

Math in the City

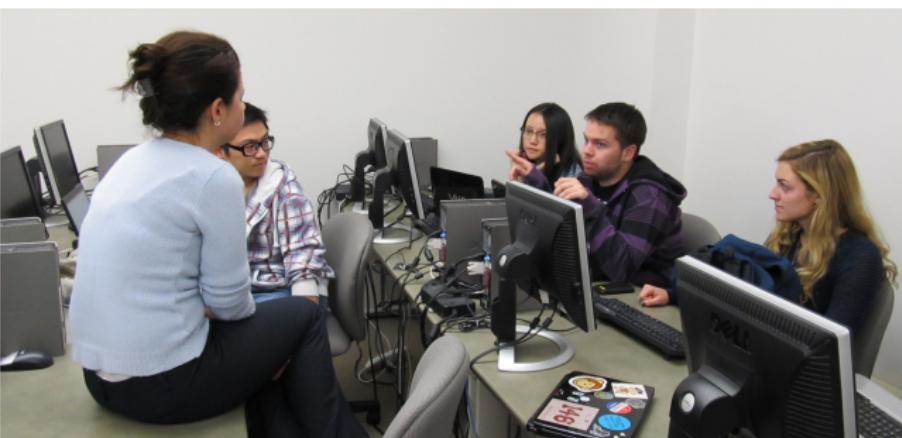
connecting the classroom to the local community
through mathematical modeling

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DUE (CCLI) 0941132



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What is Math in the City?

Course design:

- project-based, innovative course engaging students in a hands-on learning experience
- students use mathematical modeling to *understand current major societal issues* of local and national interest
- run in collaboration with *local businesses and government organizations* which provide data and act as consultants

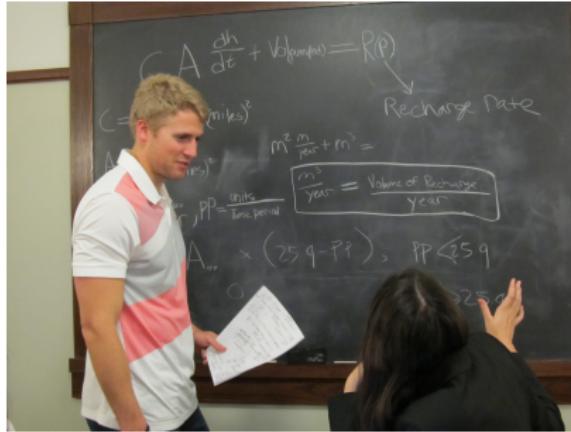
Benefits:

- engages students in a learning and discovery process
- teaches them how to adapt their knowledge to unfamiliar situations, tackle real-life problems and messy data

Why do we need Math in the City?

"Math in the City made you think. A lot."

Anonymous student feedback



Choosing a hot topic

- 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.



producers

Turning Off The Spigot In Western
Kansas Farmland

by DAN CHARLES

August 27, 2013 3:03 AM

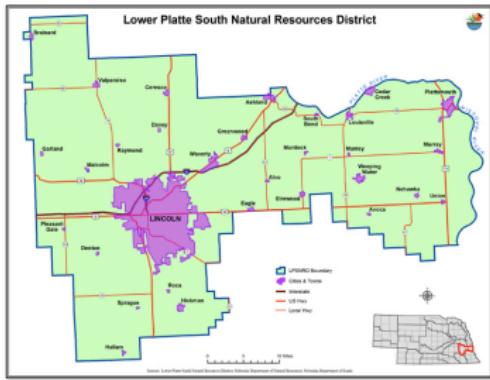
JournalStar.com

Well owners wonder where the water went

SEPTEMBER 09, 2013 4:00 AM • BY ART HOVEY / LINCOLN JOURNAL STAR

Working with an external collaborator

- Collaborator: Dick Ehrman, water resource specialist at the Lower Platte South Natural Resources District (LPS NRD)
- Provided data on groundwater level measurements from ~150 observation wells located in rural areas around Lincoln, NE

