

# Online homework in Mathematics using WeBWorK

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# Motivation

## Issues


- Free up TA time to use it more effectively and efficiently while continuing to provide feedback on homework.

## Approach

- WeBWorK, an open-source online homework system supported by the Mathematical Association of America and the NSF.

# What is WeBWorK?

An open-source online homework tool . . .

 **WeBWorK**

Logged in as student.  
[Log Out](#)

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## HW3

[Download a hardcopy of this homework set.](#)

Name	Attempts	Remaining	Worth	Status
<a href="#">Problem 1</a>	0	unlimited	1	0%
<a href="#">Problem 2</a>	0	unlimited	1	0%
<a href="#">Problem 3</a>	0	unlimited	1	0%
<a href="#">Problem 4</a>	0	unlimited	1	0%
<a href="#">Problem 5</a>	0	unlimited	1	0%
<a href="#">Problem 6</a>	0	unlimited	1	0%
<a href="#">Problem 7</a>	0	unlimited	1	0%

**Set Info**

**WeBWorK assignment number HW3 is due : 05/22/2008 at 05:30am EDT.**

The [main page](#) for the course contains the syllabus, grading policy and other information.

The primary purpose of WeBWorK is to let you know that you are getting the correct answer or to alert you if you are making some kind of mistake. Usually you can attempt a problem as many times as you want before the due date. However, if you are having trouble figuring out your error, you should consult the book, or ask a fellow student, one of the TA's or your professor for help. Don't spend a lot of time guessing -- it's not very efficient or effective.

Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as  $2 \wedge 3$  instead of 8,  $\sin(3 * \pi/2)$  instead of -1,  $e \wedge (\ln(2))$  instead of 2,  $(2 + \tan(3)) * (4 - \sin(5)) \wedge 6 - 7/8$  instead of 27620.3413, etc. Here's the [list of the functions](#) which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professors.

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Page generated at 10:22am on May 12, 2008  
WeBWorK © 2000-2006 The WeBWorK Project

# WeBWorK offers:

- Answer styles
  - Numbers (with specified error tolerance)
  - Mathematical expressions
  - Words
  - Multiple Choice
- Randomized parameters: can generate unique numbers and graphs for each student
- Set number or unlimited attempts, with instant feedback
- Large existing problem database of math problems
- Quiz mode for limited-time assignments

# Implementation

WeBWorK is currently (or has been) used in

MATH 100/180 – Differential Calculus

MATH 104/184 – Differential Calculus

MATH 110 – Differential Calculus

MATH 101 – Integral Calculus

MATH 105 – Integral Calculus

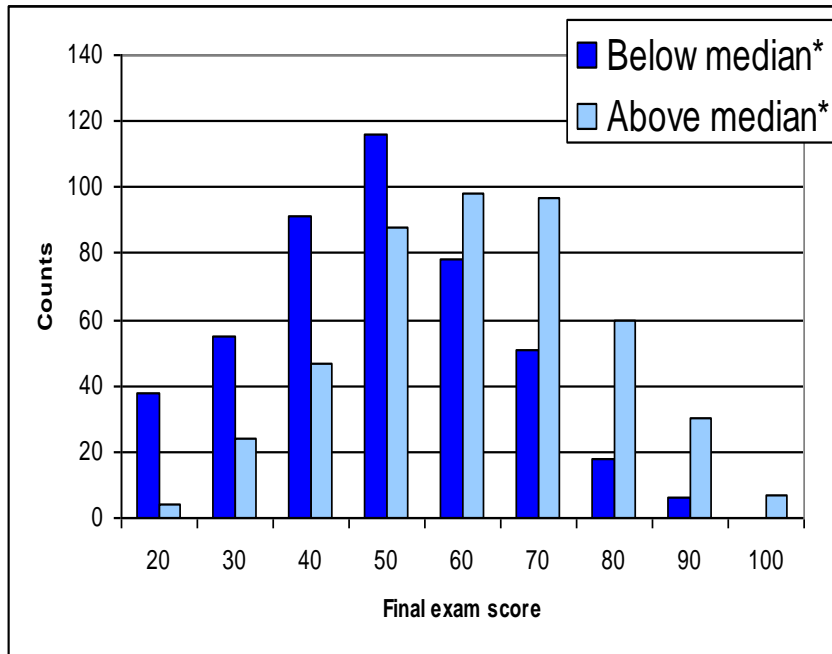
Course implementation:

