University of Puerto Rico
Mayagüez Campus
College of Arts and Sciences
Department of Mathematical Sciences

COURSE SYLLABUS

GENERAL INFORMATION:

COURSE TITLE:	**Applied Linear Regression**
ALPHANUMERIC CODIFICATION:	ESMA 6205
CONTACT HOURS / CREDITS	45 hours / Three credits
PREREQUISITES, COREQUISITES AND OTHER REQUIREMENTS:	

COURSE DESCRIPTION:

ENGLISH: Introduction to the theory and application of regression models using statistical software. Simple and multiple linear regression models and robust regression methods will be studied. In addition, residual analysis will be performed to validate model assumptions and explore alternatives. Inference about the linear model will be performed. An introduction to generalized linear models, random and mixed effects models, Lasso and ridge regression will also be provided. **Face-to-Face.**

SPANISH: Introducción a la teoría y aplicación de modelos de regresión utilizando software estadístico. Se estudiarán modelos de regresión lineal simple y múltiple y métodos de regresión robusta. Además, se realizará un análisis de residuos para validar los supuestos del modelo y explorar alternativas. Se realizarán inferencias sobre el modelo lineal. También se proporcionará una introducción a los modelos lineales generalizados, modelos de efectos aleatorios y mixtos, regresión Lasso y Ridge. **Curso presencial.**

LEARNING OBJECTIVES:

At the end of the course students will be able to:

1. Identify the independent and dependent variables to perform a simple and multiple linear regression.
2. Perform the corresponding model diagnostics to validate their model assumptions.
3. Apply inferential techniques under the simple and multiple linear regression.
4. Recognize and understand a generalized linear model framework.
5. Students will be able to perform statistical inference for the generalized linear regression.
6. Recognize and understand a random-effect model and mixed-effect models framework.
7. Perform statistical inference for the random effect model and mixed-effect models.

8. Perform and interpreted the lasso and ridge regression.

SUGGESTED TEXTBOOK:
NETER, J., KUTNER, M. H., NACHTSHEIM, C. J., & WASSERMAN, W. (1996). APPLIED LINEAR STATISTICAL MODELS

COURSE OUTLINE AND TIME DISTRIBUTION:

CONFERENCE TOPIC	TIME DISTRIBUTION (HOURS)
	FACE TO FACE
Introduction	2 hours
Matrix Calculus	2 hours
Introduction to linear regression - Simple linear regression - Multiple linear regression	3 hours
Estimation - Least Squares Estimation - Estimability - Sampling distributions of the estimators - Estimation of the mean response - Prediction of a new observation	5 hours
Diagnostics and Remedial Measures - Properties of residuals - Semistudentized residuals - Nolinearity - Assumptions of the error variance - Normality of the error terms - Multicollinearity Diagnostics - Variance Inflation Factor	3 hours
Evaluation	2 hours
Statistical inference for the regression parameters - Analysis of Variance (ANOVA) - Hypothesis testing for parameters - Confidence intervals	3 hours
Model Selection and Validation - R-squared - Mallows Cp - Aikake Information Criterion (AIC) and Bayesian Information Criterion (BIC) - Forward stepwise selection	3 hours

- Backward stepwise selection	
Identifying Influential Cases - DFFITS - Cook's Distance - DFBETAS	3 hours
Evaluation	2 hours
Introduction to Generalized Linear Models Logistic Regression - Probit and Logistic mean response functions - Inference about regression parameters - Model Selection - Prediction	3 hours
Binomial Regression - Probit and Logistic mean response functions - Inference about regression parameters - Model Selection - Prediction	3 hours
Poisson Regression - Inference about regression parameters - Model Selection-Prediction	3 hours
Introduction to Random Effect and Mixed-Effects - Inference about regression parameters - Model Selection - Prediction	4 hours
Lasso and Ridge Regression	2 hours
Evaluation	2 hours
TOTAL CONTACT HOURS	**45 hours**

INSTRUCTIONAL STRATEGIES:

Some of the following may be used:

☒ Lectures	☒ Project Based Learning
☒ Discussion	☒ Seminars or Workshops
☒ Cooperative Learning	☒ Problem Based Learning (PBL)
☒ Case Studies	☒ Flipped Classroom
☒ Lectures with Guest Speakers	☒ Team based learning

MINIMUM OR REQUIRED RESOURCES AVAILABLE:

RESOURCE	FACE-TO-FACE
Classroom or laboratory	Institution
Account in the institutional learning management	Institution

platform (e.g. Moodle or Blackboard)	
Institutional email account	Institution
Computer with high-speed internet access or mobile device with data service	Student
Programs or applications: word processor, spreadsheets, presentation editor	Student
Webcam or mobile with camera and microphone	Student
Integrated or external speakers	Student
Whiteboard	Institution
Digital projector	Institution

ASSESSMENT TECHNIQUES:

Assessment Technique	**Relative Weight**
☒ Exams	30% (15% each)
☒ Assignments	30%
Total:	**100%**

Standard scale: 90 to 100 A; 80 < 90 B; 70 < 80 C; 60 < 70 D; < 60 F

REASONABLE MODIFICATION (REASONABLE ACCOMMODATION):

The University of Puerto Rico (UPR) acknowledges the right of students with disabilities to an inclusive, equitable, and comparable post-secondary education. In accordance with its policy toward students with disabilities, based on federal and state legislation, every qualified student with disabilities is entitled to equal participation in those services, programs, and activities that are physically, mentally or sensorially natured and have thus substantially affected one or more major life activities, such as their area of post-secondary studies. They have the right to receive reasonable accommodation or modifications. If you require accommodation or reasonable modification in the course, you must inform the professor without the need to disclose your condition or diagnosis. Simultaneously, you should promptly request the Office of Services for Students with Disabilities (OSEI) of the unit or campus for your need for modification or reasonable accommodation.

