Taking MAB122/127 Online

Douglas Stebila

School of Mathematical Sciences, QUT

Friday, June 29, 2012

Outline

1. Facebook group
2. Online consultation hours
3. Online mathematics software
4. Online assessment
5. Online diagnostic tests
6. Conclusion
7. Demo of WeBWorK system

Acknowledgements

Dr Beth Addison-Smith
Helped setup WeBWorK
system; diagnostic tests;
co-taught MAB122/127.

Dr Glenn Fulford
Initiated QUT's investigation
into online assessment.

MAB122/127

- ▶ "Linear Algebra and Multivariable Calculus" / "Mathematics for Engineering 2"
- ▶ 250 students: 70% engineers, ∼15% maths, ∼15% others
- ▶ 6 weeks linear algebra (systems of equations, row reduction, determinants, vector equations, inner product, row/column space, linear transformations, eigenvalues/vectors)
- ▶ 6 weeks calculus (polar/spherical coordinates, level curves, multiple integrals, order of integration, partial differentiation, tangents, gradients, parametric equations)
- ▶ 20% written assessment (best 4 out of 5)
- ▶ 20% online assessment (best 4 out of 5)
- ▶ 60% final exam

Facebook group

Douglas Stebila

FAVOURITES
News Feed
Messages
Events
Close friends   20+
Photos

GROUPS
QUT MAB122/MAB127 ...
MAB127 Mathematics fo...
Fass Theatre Com...   16
Massey Mathlete Alumni
University of Wate...   20+
Create group

APPS
Apps and Games
Pokes
The Travel List Challenge
Where I've Been

FRIENDS
Family   20+
Queensland Unive...   8
Sun Microsystems
Brisbane Area   18

Friends on Chat

QUT
MAB122
MAB127

Queensland University of Technology

2012/S1

Algebra and Analytic Geometry

Mathematics for Engineering 2

QUT MAB122/MAB127 2012/S1   About   Events   Photos   Files   ✓ Notifications

Write post   Add photo/video   Ask question   Upload file

166 members · Chat

Write something...

+ Add friends to group

yesterday at 11.35.....

Sponsored   See all

http://desibbrg.org/images/51329874056304710912.jpg
desibbrg.org

Last five minutes
Of exam

Like · Comment · Follow post · Share · 14 June at 13:10

4 people like this.

Write a comment...

Douglas Stebila changed the group privacy setting to Closed.

Chat (7)

Overview

- ▶ Created a Facebook group specifically for MAB122/127 this semester (in contrast to long-running student MAB127 group).
- ▶ Advertised group to students via Week 1 document and Blackboard.
- ▶ 173 students joined.
- ▶ Primary goal: foster discussion and answer questions.

Participation

- ▶ 173 students on Facebook group (out of 252 enrolled)
- ▶ 315 stories
    - ▶ 72 stories posted by teaching staff
- ▶ 1825 comments
    - ▶ 177 comments posted by teaching staff

My key principles

- No "Facebook-exclusive content".
- Try to avoid cutting off threads of discussion.
  - A few times when students started saying more than was appropriate for academic integrity.
  - A few times with language, particularly in the days leading up to the exam.
- I won't accept friend requests from students.

Feedback (end-of-semester survey)

- ▶ 82% of students reported referring to Facebook group frequently.
- ▶ Students said:
  - ▶ "it made the course seem more personable and the content more tangible"
  - ▶ "if the lecturers didn't use the Facebook group it would not have been nearly as effective"
  - ▶ "was helpful when struggling with a question peers would help"
  - ▶ "its great if you need help with a particular question, or want to get together and study with other MAB127 members"
  - ▶ "never actually bothered with the Facebook group... I'm 33 and a bit of a social media dinosaur"

Recommendations

- ▶ Need to be clear on academic integrity rules from the start.
- ▶ Students respond to "tone" from instructors on Facebook.
- ▶ Running your own Facebook group better than using existing Facebook groups.
- ▶ Use a "closed group" or even a "secret group" for privacy reasons.
- ▶ Be aware of QUT's social media guidelines.[1]
- ▶ Not a problem to use your personal Facebook account instead of a separate account; but be sure to configure your privacy settings appropriately.
- ▶ Should shut down group after end of semester; not necessarily immediately during/after exam.

---

[1]http://www.els.qut.edu.au/docs/SocialMediaGuidelines.pdf

My opinion

Excellent tool for large classes; I would definitely use it again.

My opinion

Excellent tool for large classes; I would definitely use it again.

Pros:

- ▶ Gave me an excuse to check Facebook at the office. ☺
- ▶ Very fulfilling to see students working outside of structured lecture time.
- ▶ Provides immediate feedback.
- ▶ Easy way of communicating with students.

My opinion

Excellent tool for large classes; I would definitely use it again.

