application	Food Security and Poverty Alleviation Climate Resilient	Crop Production; Animal Production Disaster Risk			
4 COLLETY 4 EDUCATION 10 INFORMALITIES 4 EDUCATION 12 ESPONSENCE 13 CLIMATE 13 ACTION		Agriculture	Reduction and MGT; Climate Change Adaptation and Mitigation			
		Good Health and Well-Being	Value Adding			
14 HELOW MARER		Environmental Restoration and Biodiversity Conservation	Bio-Energy/Fuel Production			
8 ECCENT WORK AND ECCINAMIC CROWN 10 REDUALINES ECCINAMIC CROWN 10 REDUCED ECCINAMIC CROWN ECCINAMIC CROWN ECCINA ECCINAMIC CROWN ECCINA	Statistics, Computing, and Analysis	Climate Resilient Agriculture	Climate Change Adaptation and Mitigation			
12 CREMENTIN AND PRODUCTION		Environmental Restoration and Biodiversity Conservation	Biodiversity Assessment			
4 COUCATION 5 CENDER	Ethnomathematics, Gender Sensitive	Gender Equality and Reduced Inequalities	Literacy/ Education			
	Resilience, and Mathematics Education	Learners and Learning Innovations*	Transformative Learning*			
4 EDUCATION 3 ECONTINUE CARINET 11 SUSTAINABLE CITES 11 SUSTAIN	Institutional and Innovation	Gender Equality and Reduced Inequalities	Gender Equality			

*Proposed Priority Area for the PSAU R&D Agenda



Proposed Conceptual Framework for PSAU R&D Agenda

(including the proposed thrust)



The **Learners and Learning Innovations** circle is the proposed research thrust of the university R&D agenda to accommodate the research agenda of the BS Mathematics program under the *Theory Building* and *Transformative Learning*.



Logical Framework

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Objective	Outcome ²	Impact ³	OVI⁴	Risks & Assumptions⁵	Potential Extension Output ⁶	Source of Budget ⁷	Responsible Personnel ⁸	Cooperating Department/ Institution ⁹	2023	2024	2025	2026	2027	2028
Pric	ority Area 1	1: Theory E	Building		•				•	•	•	•	•	•
1.1	Proposed math theories	Add new math theories	Proof of proposed theories	Proposed theories may already exist	Seminar on the proposed new theories	Php 5,000	Department of Mathematics faculty members and students	SUCs offering BS Math program and other related field	Propose new Math formula.	Prove the proposed formula. Propose new Math formula				
1.2	Proposed math methods and computer programs	Add new math methods and computer programs	Proof of proposed methods	Proposed methods and programs may already exist	Seminar on the proposed methods and programs	Php 5,000	Department of Mathematics faculty members and students	SUCs offering BS Math program and other related field		Propose new method and computer program	Propose new method and computer program	Propose new method and computer program	Propose new method and computer program	Propose new method and computer program

Column Definitions:

¹ Objective: Specific goals or targets within each priority area.

² Outcome: The expected short-term results or changes that occur as a result of achieving the objectives.

³ Impact: The long-term, broader effects or changes that occur as a result of achieving the objectives.

⁴ OVI: Objectively Verifiable Indicators that provide evidence for the achievement of objectives and outcomes.

⁵ Risks & Assumptions: Factors that may influence the success of the research program and assumptions made during planning.

⁶ Potential Extension Output: Possible outputs from the research that can be translated into extension programs or services for wider implementation and dissemination.

⁷ Source of Budget: The funding sources for the resources needed to achieve the objectives.

⁸ Responsible Personnel: The team members responsible for implementing the activities and achieving the objectives.

⁹ Cooperating Department/Institution: Internal or external partners involved in the implementation of the activities and achieving the objectives.

¹⁰ Year 1 to Year 6: The activities planned for each year of the 5-year research program, including milestones and deliverables.

