

# **Math in the City Fall 2013**

in collaboration with the  
**Nebraska Natural Resources Districts**

**Alexandra Seceleanu and Katie Haymaker**

University of Nebraska–Lincoln





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by DAN CHARLES

August 27, 2013 8:03 AM

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- Spring 2013, we thought that data involving groundwater would make interesting projects.
  - The midwest had undergone a serious drought during the summer of 2012.
  - Stories about the depletion of the southern parts of the Ogallala Aquifer appeared in local and national papers.

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- May - Met with Dick, had initial discussions about the projects and data.
- August - Emailed with Dick about the data and planned the background material and intros to Latex and Excel.

COURSE  
SATISFIES  
ACE OUTCOME 10  
REQUIREMENT

## Math in the City (Math 435) for Fall 2013

a course in mathematical modeling in cooperation with the  
Nebraska Department of Natural Resources



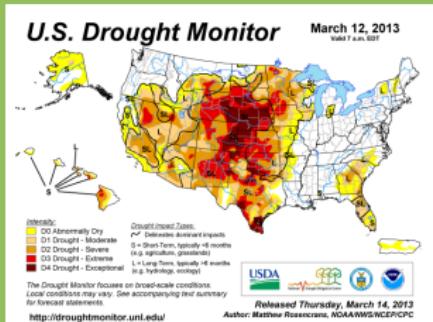
- ✓ Instructors will cover material on mathematical modeling and will give tutorials on any software to be used.
- ✓ Groups of students work on projects under the supervision of the instructors and outside collaborators.
- ✓ Course grades will be largely based on the mathematical modeling projects completed by the groups of students during the semester.

### Fall 2013 topics include:

- ✓ Defending against drought:  
how effective are our measures ?
- ✓ Predicting water supply and demand  
in the state of Nebraska.
- ✓ Using and protecting the Ogallala aquifer.

Class meets MWF 2:30 – 3:20 in 204 Oldfather Hall.

For questions, contact *Alexandra Seceleanu* at  
[aseceleanu@unl.edu](mailto:aseceleanu@unl.edu)



# Setting up the course

- Good communication is **key** for all parties involved. On the first day we distributed the student handbook and created a homework assignment about it.
- Set ground rules, expectations.
- Presented the topics for the projects and handed out the first homework assignment.

# Mathematical Background and Software

- For the first 6 weeks of classes Alexandra covered necessary background material during the Monday and Wednesday lectures. On Fridays we met in the lab and each group worked with the data.
- During the first couple of weeks Katie offered introductory LaTeX and Excel sessions.
- After the first 6 weeks, we met exclusively for project work.

# Homework

We gave four equally weighted homework assignments:

- ① Expert topic.
- ② Guesstimation problems.
- ③ Differential equations problems including a water flow problem
- ④ Problem using Euler's method and data from the 2006 project.

We emphasized that instructions = grading rubric.

# Groups



## Group work

- Forming groups. During the first week of classes students chose topics for their projects; having a common interest binds students together.
- Students exchanged contact information (phone, email, FB).
- Discussions with **each** group during class meeting time.
- Discussions with groups during their weekly **out-of-class** meetings were sometimes arranged as needed.
- It is essential for groups to meet **outside of class** on a regular basis.

# Organizing a schedule

- Deadlines are necessary to get the projects going.
- Gave students the schedule for the semester

<b>First project draft</b> (Introduction)	Sept 27
<b>Second project draft</b> (Methods & partial Results)	Oct 25
<b>Third project draft</b> (Results and Conclusions)	Nov 15
<b>Final project report due</b>	Nov 25

- For each project draft the expectations in terms of contents and organization were clearly outlined in a set of instructions.
- Each group received detailed feedback on every draft.
- For the third project draft each group received personalized instructions to match their results to date.

# Journals

Journal prompt:

- I learned ...
- I had difficulties with ...
- I need to ...
- This week, my contribution to the project was ...

Sample entry:

“ This week, we made huge progress on our project. We met Wednesday before class and Sunday afternoon, and we refined our model to incorporate the evapotranspiration rate (90-93% of precipitation, which I found surprisingly high) into the recharge rate, sense-checked the recharge rate to make sure we were comparing apples to apples, metaphorically—instead of comparing square miles with square inches, we translated all of the area into square inches, and in the cases expression of the recharge rate, where one case shows drought years, and one shows non-drought years, we made sure we were comparing  $\frac{dh}{dt}$  with  $\frac{dh}{dt}$ .”

# Project work

- Groups used different software to work on their projects, depending on the experience of the group members (SAS, Python, Mathematica).
- As the end of the project got closer, students needed to meet more outside of class as a group.
- The class visited Dick at the LPS NRD office on Nov. 25. Each group prepared a 10 minute mini-presentation, Dick showed them around the office, and they got feedback on their projects from NRD experts.

# Grade challenges

- Grade anxiety was common this year.
- After the first assignment, we offered a small extra credit assignment that also served as an intro to Beamer.
- Some students needed to have clear individualized assignments for project drafts in order to contribute to their group.
- Differences in expectations – academically (CS versus Math), and in group work.

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- ... students don't participate equally? Talk with each student and read the journals to assess each student's contribution.

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- Group dynamics can be particularly challenging.
- The original vision of each project doesn't always work out.  
(The most basic "box model" for modeling the groundwater data was difficult to implement due to the complicated aquifer system and missing data.)
- We utilized clear, precise instructions and deadlines.
- Students were involved in all steps of the work:
  - They obtained additional data (precipitation data, drought index data).
  - They posed and answered many of the questions.
  - They chose how to handle the data and what tools to apply.
  - In some cases, they sought advice from outside experts.

# Impressions of a Teaching Assistant

## General comments:

- MiTC provides great experience working with students one-on-one.
- Co-teaching was very valuable for me; we discussed many aspects of the course, grades for the drafts and participation scores.
- Working on feedback on paper drafts and presentations gave me a sense of what it is like to advise undergraduates.
- I value the support network that exists for this course – we sought advice from past instructors, experts in differential equations.

# Impressions of a Teaching Assistant

## Specific lessons:

- When groups are feeling frustrated, it is important to be enthusiastic and encouraging so they feel motivated to keep working hard.
- Dealing with group dynamics can be tricky; it requires flexibility and patience.
- Talking to both instructors and outside experts helped the groups come up with new ideas and directions.
- Helping the students to brainstorm about their projects was really fun.

# Impression of a new instructor

- Teaching MitC is not reserved to applied mathematicians, but be prepared to learn alongside (and from) the students.
- The hands-on, hands-off and the “whatever works” approaches.
- Overcoming negativity is a big part of the process.
- Working with students with diverse cultural backgrounds one needs to be sensitive and adjust the methods appropriately.
- One of the most rewarding aspects is when the groups become independent and are truly “experts” in their topic.

## Special thanks to

- Dick Ehrman, water resource specialist at LPS NRD
- Dr. Darryll Pederson and Dr. Steve Hu from UNL Earth and Atmospheric Sciences
- Stephen Hartke for assistance in finding our collaborator
- Mikil Foss for developing the course materials for the mathematical background
- Petronela Radu for providing the encouragement, advice and moral support we needed throughout the course