Pros:

- ▶ Gave me an excuse to check Facebook at the office. ☺
- ▶ Very fulfilling to see students working outside of structured lecture time.
- ▶ Provides immediate feedback.
- ▶ Easy way of communicating with students.

Cons:

- ▶ Blurs work/home balance because you see notifications from Facebook group when checking your own personal account outside of work hours.
- ▶ Excludes students who choose not to use Facebook.
- ▶ Students can be very casual on Facebook.

My opinion

Excellent tool for large classes; I would definitely use it again.

Pros:

- ▶ Gave me an excuse to check Facebook at the office. ☺
- ▶ Very fulfilling to see students working outside of structured lecture time.
- ▶ Provides immediate feedback.
- ▶ Easy way of communicating with students.

Cons:

- ▶ Blurs work/home balance because you see notifications from Facebook group when checking your own personal account outside of work hours.
- ▶ Excludes students who choose not to use Facebook.
- ▶ Students can be very casual on Facebook. ("u da man dougie!!!")

Online consultation hours

Overview

2011/S1

- ▶ normal consultation hour
- ▶ 1 hour per week, immediately after one lecture
- ▶ 3 students total over 7 weeks (two of which were trying to hand in late assignments)

2012/S1

- ▶ online consultation hour
- ▶ 1 hour per week, Thursday at 6pm
- ▶ using Blackboard Collaborate

Technology

Blackboard Collaborate

- ► Cross-platform (Java) online application; works on most desktop computers but not mobile devices
- ► Text chat; multi-user voice chat; video
- ► Screen sharing
- ► Built in to Blackboard; practice mode available outside of Blackboard[2]

iPad with AirSketch[3]

- ► AirSketch is an iPad app that allows you to draw on the iPad and display that canvas on a web browser on a nearby computer
- ► Draw on iPad $\rightarrow$ Display on my computer's web browser $\rightarrow$ Share screen using Blackboard Collaborate

---

[2]http://www.els.qut.edu.au/blendedlearning/collaborate/
[3]http://www.qrayon.com/home/airsketch/

$$f(x) = 2x^2$$

$$\frac{df}{dx} = 4x$$

Participation

- ▶ Usually around 4–8 students would drop by over the 1 hour duration.
- ▶ Some students would be "lurkers", hanging around for the whole session and mostly watchling/listening.
- ▶ Others would ask their question and then leave promptly.
- ▶ Estimate 20–30 different students took part over the semester.

Feedback (end-of-semester survey)

Student comments:

Which type of consultation hours would you prefer?
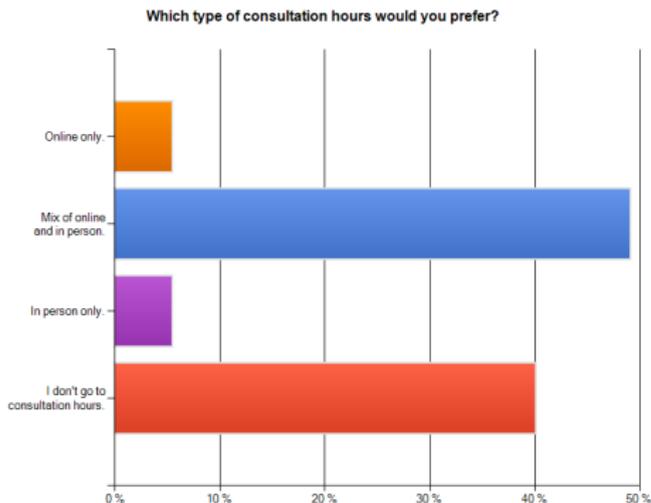
- ▶ **Liked it**: "online was very helpful"

- ▶ **Timing problems**: "too early in the evening"; "clashed with other commitments"; "was working whenever consultation was on"

- ▶ **Technology problems**: "I could not use online consultation for whole semester as I could not get into it"

- ▶ **Not needed**: "there were enough resources (including the Facebook page) to be able to answer any question I had"; "I know I should use consultation hours but I never actually got around to it"

My opinion

- ▶ I had few problems with Blackboard Collaborate.
- ▶ Using iPad AirSketch was not entirely reliable.
- ▶ Took me a while to be comfortable with when was the right time to "voice chat" versus "text chat".
- ▶ Numerically, much better attendance than when I had in-person consultation hours.
- ▶ Online much easier for students to attend than in person.
- ▶ Biggest drawback: no easy way for students to show you their work.
- ▶ Ideally: 1 hour online, 1 hour in person. But if I had to pick only one, I would probably go with in person, especially when used in conjunction with Facebook group.