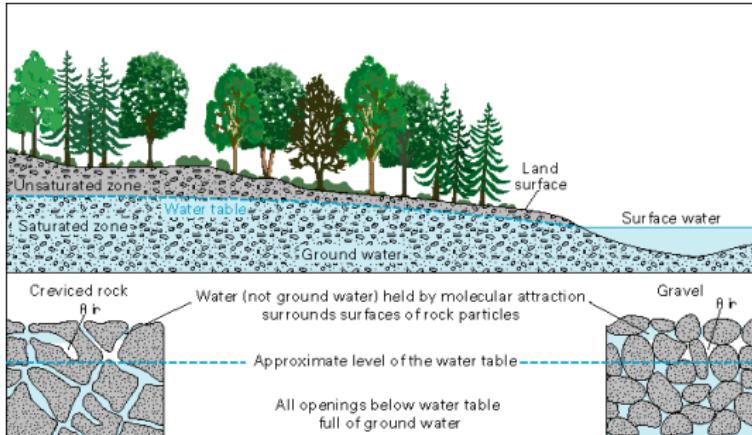


Mathematical background

- Basics of Ordinary Differential Equations
- Ground water balance equation

$$\frac{\Delta Vol}{\Delta t} = H_{in} - H_{out} + V_{in} - V_{out}.$$

- V_{in} included precipitation, V_{out} included usage for crops and personal water use, and other water loss. $H_{in} - H_{out}$ is difficult to measure.



- All groups were taught scientific typesetting using LaTeX and basic data analysis using Excel
- Groups used different software to work on their projects, depending on the experience of the group members
 - SAS
 - Python
 - Mathematica
 - R



Groups



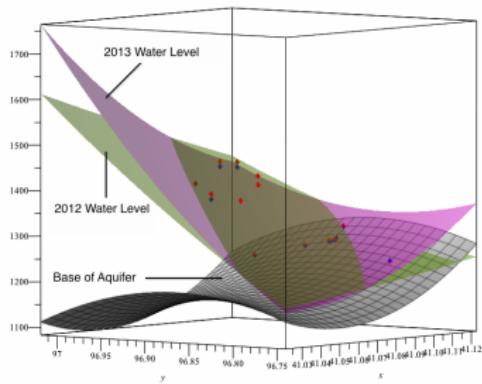
Projects I - groundwater recharge

- ① Predicting Groundwater Response to Drought

Value added: de-mystified a complicated drought index

- ② Hydrological Variations in the Lower Platte South Region

Value added: accurate estimates of future groundwater levels



Error:

- 2% deep wells
- 6% shallow wells.

Very good!

Projects II - groundwater usage

- ③ Sustainability of Groundwater Resources in the Crete-Princeton-Adams Aquifer
Value added: suggested more water-efficient crop choices
- ④ Water Usage in Upper Big Blue Natural Resources District
Value added: simple model that can easily be implemented by farmers



Social values emphasized

Using & protecting the natural resources available in Nebraska:

- Evaluating sustainability of groundwater resources
- Formulating solutions and recommendations to the authorities towards avoiding over-usage of water resources

Broader aspects:

- Understanding the local economy and its main actors.
- Understanding the work environment and value of NRD's.

Universal value:

- Promoting awareness towards environmental issues.

What the students appreciated most in 2013

- "I think one of the best experiences came with having to learn how to navigate a group research project that started with an **open-ended question and a large quantity of data.**"
- "**My favorite part was working with the Natural Resources Districts** and being able to give a preview of the presentation to LPS because it made me realize how realistic and relevant the work is that we did this semester."
- "I really enjoyed learning and working with my teachers and I **liked the sense of community** that came from doing Math in the City with everyone."

Final presentations



Thank you!

<http://www.math.unl.edu/~math-mitc/>