Certificate of Math and Programming Courses

To Whom It May Concern,

This is to certify that Mr. Hongtao Ma (Student ID: 2020221242) has successfully completed the following courses, as outlined in the attached syllabus. His academic performance meets the admission requirements for your Master's program.

Academic Semester	Course	Scores	Syllabus
2020-2021-1	Calculus	82	Page 02
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2021-2022-1	Probability and Mathematical Statistics	82	Page 08
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Beijing International Studies University
School of Economics
Office of Academic Affairs, Beijing International Studies University
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Part 01 Math course

Calculus

Course Code: 490001111
Course Name: Calculus
Credits: 4
Category: Compulsory Course

1. Course content

Module 1: Functions

1.1 Sets: Concepts of sets, set operations, intervals, and neighborhoods.
1.2 Mappings: Concepts of mappings, inverse mappings, and composite mappings.
1.3 Functions: Concepts of functions, basic characteristics of functions, composite and inverse functions, operations of functions, elementary and elementary transcendental functions, establishing function relationships, common functions in economics.

Module 2: Limits and Continuity

2.1 Limits: Definitions of sequence limits, properties of convergent sequences (uniqueness, boundedness); definitions of function limits, left and right limits, properties of function limits (local sign preservation, local boundedness), concepts of infinitesimals and infinities; four arithmetic operations of limits, two criteria for the existence of limits (squeeze theorem and monotone bounded theorem), two important limits, comparison of infinitesimals.
2.2 Continuity of Functions: Definition of continuity, types of discontinuities, continuity of elementary functions, properties of continuous functions on closed intervals (extreme value theorem, zero point theorem, intermediate value theorem).

Module 3: Differential Calculus of Single-Variable Functions

3.1 Derivatives and Differentials: Definition of derivatives, geometric interpretation, economic interpretation (including the concepts of marginal analysis and elasticity), relationship between differentiability and continuity; arithmetic rules of derivatives,

rules for differentiating composite functions, derivative formulas of basic elementary functions; concept of higher-order derivatives, methods for finding first and second-order derivatives of elementary functions, differentiation of implicit functions and parametric equations; definition and rules of differentials (including the invariance of differential form), concepts and calculation of marginal and elasticity.

3.2 Mean Value Theorems and Applications of Derivatives: Rolle's theorem, Lagrange mean value theorem, Cauchy mean value theorem; L'Hôpital's rule; determining monotonicity using derivatives, finding local extrema and solving simple maximum and minimum problems, determining concavity and inflection points of function curves, horizontal and vertical asymptotes, graphing functions.

Module 4: Integral Calculus of Single-Variable Functions

4.1 Indefinite Integrals: Definition of antiderivatives and indefinite integrals, properties of indefinite integrals, basic integration formulas, substitution method, integration by parts, integration of rational functions, trigonometric rational functions, and simple irrational functions.

4.2 Definite Integrals and Applications: Definition and properties of definite integrals, the function of upper limit of integration and its derivative, Newton-Leibniz formula, substitution and integration by parts for definite integrals; concept of improper integrals; approximate computation of definite integrals; applications in geometry (area, volume of solids of revolution), simple applications in economics.

4.3 Two Types of Improper Integrals: Definitions and properties, Gamma function.

Module 5: Multivariable Calculus

5.1 Vector Algebra: Rectangular coordinate system in space, concept of vectors, linear operations of vectors, vector coordinates, dot product, cross product, angle between two vectors, conditions for vectors being parallel or perpendicular.
5.2 Planes and Straight Lines: Equations of planes (point-normal form, general form, intercept form), equations of straight lines (parametric form, symmetric form, general form).
5.3 Surfaces and Space Curves: Concepts of surface equations, several types of quadric surfaces.
5.4 Multivariable Functions: Concepts of multivariable functions, graphical representation of bivariate functions, limits and continuity of bivariate functions, properties of continuous functions on closed bounded regions.

5.5 Partial Derivatives and Total Differentials: Definition and computation of partial derivatives, concept of higher-order partial derivatives and calculation of second-order partial derivatives for composite functions; definition of total differentials, necessary and sufficient conditions for the existence of total differentials, rules for differentiating multivariable composite functions, formulas for finding partial derivatives of implicit functions (including systems of equations).
5.6 Applications of Partial Derivatives: Finding extrema of multivariable functions, solving maximum and minimum problems, conditional extrema, Lagrange multiplier method.
5.7 Double Integrals: Concepts, properties, and calculations of double integrals (in rectangular and polar coordinates); double integrals over simple unbounded regions.