FERMAT Research and Development Agenda 2023-2028

(Foundational and Expanded Research on Mathematical Application and Theory)



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Objective	Outcome ²	Impact ³	OVI⁴	Risks & Assumptions⁵	Potential Extension Output ⁶	Source of Budget ⁷	Responsible Personnel ⁸	Cooperating Department/ Institution ⁹	2023	2024	2025	2026	2027	2028
Pric	ority Area 2	2: Modeling	g, Optimi	zation, and	Applicatio	n								
2.1	Applied mathematic al model to various field of study	Utilized the application of mathematica I models	Modeled various data- driven insights in different fields of study	Lack of information or data about the study being conducted	Seminar- workshop on the utilization of the mathematic al model	Php 10,000	Department of Mathematics faculty members and students		Apply and validate math modeling relative to agriculture, climatology , health, disaster- risk reduction, food security, and the like.					
2.2	Solved the maximum/ minimum target using optimizatio n model in various field of study	Application of solved optimization model	Optimized the data on a specific field of study.	Unable to take into account every possible constraint required for the optimization model and long-term utility, or applicability of the resulting solution may not be guaranteed.	Seminar- workshop on the utilization of the optimizatio n model	Php 10,000	Department of Mathematics faculty members and students	Manila Observatory R&D Office	Problem identificatio n and selection of appropriate optimizatio n algorithms		Formulate an optimizatio n model Problem identificatio n and selection of appropriate optimizatio n algorithms	Formulate an optimizatio n model Problem identificatio n and selection of appropriate optimizatio n algorithms	Formulate an optimizatio n model Problem identificatio n and selection of appropriate optimizatio n algorithms	Formulate an optimizatio n model
2.3	Apply math theories and algorithms and produced actual outputs	Approved outputs for intellectual property for utilization and application in	Actual outputs	Produced output may already exist.	Workshop on the utilization of produced outputs	Php 20,000	Department of Mathematics faculty members and students	Extension and Training Office	Application of graph theory, abstract algebra, geometry, analytic geometry,					



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Objective	Outcome ²	Impact ³	OVI⁴	Risks & Assumptions⁵	Potential Extension Output ⁶	Source of Budget ⁷	Responsible Personnel ⁸	Cooperating Department/ Institution ⁹	2023	2024	2025	2026	2027	2028
	from the application	the field of interest.							trigonometr y, linear algebra in different disciplines	trigonomet ry, linear algebra in different disciplines				
Pric	ority Area 3	B: Statistic	s and Co	mputing	•					• •				•
3.1	Applied statistical methods and computatio nal programs to analyze complex data sets.	Provide statistical data-driven insights to various field such as climate, finance, public health and food security.	Statistical insights on different fields of study	Accuracy and availability of data gathered from other organization/ databases	Seminar on the outputs of the study	Php 5,000	Department of Mathematics faculty members and students	Manila Observatory Philippine Statistics Authority Department of Health	Apply statistical method and computatio ns on climate, finance, public health and food security.					
3.2	Produced data visualizatio n dashboards and application s.	Published the data visualization dashboards and used by various stakeholders	Published on web the data visualizati on dashboar ds and applicatio ns.	Large data sets may affect the quality of the dashboards and applications. Also, some applications are paid subscription.	Seminar on the application and used of developed data visualizatio n dashboards	Php 10,000	Department of Mathematics faculty members and students	Manila Observatory Philippine Statistics Authority Department of Health	Produce data visualizatio n dashboard s on climate, finance, public health, food security and like through trend and spatio- temporal analyses.					



