湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Data Use in Science
Course Code	SCIE 4403
Semester	Winter 2027
Course Length	8 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite(s)	N/A
Antirequisite	SCIE 4401 Data Use in Science (4 Weeks)

Course Description:

This course introduces students to data collection and analysis to investigate questions relevant to research in the natural sciences. Methods such as ANOVA and linear regression are demonstrated and practised in a computer laboratory environment using experimental and observational data.

Throughout the course, scientific interpretation and hypothesis testing are emphasised. Students develop the knowledge to analyse data and explain the data using models. They learn to recognise the appropriate statistical technique for different types of data, and how to obtain results using computer software.

The course equips students with the knowledge and skills they need to undertake research in their honours or master's thesis and beyond in private or public employment.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical Thinking Skills** - Students will engage in analytical thinking, demonstrating the ability to critically evaluate, synthesize, and apply knowledge to complex problems, and construct well-reasoned solutions and arguments.
- **Independent Research and Inquiry** - Students will conduct independent research, utilizing academic resources to explore relevant topics, formulating research questions, analyzing data, and presenting findings in a coherent, scholarly manner.
- **Problem-Solving and Application** - Students will apply theoretical concepts and methodologies learned in the course to real-world problems, demonstrating the ability to develop practical solutions informed by academic inquiry.

- **Global and Cultural Awareness** - Students will gain awareness of the global and cultural contexts relevant to the course, appreciating diverse perspectives and considering the implications of their studies in a broader, international context.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Collect and interpret observational and experimental data relevant to natural science research.
- Formulate and test scientific hypotheses using appropriate statistical procedures.
- Demonstrate an understanding of statistical methods such as ANOVA and linear regression.
- Recognise the appropriate statistical technique for different types of data and study designs.
- Use computer spreadsheets and statistical software such as R/RStudio to produce professional-quality data analysis, graphics, and reporting.
- Interpret statistical outputs, identify assumptions and limitations, and communicate results clearly in written scientific reporting.

Textbooks:

1) Whitlock, M. C., & Schluter, D. (2020). *The Analysis of Biological Data* (3rd ed.). Roberts and Company.
2) Crawley, M. J. (2014). *Statistics: An Introduction Using R* (2nd ed.). Wiley.
3) R Core Team. (2024). *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing.
4) Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). *R for Data Science (2nd ed.).* O'Reilly Media.
5) Quinn, G. P., & Keough, M. J. (2002). *Experimental Design and Data Analysis for Biology.* Cambridge University Press.

Course Requirements:

Written Assignments (40%)
A sequence of computer-based assignments that apply statistical methods to experimental and observational datasets. Assignments require data handling, analysis in R/RStudio, graphical output, and written scientific interpretation of results, including assessment of model assumptions and limitations.

Online Quizzes (25%)
Short quizzes assessing understanding of core statistical concepts, hypothesis testing, study design, and the selection of appropriate techniques for different data types.

Data Analysis Report (25%)
Students produce an independent data analysis report on a scientific dataset. The report should include:

- Scientific question and study design description
- Data preparation, exploration, and descriptive summaries
- Appropriate statistical analysis (e.g., ANOVA or regression) with justified methods

- Diagnostic checks of assumptions and model fit
- Clear, reproducible graphics and interpreted results
- Discussion of limitations, conclusions, and research implications
- The report will be assessed on statistical reasoning, technical execution, and the clarity of scientific communication.

Participation and Tutorial Activities (10%)
Students are expected to complete preparatory material, participate in computer laboratory sessions and tutorials, contribute to class discussion, and complete in-class practical activities.

Assessments: Activity	**Percent Contribution**
Written Assignments	40%
Online Quizzes	25%
Data Analysis Report	25%
Participation and Tutorial Activities	10%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	**Percentage of available points**
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

SCIE 4403 Schedule		
Lecture	Topic	Readings
L1	Introduction to Data Use in Science and the Research Process	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 1-2.
L2	Data Collection, Sampling, and Study Design	Quinn & Keough (2002). *Experimental Design and Data Analysis for Biology*, Ch. 1-2.
L3	Descriptive Statistics and Data Exploration	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 3-4.
L4	Data Visualisation and Graphical Presentation	Wickham, Çetinkaya-Rundel & Grolemund (2023). *R for Data Science*, Ch. 3.

L5	Probability, Distributions, and Sampling Distributions	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 5-6.
L6	Hypothesis Testing and Confidence Intervals	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 9-10.
L7	Comparing Groups: t-tests and Non-Parametric Alternatives	Crawley (2014). *Statistics: An Introduction Using R*, Ch. 5.
L8	Analysis of Variance (ANOVA): One-Way Designs	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 15.
L9	ANOVA: Assumptions, Diagnostics, and Multiple Comparisons	Quinn & Keough (2002). *Experimental Design and Data Analysis for Biology*, Ch. 3.
L10	Experimental and Observational Data in the Laboratory	Course dataset and laboratory activities.
L11	Association and Correlation	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 16.
L12	Linear Regression: Concepts and Interpretation	Crawley (2014). *Statistics: An Introduction Using R*, Ch. 7.
L13	Regression: Model Fit, Residuals, and Assumptions	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 17.
L14	Multiple Regression and Model Selection	Crawley (2014). *Statistics: An Introduction Using R*, Ch. 8.
L15	Count Data, Proportions, and Contingency Tables	Quinn & Keough (2002). *Experimental Design and Data Analysis for Biology*, Ch. 12.
L16	Introduction to R/RStudio: Data Import and Manipulation	Wickham et al. (2023). *R for Data Science*, Ch. 4-7.
L17	Reproducible Workflow, Scripting, and Code Organisation	Wickham et al. (2023). *R for Data Science*, Ch. 9-10.
L18	Data Quality, Missing Data, and Outlier Treatment	Quinn & Keough (2002). *Experimental Design and Data Analysis for Biology*, Ch. 4.
L19	Power Analysis and Sample Size	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 11.
L20	Scientific Interpretation and Evidence-Based Reasoning	Whitlock & Schluter (2020). *The Analysis of Biological Data*, Ch. 20.
L21	Ethics, Data Sharing, and Responsible Research	Course readings and research integrity guidelines.
L22	Data Analysis Report Workshop	R Core Team (2024). *R: A Language and Environment for Statistical Computing*.
L23	Report Writing, Graphics, and Communication of Results	Wickham et al. (2023). *R for Data Science*, Ch. 28.
L24	Project Presentations, Peer Review, and Course Synthesis	Course datasets and readings listed in L8, L13, and L22.
L25	Final Examination	Review all materials.

Accommodation Statement:

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor’s attention. Students who may require assistance in

emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations

All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates

All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work

The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities

Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.