Module 6: Ordinary Differential Equations and Difference Equations

6.1 General Concepts of Differential Equations: Definitions of differential equations, order, solution, general solution, initial conditions, and particular solutions.
6.2 First-Order Differential Equations: Separable equations, homogeneous equations, first-order linear differential equations.
6.3 General Concepts of Difference Equations: Definitions of difference equations, order, solution, general solution, initial conditions, and particular solutions.
6.4 Linear Difference Equations: First-order linear homogeneous difference equations with constant coefficients, first-order linear nonhomogeneous difference equations with constant coefficients, second-order linear homogeneous difference equations with constant coefficients; simple economic applications of difference equations.

Module 7: Infinite Series

7.1 Series of Constants: Definition of infinite series and their convergence or divergence, basic properties of infinite series, necessary condition for convergence, convergence or divergence of geometric series and p-series; convergence tests for positive term series (comparison test, ratio test, root test), Leibniz's test for alternating series, concepts of absolute and conditional convergence and their relationship.
7.2 Power Series: Concept of power series, Abel's theorem, simple methods for finding the radius of convergence of power series, basic properties of power series within their interval of convergence, sum functions of power series; expansion of elementary functions into power series.

2. Textbook and Major References

Textbook:
Calculus (5th Edition), Chief Editor: Zhao Shuyuan
Publisher: Renmin University of China Press

Reference Book:
Advanced Mathematics, Chief Editor: Department of Applied Mathematics, Tongji University
Publisher: Higher Education Press

3. Assessment Methods

The final grade will be composed of the following components:

Regular Performance: 50%

Final Examination (closed book): 50

Liner Algebra

Course Code: 490002121
Course Name: Liner Algebra
Credits: 4
Category: Compulsory Course

1. Course Content

Module 1: Determinants

1.1 Second- and Third-Order Determinants
1.2 Permutations and Their Inversion Numbers
1.3 Definition and Properties of n-Order Determinants
1.4 Computation of Determinants
1.5 Cramer's Rule for Solving Systems of Linear Equations

Module 2: Matrices and Their Operations

2.1 Concepts of Matrices, Identity Matrix, Diagonal Matrix, and Symmetric Matrix
2.2 Linear Operations, Multiplication of Matrices, Transposition and Its Properties
2.3 Concept and Properties of Inverse Matrices; Finding the Inverse Using the Adjoint Matrix
2.4 Operations on Block Matrices
2.5 Elementary Row Transformations; Finding the Inverse via Elementary Transformations
2.6 Concept of Matrix Rank; Properties of Invertible Matrices

Module 3: Theory of Systems of Linear Equations

3.1 Conditions for the Existence of Solutions to Linear Systems
3.2 n-Dimensional Vectors and Their Linear Operations
3.3 Linear Dependence and Independence of Vector Sets: Definitions, Related Theorems, and Criteria
3.4 Rank of a Set of Vectors
3.5 Structure of the Solutions to a System of Linear Equations

Module 4: Eigenvalues and Eigenvectors of Matrices

4.1 Concepts of Eigenvalues and Eigenvectors, and Methods for Finding Them
4.2 Schmidt Orthogonalization Method; Concept and Properties of Orthogonal Matrices
4.3 Concept and Properties of Similar Matrices
4.4 Necessary and Sufficient Conditions and Methods for Matrix Diagonalization
4.5 Real Symmetric Matrices and Their Similar Diagonal Forms

2. Teaching Materials and Main Reference Books

Textbook:
Linear Algebra
Editor-in-Chief: Zhao Shuyuan
Publisher: China Renmin University Press

Reference Books:
Linear Algebra
Editor-in-Chief: Department of Applied Mathematics, Tongji University
Publisher: Higher Education Press

3. Assessment Method

Student grades will consist of the following components:

Regular Performance (Attendance, Homework, Quizzes, etc.): 50%

Final Exam (Closed-Book): 50%

Probability

Course Code: 490003131
Course Name: PROBABILITY AND MATHEMATICAL STATISTICS
Category: Compulsory Course
Credits: 2
Prerequisite Courses: Calculus, Linear Algebra

1. Course Content

Module 1: Fundamentals of Probability

Chapter 1: Random Events and Probability

§1.1 Random Events
§1.2 Probability
§1.3 Conditional Probability and the Law of Total Probability
§1.4 Independence of Events and Bernoulli Trials

