Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): **MATH 3805 Regression Analysis (3,3,1)**

Course Aims: This course aims to provide an understanding of the classical and modern regression analysis and techniques which are widely adopted in various areas such as business, finance, biology, and medicine. There have been great developments in the past decades such as nonlinear regression, robust regression, nonparametric regression etc. With the help of a statistical package such as SAS, MATLAB or R, students can analyze multivariate data by modern regression techniques without any difficulty.

Prerequisite: MATH2207 Linear Algebra and one of the following: MATH2005 Calculus, Probability, and Statistics for Computer Science or MATH2006 Calculus, Probability, and Statistics for Science or MATH2206 Probability and Statistics or MATH2216 Statistical Methods and Theory

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Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
1	Apply and explain the general procedures of statistical inference (including parameter estimation, hypothesis testing, and confidence interval construction) for linear regression models, conduct model selections and diagnostics, and know basic procedures for non-linear regression analysis.
2	Build up linear and non-linear regression models, perform statistical analyses (e.g., parameter estimation, hypothesis testing and confidence interval construction), conduct appropriate diagnostic and assumption checking, and interpret the results.
3	Work effectively in a team as well as solve problems independently.

Teaching & Learning Activities (TLAs)

CILO	TLAs will include the following:
1,2,3	**Lecture/tutorial and in-class activity** Instructor will use lectures to introduce the subjects of the course's materials and examples will be used to demonstrate the introduced methodologies. Students will consolidate the knowledge through discussion within lectures/tutorials.
1,2,3	**Q&A time** Instructor will give Q&A time to the students to raise questions regarding the homework and lectures every week.
1,2,3	**Programming assignment** Instructor will use programming assignments, when and where applicable, to allow students to apply the methodologies learnt in the lecture and to solidify their understanding of the statistical procedures.

Assessment:

No.	Assessment Methods	Weighting	CILO Address	Remarks
1	Continuous Assessment (assignments, test, and mini-project)	40%	1,2,3	Assignments are designed to measure how well the students have learned various techniques for regression analysis. The students will learn to use the software SAS to solve real life problems. The team- project is designed to stimulate students' interest in furthering understanding and analyzing practical problems in real life situations. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions.
2	Final Examination	60%	1,2,3	Final Examination is designed to see how far students have achieved their intended learning outcomes in both Knowledge and Skills domains. Students should have a thorough understanding to apply statistical methods and models to real data and draw inference. They are also expected to identify steps in the modeling process, understand the underlying assumptions implicit in each family of models, and recognize which assumptions are applicable.

Course Intended Learning Outcomes and Weighting:

Content	CILO No.
I. Introduction	1
II. Simple Linear Regression Model	1,2,3
III. Multiple Linear Regression Models	1,2,3
IV. Selection of Variables	1,2,3
V. Statistical Diagnostics	1,2,3
VI. Nonlinear Regression Analysis	1,2,3

Textbook

1. W. Mendenhall and T. Sincich, A Second Course In Statistics: Regression Analysis, 7th Ed., Pearson, 2011.

References

1. Raymond H. Myers, Classical And Modern Regression With Applications, 2nd Ed., PWS-KENT, 1990.
2. G.B. Wetherill, Regression Analysis with Applications, Chapman and Hall, 1986.
3. A Sen and M. Srivastava, Regression Analysis, Theory, Methods and Applications, Springer-Verlag, 1990.

Software

1. SAS
2. MATLAB
3. R

Course Contents in Outline:

Topics

I Introduction
- A Regression analysis
- B Some matrix algebra
- C Moments of a random vector
- D Multivariate normal distribution

II Simple Linear Regression Model
- A Simple linear models
- B Least squares estimation
- C Properties of the least squares estimator
- D Correlation and decomposition of the sum of squares
- E Discussion

III Multiple Linear Regression Models
- A Model description
- B Estimation
- C Properties of the least squares estimators
- D Various hypothesis tests
- E Multicollinearity in multiple data
- F Quality of fit and prediction

IV Selection of Variables
- A Contribution of a variable in the model
- B Forward selection and backward elimination
- C Stepwise procedure
- D All possible subsets and other techniques of selection variables

V Statistical Diagnostics
- A Analysis of residuals
- B Diagnostic plots
- C Detection of outliers
- D Influence diagnostics

VI Nonlinear Regression Analysis
- A Nonlinear regression model
- B Estimation of the parameters

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