Introduction

The aim of this course is to teach students about the process of applying mathematical models to hydrological problems using a survey of numerical models, both stochastic and deterministic. Students will be able to identify appropriate modelling strategies for various applications and identify the limitations of various hydrological modelling techniques. Students will understand the process to develop and apply models for hydrological applications, scrutinize model output and effectively communicate their results. Practical examples of hydrological model applications such as flood forecasting, climate change impact assessment and risk assessment will be used to support theoretical concepts. Topics to be covered will include:

- The concept of modelling as applied to hydrologic systems;
- The structure of deterministic models and examples of applications in hydrology
- Selected stochastic processes and examples of hydrologic applications.

Students will build skills in data analysis, model development and result presentation by completing the lab assignments portion of the course. Lab 1 will set the context for lab expectations and the presentation of submitted assignments. Labs 2 to 4 will provide students the opportunity to calibrate and develop a hydrological model and apply the model to a real-world impact assessment using deterministic models. Lab 5 will focus on the development and evaluation of stochastic models for hydrological applications.

Textbooks


Note: This text is available as an e-book from the McMaster Library
Lectures
Lectures will occur on Wednesdays from 11:30-13:20 in Room BSB 108 following the attached schedule. Lectures are the main form of communication and therefore **ALL students are expected to attend ALL lectures.** It is the responsibility of individual students to obtain notes for any classes that are missed. Note that the schedule may change slightly throughout the term.

*Students are NOT authorized to record lectures or lab information sessions using video, audio or image recording devices without documented approval from the course instructor.*

Evaluation Scheme
This course will consist of four (4) lab assignments and a final exam. The final exam will include content from lectures, text readings and lab content. Students should be aware that lab assignments have different weights for pedagogical reasons and based on the content coverage in the labs.

<table>
<thead>
<tr>
<th>Lab Assignments</th>
<th>50%</th>
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<tbody>
<tr>
<td>Lab 1 – 2%</td>
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<tr>
<td>Lab 2 – 15%</td>
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<tr>
<td>Lab 3 – 9%</td>
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<td>Lab 4 – 15%</td>
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<tr>
<td>Lab 5 – 9%</td>
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**Final Exam**  
50%

*5% will be deducted for each day of a late lab report submission*

Labs
Attendance at all lab sessions is mandatory. A complete lab schedule is attached with the lecture schedule. Labs are designed to enhance lecture material content and build transferable skills used in the analysis, communication and presentation of results. With such a goal in mind it is mandatory that all submitted lab assignments be presented in a professional manner. All assignment text is to be organized by sub-headings and created with word processing software. All figures and tables are to be appropriately labeled, generated with appropriate computer software and inserted into the text with captions. Further details on these requirements will be provided during the Lab 1 information session. Labs will be held on Tuesdays from 11:30-13:20 in KTH B121.

The course will contain five lab assignments. The topics are as follows:

Lab 1: Introduction to Excel as a Modelling Environment  
Lab 2: Development of the HBV Hydrological Model  
Lab 3: Calibration and Sensitivity Analysis  
Lab 4: Autoregressive Modelling in the Great Lakes Basin
Lab 5: Climate Change Impact Assessment

**Missed Work**

Labs work is essential to ensure students gain an understanding of the hydrological modelling process. In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Request for Relief for Missed academic Term Work”. Please note these regulations have changed beginning Fall 2015.

1) Report absence of up to 3 days using the McMaster Student Absence Form (MSAF).
2) Contact the instructor within 5 days to find out what accommodations, if any, will be made.

If you have any questions about the MSAF, please contact your Associate Dean’s office.

**Contact**

Several avenues of contact are available to students within this course. Students are strongly encouraged to take advantage of lecture time to ask questions and seek clarification.

Avenue to Learn will be available for the course and include a discussion board. This venue will be periodically but not continually by the course instructor or TA. Students are encouraged to actively discuss questions, but cannot post lecture notes, data sets or direct solutions to lab problems.

As a courtesy and to ensure timely response to emails, you must include your name and student ID number in the email signature and course code in the email subject line. **Emails sent from within Avenue will not be responded to.** Emails should be written in a professional manner, spell checked and proof read prior to sending them.