Module 2: Random Variables and Distributions

Chapter 2: Random Variables and Their Distributions

§2.1 Random Variables and Distribution Functions
§2.2 Common Univariate Probability Distributions
§2.3 Bivariate Random Variables and Their Distributions
§2.4 Multivariate Random Variables and Their Distributions
§2.5 Distributions of Functions of Random Variables

Module 3: Moments and Laws of Large Numbers

Chapter 3: Numerical Characteristics of Random Variables

§3.1 Mathematical Expectation
§3.2 Variance
§3.3 Numerical Characteristics and Applications of Common Distributions
§3.4 Covariance Matrices and Correlation Coefficients

Chapter 4: Law of Large Numbers and Central Limit Theorem

§4.1 Law of Large Numbers

§4.2 Central Limit Theorem

Module 4: Sampling and Parameter Estimation

Chapter 5: Sampling Distributions

§5.1 Population and Sample
§5.2 Sample Statistics and Their Distributions
§5.3 Sampling Distributions

Chapter 6: Parameter Estimation

§6.1 Point Estimation
§6.2 Evaluation Criteria for Estimators
§6.3 Interval Estimation
§6.4 Confidence Intervals for Mean and Variance of Normal Distributions
§6.5 Confidence Intervals for Parameters of Non-Normal Distributions

Module 5: Hypothesis Testing

Chapter 7: Hypothesis Testing

§7.1 Fundamentals of Hypothesis Testing
§7.2 Hypothesis Testing for Parameters of a Single Normal Population
§7.3 Hypothesis Testing for Parameters of Two Normal Populations
§7.4 Hypothesis Testing for Parameters of Non-Normal Populations
§7.5 Hypothesis Testing of Population Distributions

Module 6: Analysis of Variance and Regression

Chapter 8: Analysis of Variance (ANOVA)

§8.1 Test for Homogeneity of Variance
§8.2 One-Way ANOVA
§8.3 Case Study of One-Way ANOVA

Chapter 9: Regression Analysis

§9.1 Introduction to Regression Models
§9.2 Simple Linear Regression
§9.3 Brief Introduction to Simple Linear Regression
§9.4 Multiple Linear Regression
§9.5 Case Study of Multiple Linear Regression

2. Teaching Materials and Main Reference Books

Textbook: Probability and Mathematical Statistics (2nd Edition), edited by Yao Mengchen, published by China Renmin University Press

Reference Books:

1. Probability and Mathematical Statistics, by Sheng Zhou et al., Zhejiang University, published by Higher Education Press, 1989.
2. Probability and Mathematical Statistics, by Mao Shisong, published by Higher Education Press, 2004.

3. Assessment Method

Regular Performance (Attendance, Homework, Quizzes, etc.): 50%

Final Exam (Closed-Book): 50%

Part 02 Programming

Python

Course Code: 000110211
Course Name: Basics Knowledge and Applications of Python
Credits: 1
Category: General Elective Course

Module 1: Course Introduction
1.1 Course Overview
1.2 Why Learn Programming
1.3 What Is a Program
1.4 History and Status of the Python Language
1.5 Module Quiz

Module 2: Introduction and Overview of Python
2.1 Python Runtime Environment
2.2 Your First Python Program
2.3 Integrated Development Environment: PyCharm
2.4 Lab: Experiencing Python Programming
2.5 Python Coding Style
2.6 Data Objects and Their Organization
2.7 Computation and Control Flow
2.8 Module Quiz

Module 3: Basics of Data Types
3.1 Basic Type: Numeric
3.2 Basic Type: Boolean
3.3 Basic Type: String
3.4 Variables and References
3.5 Lab: Basic Data Types
3.6 Module Quiz

Module 4: Advanced Data Types
4.1 Container Types: Lists and Tuples
4.2 Container Type: Dictionary
4.3 Container Type: Set
4.4 Mutable vs Immutable Types
4.5 Building Complex Data Structures
4.6 Input and Output

4.7 Lab: Operations on Container Types
4.8 Module Quiz

Module 5: Fundamentals of Computation and Control Flow
5.1 Automated Computational Process
5.2 Control Structures
5.3 Control Flow: Conditional Branches
5.4 Control Flow: While Loops
5.5 Control Flow: For Loops
5.6 Lab: Basic Computational Programs
5.7 Module Quiz