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Objective	Outcome ²	Impact ³	OVI⁴	Risks & Assumptions⁵	Potential Extension Output ⁶	Source of Budget ⁷	Responsible Personnel ⁸	Cooperating Department/ Institution ⁹	2023	2024	2025	2026	2027	2028
Pric	ority Area 4	1: Ethnoma	athematio	cs, Gender S	ensitive F	Resilien	ce, and Mat	hematics E	ducation					
4.1	Enhanced cultural livelihood and improved the mathematic al skills of participants	Proposed culture- based products based on mathematica I perspectives	Increased the sales of products.	Risk of cultural biases, exclusion, and limited diversity in hindering inclusive and diverse perspectives.	Training program on making the proposed mathematic al culture- based products.	Php 10,000	Department of Mathematics faculty members and students	Extension and Training Office College of Arts and Sciences Extension Unit Magalang LGU	Analyze the existing products in math perspectiv e	Utilized the produced culture- based products	Monitor the cultural livelihood of participant s.	Monitor the cultural livelihood of participant s.	Monitor the cultural livelihood of participant s.	Monitor the cultural livelihood of participant s.
4.2	Analyze the resilience of various groups in the academic community.	Produce and conduct intervention programs for the improvement of resiliency of teachers and students.	Analysis of the resilience of the academic communit y	Resource limitations.	Intervention program	Php 15,000	Department of Mathematics faculty members and students	Gender and Development Office	Administer a comprehen sive survey on the gender sensitive resiliency of the academic community	Design and conduct the developed interventio n program	Proposed a study on gender sensitive resilience of the admin personnel	Design and conduct the developed interventio n program		
4.3	Improved teaching methods and curriculum design leading to enhanced mathematic al understandi ng and performanc e among teachers.	Capacitate teachers in teaching research and advanced mathematics and statistics.	Analyzed the progress of participant in the training program	Engagement of participants and resource limitations.	Extension cum Research of the department – Magalang MEET (Mathemati cs Enrichment and Enhancem ent Training) Program	Php 20,000	Department of Mathematics faculty members and students	High Schools of Magalang	Initial launching of MEET Program at Andres Luciano High School	Launching and implement ation of MEET program to different high schools of Magalang with monitoring of participant s' progress	Continuatio n of MEET program to different high schools	Propose other interventio n programs		



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Objective	Outcome ²	Impact ³	OVI⁴	Risks & Assumptions⁵	Potential Extension Output ⁶	Source of Budget ⁷	Responsible Personnel ⁸	Cooperating Department/ Institution ⁹	2023	2024	2025	2026	2027	2028
Pric	ority Area &	5: Institutio	onal and	Program-ba	sed									
5.1	Traced BS Mathematic s graduates	Improved employ- ability for BS Mathematics graduates through curriculum design and industry collaboration	Published tracer study and employabi lity	Partnership challenges					Conduct tracer study research and employ- ability assessmen t for BS Math graduates	Publish the tracer study				
5.2	Data-driven curriculum improveme nts ensure relevance, standards alignment, and technology integration, enhancing student preparedne ss and learning outcomes.	Improve student readiness for future challenges and increased effectiveness of the BS Mathematics program.	Improved math performan ce through assessme nts and scores	Implementation challenges, limited resources, and alignment difficulties.	Seminar- workshop	Php 5,000	Department of Mathematics faculty members and students	Office of the Vice President for Academic Affairs		Conduct study on the enhancem ent of the BS Math curriculum	Implement the proposed enhancem ent strategy and modality	Monitor the student readiness		
5.3	Developme nt and validation instructiona I materials for math subjects and related fields	Copyrighted and utilized the developed IMs	Approval sheet of IMs	Engagement in making instructional materials					Develop IMs	Develop and validate IMS	Develop and validate IMS	Develop and validate IMS	Develop and validate IMS	Develop and validate IMS



Roadmap





Collaboration & Partnerships

Priority Area 1: Theory Building

Partner Type	Partner Name	Role
External	Central Luzon State University	Collaborative research

