Spatial Data Programming
Instructors: Ruixin Yang

Contact Instructor: Ruixin Yang
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Time & Place: Wednesdays, 7:20pm-10:00pm, Exploratory Hall 2310
Office Hours: Tuesdays, 2:30 pm-4:30 pm or by appointment.

Text Books:
Required (Primary):
- Stormy Attaway, 2013, Matlab, A Practical Introduction to Programming and Problem Solving, 3rd Edition, Butterworth-Heinemann, Boston. (Call Number: QA297 .A87 [1st edition]; ISBN: 978-0124058767). Fourth edition: July 2016. Other editions (2nd-4th) will be fine.

Recommended (Secondary):
- Amos Gilat, Vish Subramaniam, 2010, Numerical Methods for Engineers and Scientists: An Introduction With Applications Using Matlab, John Wiley & Sons Inc. (QA297 .G49 2008; ISBN-10: 0470565152; ISBN-13: 9780470565155)
- Nicholas J. Higham, D. J. Higham, Desmond J. Higham, 2005, Matlab Guide (2nd edition), Society for Industrial & Applied. (QA297 .H5217; ISBN-10: 0898715784; ISBN-13: 9780898715781)
- Martinez and Angel R. Martinez, 2008. "Computational statistics handbook with MATLAB," Chapman & Hall/CRC, Boca Raton, Florida (QA276.4 .M269 2008)

Supplementary Materials (on math and statistics)

GMU Catalog Entry (unofficial):
This course will cover statistics, math, and scientific programming. Scientific programming in Matlab will be the major component of the courses. Important math and statistics concepts, methods, and algorithms, which are fundamental and needed for other GGS courses, will be covered, and their implementation will be integrated with the Matlab programming. Tentative topics include probability concept and theory, specific distributions, random number generators, basic descriptive statistics, and basic principles of inferential statistics. Application materials will be added later based on the interest of the class.

Prerequisites: none
Prerequisite Skills: A good comprehension of algebra and basic trigonometry. Basic calculus is helpful but not required.

Goals and Objectives:
To introduce essential principles in **Statistics, Mathematics and Scientific Programming** to those students majoring in GGS graduate programs. Both understanding and the

implementation of the corresponding analysis methods and programming techniques will be covered.

Learning Outcomes:

After successful completion of this course,
1. Students will understand essential principles of statistics;
2. Students will be able to analyze given general data sets and to compute descriptive measures;
3. Students will be able to solve data analysis problems with scientific programming.
4. Students will be able to use numerical simulation for inferential statistics

Course Web Site: Mason Blackboard System at mymason.gmu.edu

Grading Policy:

Homework Assignments:	70%
Final Assignments(470)/Project(590)	30%
Total	100% (**Letter grades based on relative numbers**)

General Course Policies
- Attendance will not be considered in the final grade.
- Late assignments will be accepted in the following 1&1/2 days (by Friday noon) with no penalty. Late assignments beyond 2 days will be accepted and considered for the final grade. However, the late submissions will not be graded as regular submissions.
- Extra credit points may be granted to extra efforts, especially those including creative thinking.

The followings are university wide required information from Office of the Provost:

ACADEMIC INTEGRITY

GMU is an Honor Code (http://oai.gmu.edu/mason-honor-code/) university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

GMU EMAIL ACCOUNTS

Students must use their Mason email accounts—either the existing "MEMO" system or a new "MASONLIVE" account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

OFFICE OF DISABILITY SERVICES

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. http://ods.gmu.edu

OTHER USEFUL CAMPUS RESOURCES:
- WRITING CENTER: A114 Robinson Hall; (703) 993-1200; http://writingcenter.gmu.edu
- UNIVERSITY LIBRARIES "Ask a Librarian" http://library.gmu.edu/ask
- COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): (703) 993-2380; http://caps.gmu.edu

UNIVERSITY POLICIES
The University Catalog, http://catalog.gmu.edu, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at http://universitypolicy.gmu.edu/. All members of the university community are responsible for knowing and following established policies.

Tentative Course Schedule (will be adjusted during the semester. Last modified on July 19, 2018):
Please consider this as a list of course contents instead of schedule. The assignment given and due dates will be adjusted accordingly. All efforts will be made to cover as much topics below as possible.

Week 1:   Course Introduction and Matlab Basics
- Syllabus
- Matlab environment and major features
- Basic data structure, variables, types
- Basic Matlab operators
- Built-in functions and constants
- Practice 1. No submissions (covers Chapter 1)
- Reading Assignment: Chapter 1 (no 1.4.5).

Week 2:   Vectors and matrices
- Definition of vectors and matrices
- Array operations
- Matrix operation
- HW1 given
- Reading Assignment: Chapter 2.

Week 3:   Matlab Programming
- Basic concepts
- Matlab script
- Basic input/output
- Simple functions
- Simple plots
- Project title due (9/12)
- Reading Assignment: Chapter 3

Week 4:   Selection and Loop Statements; Functions
- Logical operators
- Selections: if (if/elseif/else) and switch
- Loops (for and while)
- Vectorized code
- Timing
- HW2 Given
- Reading Assignment: Chapter 4 and 5

Week 5:   More Programming and String Operations
- More functions
- Variable scope
- Debugging
- String creation
- Operations on strings
- Conversion between strings and other data types
- Reading Assignment: Chapters 6 and 7

Week 6:   Cell Arrays and Structures
- Cell arrays

- Structure
    - Shapefile reading with structures
- Reading Assignment: Chapter 8

Week 7:   Statistics I
- Random numbers
- Probability
- Central limit theorem (CLT)
- Simulation of CLT
- Reading Assignment: Class Notes

Week 8:   Statistics II
- Correlation analysis and simulation of the hypothesis testing for correlation
- Linear regression
- HW4 given
- Reading Assignment: Class Notes

Week 9:   Advanced Input/Output
- Lower level file I/O functions
- Spreadsheet file I/O functions
- Project outline due (10/24)
- HW5 given
- Reading Assignment: Chapter 9

Week 10:   Advanced Input/Output (Cntinued)
- Spreadsheet file I/O functions
- Images reading
    - Image reading and display
    - Imagery data, colormap
- Reading Assignment: Section 13.2

Week 11:   Image Processing (Cntinued). Set Operators
- true color imagery
    - data structure
    - modification
- Image enhancement
- Set operators
- HW6 given
- Reading Assignment: Sections 12.2 and 12.3

Week 12:   Advanced Topics
- Advanced functions
    - Anonymous functions
    - Function handle and function functions
    - Variable number of arguments
    - Recursive functions
- Advanced plots
    - Various plot types
    - Animation
    - 3D plots
    - Graphic handle and property modification (manual and with code)
    - Figure output in popular photo formats

- Reading Assignment: See above

Week 13: Advanced Topics (Continued). Statistics II
- Miscellaneous Topics
    - Symbolic operations
    - Curve fitting
    - Square matrix
    - Access folder contents
- Spatial Point Pattern
    - Randomness and Poisson distribution
    - Quadrat Analysis
    - Average neighbor analysis
- HW6 due
- Reading Assignment: Chapter 14

Week 14: Statistics II and Statistics III
- Spatial Point Pattern (Continued)
    - K-Function
- Time series and temporal anomalies
- Spatial Autocorrelation (SAC)
    - Variogram
    - Spatial weight matrix
    - Moran's I

Week 15: **Final Exam Week:** (Wed. 12/12)
- Assignment/Final Exam/Project report due (hard deadline)