Module 6: Advanced Computation and Control Flow
6.1 Code Organization: Functions (def)
6.2 Function Parameters
6.3 Lab: Creating and Calling Functions
6.4 Using External Modules
6.5 Module Quiz

Module 7: Fundamental Extension Modules
7.1 Time-Related: datetime Module
7.2 Time-Related: calendar Module
7.3 Time-Related: time Module
7.4 Arithmetic Modules
7.5 Persistence Module: shelve
7.6 Reading and Writing Text Files
7.7 Lab: Timing and File Handling
7.8 Simple Graphical Interface
7.9 Turtle Graphics
7.10 Lab: Simple Drawing
7.11 Module Quiz

Module 8: Fundamentals of Advanced Features
8.1 Object-Oriented Programming: What Is an Object
8.2 Object-Oriented Programming: Class Definition and Invocation
8.3 OOP: Special Methods in Classes
8.4 Custom Object Sorting
8.5 OOP: Class Inheritance
8.6 Lab: Classes and Objects
8.7 Module Quiz

Module 9: Advanced Programming Features
9.1 Exception Handling
9.2 Comprehensions
9.3 Generator Functions

9.4 Lab: Using Generators
9.5 Image Processing Libraries
9.6 Web Service Frameworks
9.7 Web Crawlers
9.8 Data Visualization
9.9 Lab: Applications of Advanced Modules
9.10 Module Quiz

Matlab

Course Code： 000095211
Course Name： Scientific Calculation and Matlab Language
Credits： 2
Category： General Elective Course

Topic 1: Fundamentals of MATLAB

1.1 MATLAB System Environment
1.2 MATLAB Numeric Data
1.3 Variables and Their Operations
1.4 Representation of MATLAB Matrices
1.5 Referencing Matrix Elements
1.6 Basic MATLAB Operations
1.7 String Processing

Topic 2: MATLAB Matrix Processing

2.1 Special Matrices
2.2 Matrix Transformations
2.3 Matrix Evaluation
2.4 Eigenvalues and Eigenvectors of Matrices
2.5 Sparse Matrices

Topic 3: MATLAB Program Flow Control

3.1 Sequential Structure Programs
3.2 Selection Structure Using if Statements
3.3 Selection Structure Using switch Statements
3.4 Loop Structure Using for Statements
3.5 Loop Structure Using while Statements
3.6 Definition and Calling of Function Files
3.7 Recursive Function Calls
3.8 Function Parameters and Variable Scope

Topic 4: MATLAB Plotting

4.1 2D Curves
4.2 Auxiliary Operations for Plotting
4.3 Other Forms of 2D Curves
4.4 3D Curves
4.5 3D Surfaces
4.6 Graph Decorations and Processing
4.7 Interactive Plotting Tools

Topic 5: Data Analysis and Polynomial Computation

5.1 Statistical Data Analysis
5.2 Polynomial Computation
5.3 Data Interpolation
5.4 Examples of Interpolation Applications
5.5 Curve Fitting
5.6 Examples of Curve Fitting Applications

Topic 6: Numerical Calculus and Equation Solving

6.1 Numerical Differentiation and Integration
6.2 Solving Linear Equations
6.3 Examples of Linear Equation Applications
6.4 Solving Nonlinear Equations and Function Extremes
6.5 Numerical Solutions of Ordinary Differential Equations
6.6 Examples of ODE Applications

Topic 7: MATLAB Symbolic Computation

7.1 Symbolic Objects
7.2 Symbolic Calculus
7.3 Series
7.4 Symbolic Equation Solving

Topic 8: MATLAB Graphical User Interface (GUI) Design

8.1 Figure Windows and Axes
8.2 Curve and Surface Objects
8.3 GUI Design Methods

8.4 GUI Design Tools
8.5 APP Design Tools
8.6 Examples of GUI Applications

Topic 9: Simulink System Simulation

9.1 Basics of Simulink Simulation
9.2 Creation and Encapsulation of Subsystems
9.3 Design and Application of S-Functions
9.4 Examples of Simulink Applications

Topic 10: External Program Interfaces

10.1 Using MATLAB in Excel
10.2 File Operations in MATLAB
10.3 Reading and Writing MATLAB Data Files in Other Programming Languages
10.4 Calling Programs Written in Other Languages from MATLAB
10.5 Calling MATLAB Functions from Programs Written in Other Languages