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Water Resources Management - Singapore University of Technology and Design

Stefano Galelli

Singapore University of Technology and Design, stefano_galelli@sutd.edu.sg

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40.232 Water Resources Management

Course description and objectives. The course develops basic skills and knowledge for modeling, managing and planning water resources systems in a participated and sustainable way. Particular emphasis is given to 1) the application of statistical modeling and optimization techniques to the design and management of natural and urban water systems, and 2) the implementation of these techniques in numerical computing environments. A key aspect of the course is a term-long team project.

The objective of the course is to:

- Define, discuss and apply the basic ideas of integrated water resources management to both natural and urban environments;
- Employ and test statistical and process-based models to describe the main components of a river basin;
- Develop and evaluate optimization-based models for the planning and management of river basins;
- Analyze the main components of urban water systems.

Prerequisites. An introductory course in the following topics: probability, statistics (or probability and statistics) and optimization.

Class time and location. Tuesdays 1.00 – 3.00 pm (ECC Building 2 2.310), Thursdays 12.30 – 14.30 pm (ECC Building 1 1.609).

Class credit and term. 12 units; Term 7, 2015.

Teaching team.

Instructor	Teaching Assistant (TA)
Dr. Stefano Galelli E-mail: stefano_galelli@sutd.edu.sg Office hours: Monday, 3-4 pm Office: Block 1, L7 1.702-18	Dr. Sean W. Turner E-mail: sean_turner@sutd.edu.sg Office hours: Friday, 3-5 pm Office: IDC, L5 3.503

Course website. The teaching material (including lectures notes, readings, homework and homework solution) will be posted on eDimension.

Course timeline.

WEEK	DATE		TIME	ROOM	SUBJECT	TEXTBOOK
1	27-Jan	Tuesday	13:00	ECC Building 2 2.310	Lecture/Tutorial/In-class project/Exam Lecture 01 - Introduction	Ch. 1
1	29-Jan	Thursday	12:30	ECC Building 1 1.609	Lecture 02 - Integrated and participatory planning	Ch. 1-2
2	3-Feb	Tuesday	13:00	ECC Building 2 2.310	Lecture 03 - Reconnaissance and actions	Ch. 3
2	5-Feb	Thursday	12:30	ECC Building 1 1.609	Tutorial 01 - Introduction to MatLab	-
3	10-Feb	Tuesday	13:00	ECC Building 2 2.310	In-class project + Lecture 04 - Criteria and Indicators	Ch. 3
3	12-Feb	Thursday	12:30	ECC Building 1 1.609	Tutorial 02 - Indicators	-
4	17-Feb	Tuesday	13:00	ECC Building 2 2.310	In-class project + Lecture 05 - Identifying the model	Ch. 4
5	24-Feb	Tuesday	13:00	ECC Building 2 2.310	Lecture 06 - The reservoir (mechanistic model)	Ch. 5
5	26-Feb	Thursday	12:30	ECC Building 1 1.609	Tutorial 03 - Simulation of a natural lake	-
5	27-Feb	Friday	15:00	ECC Building 1 1.609	Lecture 07 - The catchment (empirical model)	Ch. 4
6	3-Mar	Tuesday	13:00	ECC Building 2 2.310	Tutorial 04 - Modelling the inflows	-
6	5-Mar	Thursday	12:30	ECC Building 1 1.609	Mid-Term Exam	-
7	10-Mar	Tuesday				
7	12-Mar	Thursday			RECESS WEEK	
8	17-Mar	Tuesday	13:00	ECC Building 2 2.310	Lecture 08 - Other components: canals, diversions and stakeholders	Ch. 4-5
8	19-Mar	Thursday	12:30	ECC Building 1 1.609	In-class project + Lecture 09 - Aggregated models	Ch. 5
9	24-Mar	Tuesday	13:00	ECC Building 2 2.310	Lecture 10 - Introduction to planning + SEMINAR	Ch. 7-8
9	26-Mar	Thursday	12:30	ECC Building 1 1.609	Lecture 11 - Optimal planning and management	Ch. 10
10	31-Mar	Tuesday	13:00	ECC Building 2 2.310	Lecture 12 - Policy search	Ch. 12
10	2-Apr	Thursday	12:30	ECC Building 1 1.609	Tutorial 05 - Operation of a regulated lake	-
11	7-Apr	Tuesday	13:00	ECC Building 2 2.310	Lecture 13 - Stochastic Dynamic Programming	Ch. 12
11	8-Apr	Wednesday	14:30	ECC Building 2 2.310	Lecture 14 - Stochastic Dynamic Programming - TDC	-
11	9-Apr	Thursday	12:30	ECC Building 1 1.609	In-class project	-
13	21-Apr	Tuesday	13:00	ECC Building 2 2.310	Lecture 15 - Introduction to Urban Water Systems + Lecture 16 - Drinking water	-
13	23-Apr	Thursday	12:30	ECC Building 1 1.609	Tutorial 06 - Design of a water distribution system	-
13	24-Apr	Friday	14:30	ECC Building 1 1.609	Final Workshop	-
14	29-Apr	Wednesday	9:00	TBC	Final Exam	-

Assessment and grading. Homework will be assigned regularly and is to be submitted by the specified deadline. There will be a mid-term exam in week 6, and the final examination will be held during week 14.