Priority Area 2: Modelling, Optimization, and Application

Partner Type	Partner Name	Role
Internal	Department of Biology	Collaborative research
Internal	Department of Forestry and	Collaborative research
	Agroforestry	
Internal	Department of Computer Studies and	Collaborative research
	Automation	
External	Manila Observatory	Collaborative research, expertise
		in climatology, data source
External	Department of Science and	Funding, technical support
	Technology (DOST)	
External	Department of Health (DOH)	Data source
External	Philippine Atmospheric, Geophysical	Data source, expertise in
	and Astronomical Services	climatology
	Administration (PAG-ASA)	
External	Department of Agriculture (DA)	Funding, technical support
External	Philippine Statistics Authority (PSA)	Data source
External	Bolgatanga Technical University	Collaborative research, technical
	(BTU)	support

Priority Area 3: Statistics and Computing

Partner Type	Partner Name	Role
External	Manila Observatory	Collaborative research, expertise
		in climatology, data source
External	Philippine Atmospheric, Geophysical	Data source, expertise in
	and Astronomical Services	climatology
	Administration (PAG-ASA)	
External	Department of Health (DOH)	Data source
External	Department of Science and	Funding, technical support
	Technology (DOST)	
External	Department of Agriculture (DA)	Funding, technical support
External	Philippine Statistics Authority (PSA)	Data source
External	Bolgatanga Technical University	Collaborative research, technical
	(BTU)	support



Priority Area 4: Ethnomathematics, Gender Sensitive Resilience, and Mathematics Education

Partner Type	Partner Name	Role
Internal	College of Education	Collaborative research
Internal	Department of Social Sciences	Collaborative research
Internal	Gender and Development Office	Collaborative research, funding
External	Commission on Higher Education (CHED)	Funding, technical support
External	National Commission on Indigenous People (NICP)	Technical support

Priority Area 5: Institutional and Program Based

Partner Type	Partner Name	Role
Internal	Office of the Registrar, Admission and	Data source
	Registration Office	
Internal	Office of the Alumni and Development	Data source



Dissemination & Impact

Priority Area 1: Theory Building

Impact Strategy	Intended Outcome	Dissemination Channel	Audience
Publish output and invent program	Published new mathematical theories in referred international journal	International Journal	Mathematics teachers and students

Priority Area 2: Modeling, Optimization, and Application

Impact Strategy	Intended Outcome	Dissemination Channel	Audience
Collaboration with other organization and department	Develop new ideas in several fields of research	Research conference	Researchers, teachers, students, practitioners.
Real-world model implementation through industrial collaboration	Enhance current management and operation	Research conference	Researchers, administrators, policy maker, relevant stakeholders.
Promotion and imposition of actual output through seminars.	Increase mathematical understanding regarding its practical application and improve quality of life.	Research conference, Seminars	Researchers, local communities, academics

Priority Area 3: Statistics and Computing

Impact Strategy	Intended Outcome	Dissemination Channel	Audience
Collaborative	Insights into trends, impact	Science and	Scientist,
Projects in Statistical data	data	Statistics journals	industry stakeholders and general public
Seminars in using data Visualization techniques and tools	Improve data understanding, insights generation and decision making through impactful data visualization	Data Visualization workshops and conference	Economists, researchers, Government Agencies
Partnership and Collaborative Research Projects to other institution	Enhance mathematical understanding and apply mathematical analysis to solve complex problems.	Research Paper/ Journals, Collaborative research conference.	Mathematicians, educators, researcher in related fields, policy makers.



Priority Area 4: Ethnomathematics, Gender Sensitive Resilience, and Mathematics Education

Impact Strategy	Intended Outcome	Dissemination Channel	Audience
Video Tutorial	Enhance learning	Video platform	Intended research
	experience		audience
Gender norm exploration	Increase gender awareness and resilience	Research publications, conferences,	Researchers, teachers, students, stakeholders
Evidence-based	Improve pedagogical	Research journals,	Educators,
program	strategies	workshops, seminars	researchers, practitioners

Priority Area 5: Institutional and Program-based

Impact Strategy	Intended Outcome	Dissemination Channel	Audience
Data-informed	Increase graduate	Research reports,	Educators,
program	employability	academic publications	employers,
			researchers
Evidence-based curriculum	Improve mathematics education	Research journals	Mathematics educators, curriculum developers, education researchers
Quality materials	Enhance math instruction	Online platforms	Mathematics teachers