- Weekly assignments worth up to 10% of final grade
- Open ended questions with randomized numbers
- Unlimited attempts (7 attempts - tried in one course)
- Common assignments to all sections in most courses
- Dedicated TA per course (in most courses) to handle emails from students

# Correlation with marks

(MATH 104/184)

- Average WeBWorK score 83.5%
- Average score on written assignments 80.3%



Online homework does not lead to more cheating

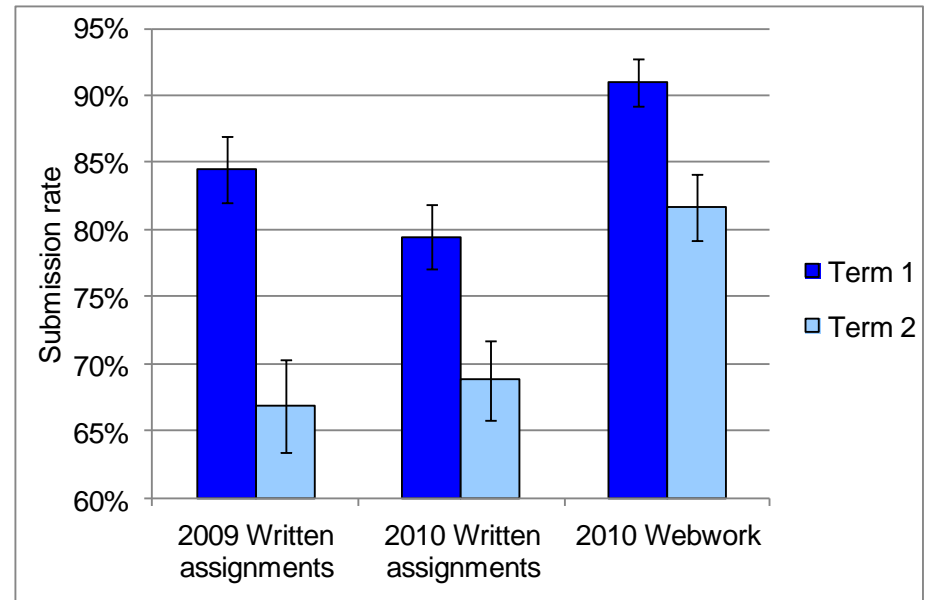
$\geq 90\%$ on homework	$\leq 30\%$ on exam
WeBWorK	6% of students
Handed-in	5% of students

\*median of overall WeBWorK score

# Assignment submission rate – Two-term course

- 2009 Written:
  - routine + challenging problems
- 2010 Written:
  - challenging problem
- 2010 WeBWorK:
  - routine problems

Submitted means received a mark of >20%

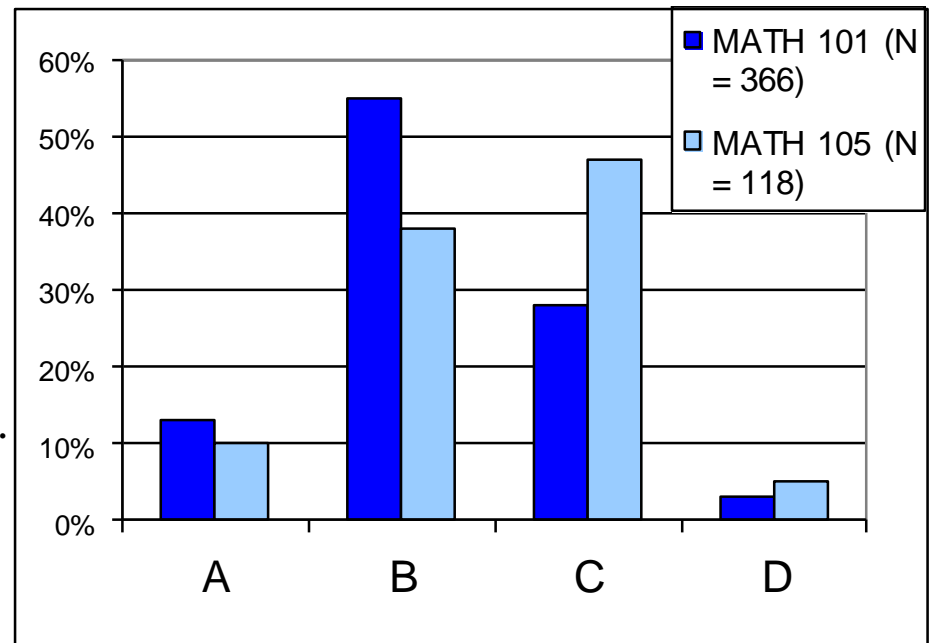


Students are more likely to do routine-type problems throughout the course if assigned in WeBWorK rather than in written assignments.