Assessment Item	Percentage
Class Participation	5%
Homework	20% (5% x 4)
Project	30%
Mid-term exam	15%
Final exam	30%

Essential reading. The following is the reference text for this course (available at the library):

- R. Soncini-Sessa, A. Castelletti, E. Weber. *Integrated and participatory water resources management. Theory*. Elsevier, Amsterdam, 2007.

The teaching team may introduce additional reading material; if so, the information will be posted on the website.

Optional reading.

- D.P., Loucks, E., Beek, J.R., Stedinger, J.P., Dijkman, M.T., Villars, M. T. *Water resources systems planning and management: An introduction to methods, models and applications*. UNESCO, Paris, 2005.
- Shaw E.M., Beven, K.J., Chappell, N.A., Lamb, R. *Hydrology in practice (fourth edition)*. Spon Press, London (UK), 2011
- R. Soncini-Sessa, F. Cellina, F. Pianosi, E. Weber. *Integrated and participatory water resources management. Practice*. Elsevier, Amsterdam, 2007.
- A. Quarteroni, F. Saleri. *Scientific Computing with MATLAB and Octave*. Springer-Verlag, Heidelberg, 2006.

Group projects. Each project consists of a planning and/or management problem for a real-world water system (e.g., water supply system, irrigation district etc.). A problem formulation, along with a dataset, will be provided.

- Group formation. Please form your own team of 3-4 people each by February 10. Each team must have a coordinator that will manage the communications with the teaching team. You will be in the same group throughout the course, working on both project and in-class presentations.
- Choosing the project. The choice will follow a first-come first-served basis and must be communicated to the teaching time by February 10, 11.55 pm.
- Project deliverables. Students will be expected to formulate the planning/management problem, identify the corresponding objectives, formulate a mathematical model of the water system and use this latter to design (by means of simulation and/or optimization) different planning/management alternatives.
- Students will be expected to deliver a preliminary report that includes the problem definition, assignment of duties to team members and a timeline for project execution by March 3 (3 pages). The teaching team will review and approve this preliminary report. Students will submit a final report by April 23 (8 pages including figures and appendices). A final workshop will take place on April 23: during the workshop each team will have a time slot of about 30 min to present the main findings of the project.
- Working space. Groups may make use of Systems Modelling Lab, which has been made available for students taking ESD courses.
- The final grade for the project will be based on the two reports and final presentation.

In-class paper presentations. In some weeks (see the table below), we will have a paper assigned for reading and presentation in class.

- Group formation. One reading will be randomly assigned to each group working on the term-long project.
- Deliverables. Each group is responsible for making a 15-min presentation during class.
- The class participation grade will be based on 1) the quality of the presentation, and 2) the involvement during other in-class activities.

Week	Paper
8	Eltahir E.A.B. (1996) El Nino and the natural variability in the flow of the Nile River. <i>Water Resources Research</i> , 32(1), 131-137.
9	Hashimoto T., Stedinger J.R., Loucks D.P. (1982) Reliability, Resiliency, and Vulnerability criteria for water resource system performance evaluation. <i>Water Resources Research</i> , 18(1), 14-20.
10	Draper A.J., Lund J.R. (2004) Optimal hedging and carryover storage value. <i>Journal of Water Resources Planning and Management</i> , 130, 83-87.

Important dates.

WEEK	DATE		Note
1	27-Jan	Tuesday	
1	29-Jan	Thursday	
2	3-Feb	Tuesday	
2	5-Feb	Thursday	
3	10-Feb	Tuesday	Project choice
3	12-Feb	Thursday	Assignment #1 (due on Feb. 18)
4	17-Feb	Tuesday	
5	24-Feb	Tuesday	
5	26-Feb	Thursday	Assignment #2 (due on Mar. 4)
5	27-Feb	Friday	
6	3-Mar	Tuesday	Project (preliminary) report
6	5-Mar	Thursday	Mid-term exam
7	10-Mar	Tuesday	RECESS WEEK
7	12-Mar	Thursday	
8	17-Mar	Tuesday	Assignment #3 (due on Mar. 23)
8	19-Mar	Thursday	Paper presentation #1
9	24-Mar	Tuesday	
9	26-Mar	Thursday	Paper presentation #2
10	31-Mar	Tuesday	
10	2-Apr	Thursday	Paper presentation #3
11	7-Apr	Tuesday	
11	8-Apr	Wednesday	Assignment #4 (due on Apr. 20)
11	9-Apr	Thursday	
13	21-Apr	Tuesday	
13	23-Apr	Thursday	Project report
13	24-Apr	Friday	
14	29-Apr	Wednesday	Final exam

Course policies.

- Policy for late homework assignments: a late homework submission (within a maximum of two days from the stipulated deadline) will result in a 20% penalization of the relevant work grade. A late submission exceeding two days from the stipulated deadline will not be considered and will thus result in a failing grade.
- Policy for missed presentations: with the exception of contingencies, students must be present for group presentations (both readings and projects).
- Do familiarize yourself with SUTD's Academic Integrity Policy, which applies to this course. Of course, we do not anticipate any problems with academic integrity. In the unlikely event that concerns do arise, all related materials will be referred to the Office of Student Affairs (OSA).
 - Collaboration: materials turned in as homework should be the result of one's own independent work. Only group reading assignments and projects are meant to be done in collaboration with others.
 - Plagiarism: to copy text or ideas from another source without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action.
 - Cheating: anyone caught cheating on the exam will receive a failing grade and will be reported to the OSA.
- If you need accommodations for any physical, psychological, or learning disability, please approach the teaching team.