**Student Services and Academic Support**

McMaster University has a variety of student support services available to accommodate the needs of individual students. See the Undergraduate Calendar for a complete listing.

Students with any needs or requiring accommodation related to a disability should contact Student Accessibility Services (http://sas.mcmaster.ca).
**Course Timetable**

<table>
<thead>
<tr>
<th>Date</th>
<th>Lab Activity</th>
<th>Lecture Description</th>
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</table>
| Sept 9 (Week 1) | No Labs      | Course Introduction, Overview Modelling Principles in Hydrology  
Beven 1.1-1.7 |
| Sept 16 (Week 2) | Lab 1        | Modelling of Hydrologic Systems and Deterministic Models  
Beven 3.1-3.10 |
| Sept 23 (Week 3) | Lab 2 Introduction | Statistical Definitions and Model Calibration  
Beven 1.8, 7.1-7.4 |
| Sept 30 (Week 4) | Work on Lab 2 | Deterministic Models  
Beven 2.1-2.9 |
| Oct 7 (Week 5)  | Work on Lab 2 | Modelling of Physical Systems 1 – Snow Processes  
Beven Box 3.1-Box 3.3 |
| Oct 21 (Week 6) | Work on Lab 2 | Modelling of Physical Systems 2 - Evapotranspiration  
Beven Box 5.1-5.6, 6.3 |
| Oct 28 (Week 7) | Lab 3 Introduction | Modelling of Physical Systems 3 – Soil Moisture  
Beven Box 5.1-5.6, 6.3 |
| Nov 4 (Week 8)  | Work on Lab 3 | Statistical Hydrology, Definitions, Concepts, Distributions  
Machiwal & Jha, Ch. 1 |
| Nov 11 (Week 9) | Lab 4 Introduction | Hydrologic Time Series Analysis  
Machiwal & Jha, Ch. 2 |
| Nov 18 (Week 10) | Work on Lab 4 | Statistical/Stochastic Hydrological Models  
Machiwal & Jha, Ch. 5 |
| Nov 25 (Week 11) | Lab 5 Introduction | Models for Changing Risk  
Beven 8.1-8.9 |
| Dec 2 (Week 12) |               | Prediction in Ungauged Basins  
Beven 10.1-10.12 |

**Fall Reading Week (October 12-17)**

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Beven Box 5.1-5.6, 6.3 |
| Oct 28 (Week 7) | Lab 3 Introduction | Modelling of Physical Systems 3 – Soil Moisture  
Beven Box 5.1-5.6, 6.3 |
| Nov 4 (Week 8)  | Work on Lab 3 | Statistical Hydrology, Definitions, Concepts, Distributions  
Machiwal & Jha, Ch. 1 |
| Nov 11 (Week 9) | Lab 4 Introduction | Hydrologic Time Series Analysis  
Machiwal & Jha, Ch. 2 |
| Nov 18 (Week 10) | Work on Lab 4 | Statistical/Stochastic Hydrological Models  
Machiwal & Jha, Ch. 5 |
| Nov 25 (Week 11) | Lab 5 Introduction | Models for Changing Risk  
Beven 8.1-8.9 |
| Dec 2 (Week 12) |               | Prediction in Ungauged Basins  
Beven 10.1-10.12 |

**Academic Integrity Statement**

All students are expected to adhere to the highest standards of honesty, integrity and ethical behaviour in the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Students are responsible for being aware of and demonstrating behaviour that is honest and ethical in their academic work. Such behaviour includes:

- Following the expectations articulated by instructors for referencing sources of information.
- Submitting original work, citing sources fully, and respecting the authorship of others.
• Asking for clarification of expectations as necessary. Students who are in any doubt as to whether an action on their part may be viewed as a violation of the standards of academic integrity should ask their instructors, lab assistants and/or advisors.
• Identifying testing situations that may allow copying.
• Preventing their work from being used by others, e.g. protecting access to computer files, etc.
• Adhering to the principles of academic integrity when conducting and reporting research.

It is your responsibility to understand what constitutes academic dishonesty. For information on the types of academic dishonesty and the consequences thereof please refer to the Academic Integrity Policy located at: http://www.mcmaster.ca/academicintegrity/.