# Self-reported behaviour

“Which of the following statements best describes your approach to answering questions on WeBWork?”  
(online survey)

- A) I answer most of the questions correctly at my first or second attempt.
- B) I often rework the same problem a few times on my own until I get the correct answer.
- C) I prefer to consult resources (notes, etc.) or ask for help if I can't find the correct answer right away.
- D) I often give up if I can't find the correct answer after a few attempts.



MATH 101 – unlimited attempts  
MATH 105 – 7 attempts max



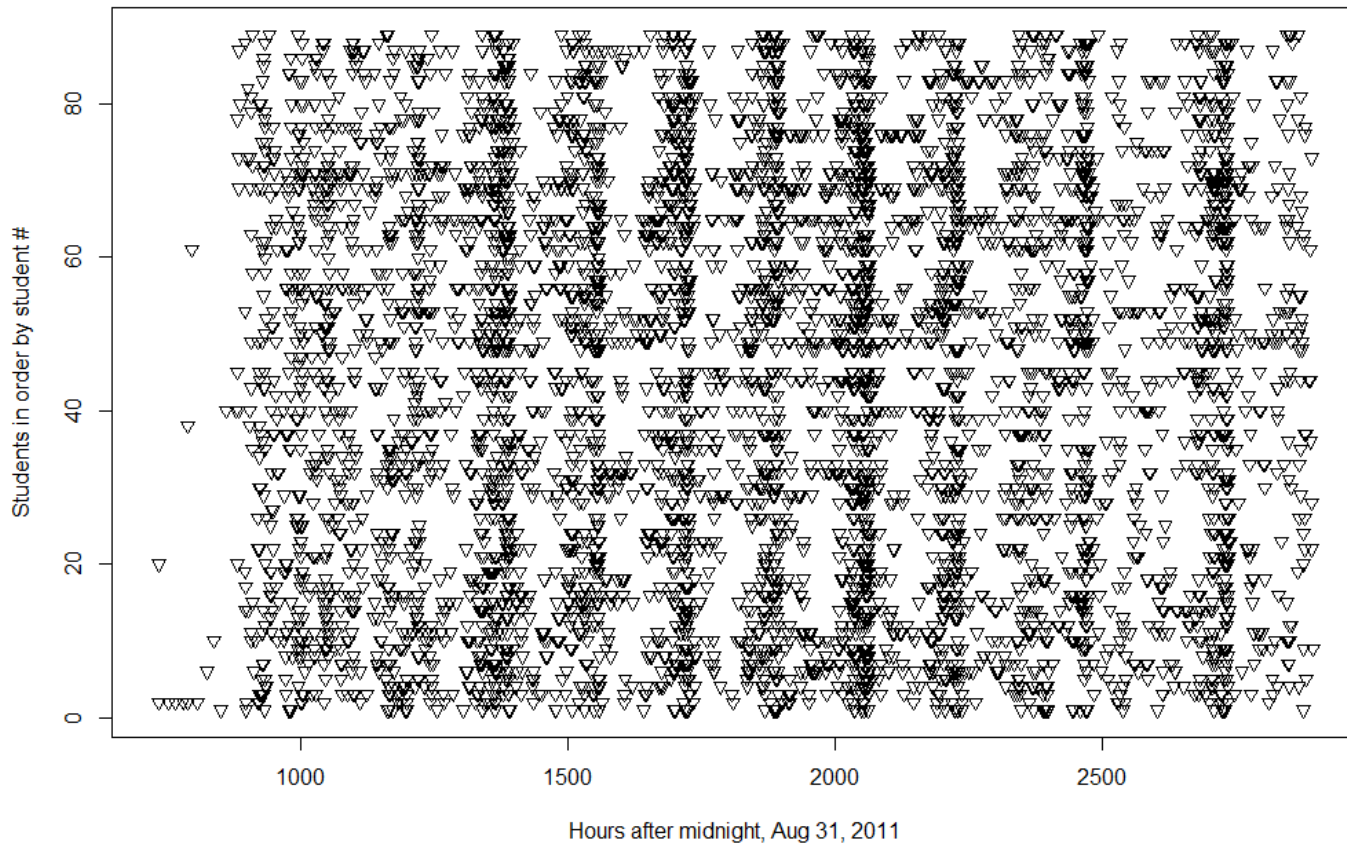
# Self-reported behaviour: Interpretation