The University of Puerto Rico at Mayagüez (RUM) recognizes that each student has an inherited right to request reasonable accommodation according to Law 51: Law for Integral Educational Services for People with Disabilities. Every student has the right to receive reasonable accommodation if he/she presents the necessary evidence to be evaluated by the Office of Services to Students with Disabilities (OSEI-RUM), and the related information can be found at the following link: https://www.uprm.edu/cms/index.php/page/85. If your case is approved by OSEI-RUM, you will receive reasonable accommodation in your courses and evaluation, and you must contact each professor for course registered. For additional information contact OSEI-RUM at the Office of the Dean of Students, DE 12, via telephone

787-832-4040 extensions 6734 or 6735, email: oseirum@uprm.edu, at the virtual office: https://meet.google.com/yvd-nrqo-mor, or join by telephone: (US)+1 475-558-0169 PIN: 814 895 818#.

ACADEMIC INTEGRITY:

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Section 6.2 of the UPR General Student Regulations (Certification No.13, 2009-2010, Board of Trustees) provides that academic dishonesty includes, but is not limited to: "fraudulent actions, obtaining grades or academic degrees by false or fraudulent simulations, copying all or part of another's academic work, copying all or part of another's answer to questions on an examination, taking or having another take any oral or written test or examination on behalf of another, and aiding or facilitating another person to engaging such conduct." Any of these actions will be subject to disciplinary sanctions in accordance with the disciplinary procedure provided in the UPR General Student Regulations in force. To ensure the integrity and security of user data, all hybrid, distance-learning and online courses shall be offered through the institutional learning management platform or through tools required by the course, which uses secure connection and authentication protocols. The system authenticates the user identity using the username and password assigned through the student institutional account. The user is responsible for keeping secure, protecting, and not sharing their password with others.

POLICY AND PROCEDURES FOR MANAGING SEX AND GENDER-BASED DISCRIMINATION AT THE UNIVERSITY OF PUERTO RICO:

The Policy and procedures for managing Sex and Gender-Based Discrimination at the University of Puerto Rico, Certification No. 107 (2021-2022) of the Governing Board, certifies that the University of Puerto Rico, as an institution of higher learning and a workplace, safeguards the rights and offers a safe space for those who interact therein, whether they be students, employees, contractors, or visitors. It seeks to promote an environment that respects diversity and the rights of the university community. This policy provides a protocol for handling situations related to the following prohibited conduct in the workplace or in the academic setting: discrimination based on sex, gender, pregnancy, sexual harassment, sexual violence, domestic violence, dating, violence, and stalking.

DIVERSITY, EQUITY, AND INCLUSION

The University of Puerto Rico is committed to establishing an environment that values diversity, promotes equity and equality, and aspires to the full inclusion of its entire university community. Courses will be offered in an inclusive and equitable environment, ensuring the participation of students with diverse backgrounds, experiences, and abilities. Thus, the University of Puerto Rico reiterates its dedication to upholding the principles of diversity, equity, and inclusion in its academic programs.

CONTINGENCY PLAN IN CASE OF AN EMERGENCY OR INTERRUPTION OF

CLASSES

In the event of an emergency or interruption of classes, the professor will contact the students through the institutional email or other available means to coordinate the continuity of the course.

The contingency plan must preserve the modality in which the course was created and programmed in the course offering.

Certification 125 2023-2024 of the Governing Board establishes that a Hybrid Course a professor offers the course simultaneously integrating two modes: 100% face-to face and online. Certification 23-29 of the Academic Senate establishes that a face-to-face course may have up to 25% of the hours at a distance and if necessary, this option may be used.

GRADING SYSTEM

☒ Quantifiable (letters, A, B, C, D, F) ☐ Not Quantifiable (Pass, Fail)

BIBLIOGRAPHY:

Any reference older than 5 years is considered classic.

a) Chambers, J. M. (2017). Linear models. In *Statistical models in S* (pp. 95-144). Routledge

b) Dobson, A. J., & Barnett, A. G. (2018). *An introduction to generalized linear models*. Chapman and Hall/CRC.

c) Faraway, J. J. (2021). *Linear models with python*. Chapman and Hall/CRC.

d) Faraway, J. J. (2016). *Linear models with R*. Second Edition Chapman and Hall/CRC.

e) Faraway, J. J. (2016). *Extending the linear model with R: generalized linear, mixed effects and nonparametric regression models*. Chapman and Hall/CRC.

f) Freedman, David A. *Statistical models: theory and practice*. cambridge university press, 2009.

g) Gareth, J., Daniela, W., Trevor, H., & Robert, T. (2013). *An introduction to statistical learning: with applications in R*. Spinger.

h) James, G., Witten, D., Hastie, T., Tibshirani, R., & Taylor, J. (2023). *An introduction to statistical learning: With applications in python*. Springer Nature.

i) Marquardt, D. W., & Snee, R. D. (1975). Ridge regression in practice. *The American Statistician, 29*(1), 3-20.

j) Neter, J., Kutner, M. H., Nachtsheim, C. J., & Wasserman, W. (1996). Applied linear

statistical models

k) Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, *58*(1), 267-288.

l) Weisberg, S. (2005). Applied linear regression.

Electronic references:

Lasso regression, https://academic.oup.com/bjs/article-abstract/105/10/1348/6122951

Linear Regression, Handbook of Statistics, 2018, https://www.sciencedirect.com/topics/mathematics/linear-regression

Linear Regression. (n.d.). In *Wikipedia*. Retrieved November 30, 2024, from https://en.wikipedia.org/wiki/Linear_regression