On-Going Mathematics Research Studies

Title	Thrust	Time Frame
Path Analysis Model of Academic	Ethnomathematics,	February 2023 to
Community Resilience to COVID-19	Gender Sensitive	December 2023
Pandemic	Resilience, and	
	Mathematics Education	
Innovating Ayta's Ethnomathematics	Ethnomathematics,	September 2023
Learning and Livelinood Practices	Gender Sensitive	
	Mathematics Education	
Poinforcing Mathematics in Research	Ethnomathomatics	January 2024 to
through Magalang MEET (Mathematics	Gender Sensitive	December 2024
Enrichment and Enhancement	Resilience, and	
Training) Program	Mathematics Education	
GIS-based Spatial Analysis of Carbon	Modeling, Optimization,	August 2023 to May
Dioxide Sequestration of Trees at	and Application	2024
Pampanga State Agricultural University		
Modeling the Growth of Kawayan Tinik	Modeling, Optimization,	August 2023 to May
(Bambusa blumeana), Giant Bamboo	and Application	2024
(Dendrocalamus asper), and Giant		
Bolo (Gigantochloa levis)		
Mathematical Modeling of Oyster	Modeling, Optimization,	August 2023 to May
Mushroom Growth at Pampanga State	and Application	2024
Agricultural University Mushroom		
Drobability Distribution Fitting of	Statistics and Computing	August 2022 to May
Rainfall Patterns in Pampanga for		2024
Effective Drought Monitoring		
Crystallography and Interlacement	Modeling, Optimization,	August 2023 to May
Pattern of Sitio Cananaoan Basketry	and Application;	2024
SIR Modeling of Food and Water-	Modeling, Optimization,	August 2023 to May
Borne Diseases Cases in Pampanga,	and Application	2024
Philippines		
Optimization Model of Egg Production:	Modeling, Optimization,	August 2023 to May
The case of Egg Master at Magalang	and Application	2024
Pampanga Madaling Dangua apaga uping SID	Modeling Optimization	August 2022 to May
Modeling Deligue cases using SIR	and Application	August 2023 to May
SIR Model of HIV/AIDS Cases in		August 2023 to May
Central Luzon Philippines	and Application	2024
On Irregular Reuleaux Triangle	Theory Building	August 2023 to May
		2024
Black Spots Identification of Road	Statistics and Computing	August 2023 to May
Accidents in Magalang, Pampanga: A		2024
GIS-based Spatial and Temporal		
Analyses		



Numerical and Graphical Simulations of Morphological Characteristics of Selected Butterfly Species	Modeling, Optimization, and Application	August 2023 to May 2024
SIR Models of Vaccine Preventable Diseases Cases in Region III, Philippines	Modeling, Optimization, and Application	August 2023 to May 2024
Campus Area Network Topology Design on Pampanga State Agricultural University Using Prim's Algorithm	Modeling, Optimization, and Application	August 2023 to May 2024
Spatial and Temporal Characteristics and Predictive Modeling of Heat Index in the Philippines	Statistics and Computing	August 2023 to May 2024
Mathematical Analysis of Influenza Like Illness (ILI) Stochastic Epidemic Model in Pampanga, Philippines	Modeling, Optimization, and Application	August 2023 to May 2024
Optimizing the Production of Mulberry Products at Pampanga State Agricultural University	Modeling, Optimization, and Application	August 2023 to May 2024
School Scheduling through Monte Carlo Simulation at Pampanga State Agricultural University	Modeling, Optimization, and Application; Institutional and Program- based	August 2023 to May 2024
Probability Distribution Fitting of Temperature in Pampanga, Philippines	Statistics and Computing	August 2023 to May 2024
Modular Arithmetic Simplification of De Moivre's Powers and Roots of Complex Numbers	Theory Building	August 2023 to May 2024