- Only a small percentage of students would give up if they can't answer the question.
- Immediate feedback supports a cycle of personal revision that would not otherwise take place with regular TA-graded assignments.
- A fixed number of attempts may affect student behaviour: They prefer to seek help from external resources rather than trying to figure out the answer on their own.

# “Email your instructor” option

- Only about 30% of students used it (MATH 101, self-reported)
- Email traffic was low (~20 emails per week)
- Reasons:
  - don’t know how it works
  - prefer to seek immediate feedback

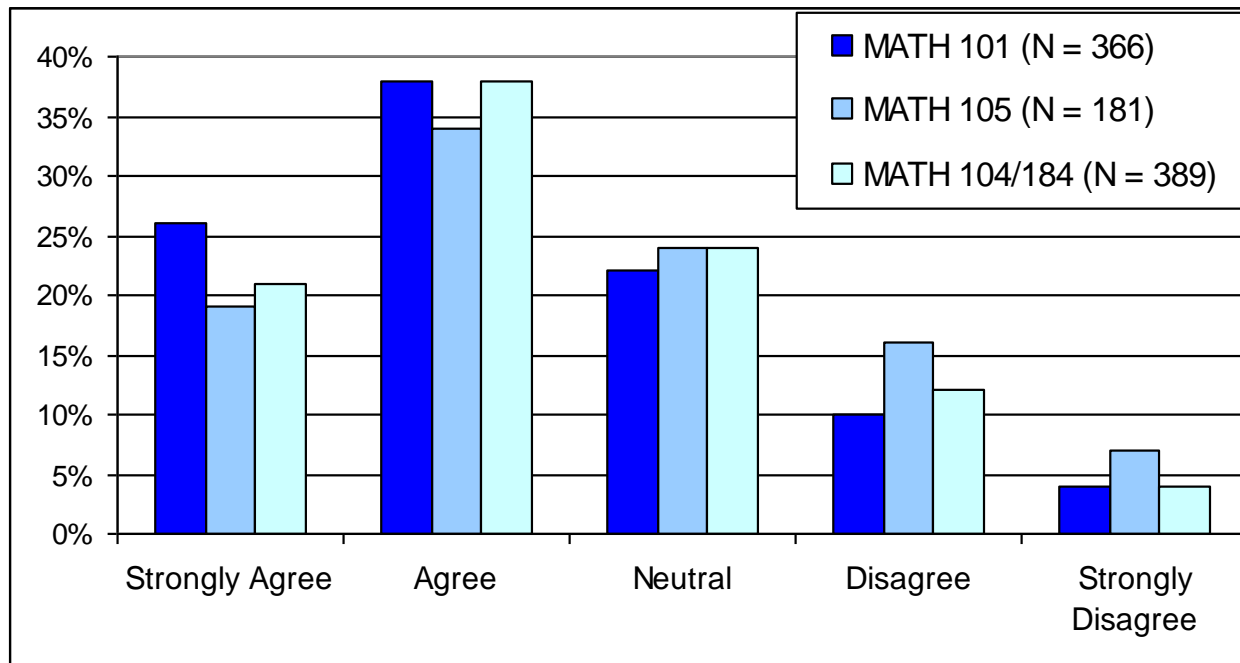
# Student Login Sample



Sample from Math 104 Section; each triangle is a login to WeBWorK.

# Students' attitudes about immediate feedback

"The immediate responses I get from WeBWork help me learn the course material." (online survey)



# Students' Attitudes about online vs paper-based homework

"If you were to take a similar course again, which homework program would you prefer?"  
(online survey)

	M101	M105	M104/184
Only written homework	10%	21%	18%
Some implementation involving WeBWorK*	81%	72%	78%
No homework at all	9%	7%	4%

# Future work

- Analyse types of errors
- Develop custom remedial assignments based on diagnostic results
- Extend to more courses
- Develop additional problem data base