



Science (SCIE) 480

Research Methods in Science (Revision 1)

Status:

Replaced with new revision, see the [course listing](#) for the current revision

Delivery mode:

Individualized study online

Credits:

3

Area of study:

Science

Prerequisites:

MATH 215 (3) or **MATH 216** (3); **MATH 265** (3); and at least two additional 3-credit science courses. Professor approval is required to register in this course.

Precluded:

None

Challenge:

SCIE 480 is not available for challenge.

Faculty:

Faculty of Science and Technology

Overview

The SCIE 480: *Research Methods in Science* program is intended to introduce undergraduate students to the practice of 21st-century scientific research and its underlying theories. To that end, the course opens with a broadly based, cross-disciplinary discussion of current designs and methods used by researchers. A wide range of conceptual and technical aspects of these methods are covered.

Key concepts of statistical analysis and mathematical modelling are introduced, including an examination of how these concepts relate to the scientific method and their use in a surprising number of research processes.

Moreover, students taking this course will gain first-hand experience with the design and writing of a research proposal, a literature search and review, and the collection, display, and analysis of scientific data.

Outline

Unit 1: THE NATURE of SCIENCE

- 1.1: Types of research
- 1.2: How to find literature resources
- 1.3: How to read scientific papers
- 1.4: Research hypothesis and null hypothesis, Type I and Type II errors
- 1.5: Random and systematic errors, accuracy and precision, bias
- 1.6: Research involving humans and animals

Unit 2: STATISTICS

- 2.1: Motivations for statistics
- 2.2: Reducing many numbers to few
- 2.3: Probability distributions
- 2.4: Connecting data and probability distributions
- 2.5: What happens to sample averages as the sample size (N) increases

- 2.6: The Central Limit Theorem
- 2.7: Comparing many samples
- 2.8: Data with categorical variables
- 2.9: Other statistical tests

Unit 3: MATHEMATICAL MODELLING

- 3.1: Basic mathematical ingredients for modelling
- 3.2: Linear regression
- 3.3: Difference equations
- 3.4: Differential equations

Unit 4: WRITING A RESEARCH PROPOSAL and PRESENTING YOUR RESULTS

- 4.1: Writing scientific papers
- 4.2: Producing scientific figures
- 4.3: Giving scientific presentations
- 4.4: Designing and writing a research proposal

Learning outcomes

Upon successful completion of this course, you should be able to

- demonstrate understanding of the different types of research and the ethical principles that must be followed if human or animals are involved.
- carry out a literature review on a specific scientific topic by using library and online resources to look for relevant scientific papers ranging from popular scientific journals to more technical specialist journals.
- differentiate between a null hypothesis and a research or alternative hypothesis, between random and systematic errors, and between accuracy and precision.
- provide reasons for including statistical methods, both descriptive and inferential, in data-driven research, and explain the importance of measurements, their accuracy and their significance.

- explain the relevance of mathematical modelling in science and demonstrate understanding of the description and prediction aspects of a mathematical model.
- apply linear regression and basic nonlinear discrete and differential equation models to sets of experimental data using Excel.
- describe the general structure of scientific articles and use this knowledge to write a research proposal.

Evaluation

To **receive credit** [↗](#) for SCIE 480, you must achieve a composite grade of at least **D (50 percent)** [📄](#) for the total of the first three assignments and a grade of at least D (50 percent) on Assignment 4 (which includes the drafting and submission of a research proposal report). The weighting of the composite grade is as follows:

Activity	Weight
Assignment 1	25%
Assignment 2	25%
Assignment 3	25%
Assignment 4	25%
Total	100%

To learn more about assignments and examinations, please refer to Athabasca University's **online Calendar** [↗](#).

Materials

Marder, M. P. (2011). *Research Methods for Science*. New York, NY: Cambridge University Press. [📖](#) (eBook)





Other Resources

The online course materials include a course orientation, study guide, and links to four scientific research papers needed for unit assignments.

Special Course Features

Access to Microsoft Excel spreadsheet software is necessary for students enrolled in *SCIE 480*.

Important links

- › [Academic advising](#) 
- › [Program planning](#) 
- › [Request assistance](#) 
- › [Support services](#) 

Athabasca University reserves the right to amend course outlines occasionally and without notice. Courses offered by other delivery methods may vary from their individualized study counterparts.

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