Online mathematics software

Online mathematics software

- ► Generate randomized practice, homework, and quiz questions for individual students.
  - ► randomize numbers in questions but use same question template
  - ► randomize questions chosen from a collection of selected questions
- ► Interpret students answers' mathematically using a computer algebra system.
- ► Allow students multiple attempts, optionally with penalties.
- ► Give students immediate feedback on correctness.
- ► Allow hints to be displayed based on answers.

Systems

Open-source

- ► WeBWorK
- ► LON-CAPA
- ► STACK with Moodle

Commercial

- ► MyMathLab (Pearson)
- ► WileyPlus (Wiley)
- ► WebAssign
- ► Maple TA

Usage according to 2010 AMS survey of US mathematics departments:[4]

1. MyMathLab: 230,000 enrolments
2. WeBWorK: >100,000 enrolments; more likely used at doctoral institutions than undergrad-only institutions
3. WebAssign: <100,000 enrolments

---

[4]E. Kehoe. AMS Homework Software Survey, *Notices of the AMS*, June/July 2010, pp. 753–757.

Open-source systems

WeBWorK

- ▶ Started in 1994.

- ▶ Supported by Mathematical Association of America.

- ▶ Stand-alone tool.

- ▶ Written in Perl with custom math engine.

- ▶ Large body of users.

- ▶ Problem library of >24k questions in 18 subjects, hundreds of categories.

Open-source systems

WeBWorK

- ▶ Started in 1994.

- ▶ Supported by Mathematical Association of America.

- ▶ Stand-alone tool.

- ▶ Written in Perl with custom math engine.

- ▶ Large body of users.

- ▶ Problem library of >24k questions in 18 subjects, hundreds of categories.

LON-CAPA

- ▶ Started in 1992.

- ▶ Full learning management system.

- ▶ Written in Perl with custom math engine.

- ▶ Not just math
  astronomy, biology, business, chemistry, civil engineering, computer science, family & child ecology, geology, human food & nutrition, human medicine, medical technology, physics, psychology

- ▶ Large body of users.

- ▶ Library available only upon joining LON-CAPA cluster.

Open-source systems

WeBWorK

- ► Started in 1994.

- ► Supported by Mathematical Association of America.

- ► Stand-alone tool.

- ► Written in Perl with custom math engine.

- ► Large body of users.

- ► Problem library of >24k questions in 18 subjects, hundreds of categories.

LON-CAPA

- ► Started in 1992.

- ► Full learning management system.

- ► Written in Perl with custom math engine.

- ► Not just math
  astronomy, biology, business, chemistry, civil engineering, computer science, family & child ecology, geology, human food & nutrition, human medicine, medical technology, physics, psychology

- ► Large body of users.

- ► Library available only upon joining LON-CAPA cluster.

STACK

- ► Started in mid 2000s.

- ► Requires external learning management system Moodle.

- ► Written in PHP, uses Maxima engine underneath.

- ► Small body of developers and users.

- ► No problem library.

WeBWorK vs. STACK

- ▶ We installed both WeBWorK and STACK.
- ▶ We created practice problems for MAB121/126 exam review in Summer 2011 as a trial to (a) become familiar with the two systems and (b) see which was easier to work with, for us and for students.
- ▶ We found WeBWorK much better to work with than STACK:
  - ▶ Installation of (standalone) WeBWorK easier and more reliable than (3-tier) STACK.
  - ▶ WeBWorK had a problem library, STACK did not.
- ▶ Our gigantic 5-student sample reported WeBWorK and STACK equally easy to use.
- ▶ No opinion on WeBWorK vs. commercial systems.

WeBWorK

Not logged in.

Main Menu

Courses

WeBWorK

WeBWorK

Welcome to WeBWorK.

Courses

- 2012S1_MAB122_127
- MAB122_127_Practice
- Maths_Diagnostic
- QUTrevision

Site Information

This is the WeBWorK system for the **QUT School of Mathematical Sciences**. Students enrolled in certain QUT maths units can use this site to take diagnostic tests quizzes and do practice questions and homework.

Select the unit you wish to use from the list at left. You will be redirected to QUT's single sign-on system to sign in with your standard QUT username and password.

If you have trouble accessing this site or have any questions, please contact your unit's instructor / coordinator, or use the "Email instructor" button from within the system. Do not call the QUT Help Desk — they won't be able to help you with this system.

WeBWorK

QUT Queensland University of Technology

Logged in as stebila.
Log Out

WeBWorK → 2012S1_MAB122_127

2012S1 MAB122 127

Main Menu

Courses
Homework Sets
Password/Email
Grades
Instructor Tools
  Classlist Editor
  Hmwk Sets Editor
  Library Browser
  Statistics
  Student Progress
  Scoring Tools
  Email
  File Manager
  Course Configuration
  Help
Report bugs

Sel.	Name	Status
☐	WeBWorK tutorial	closed, answers available
☐	Week 3	closed, answers available
☐	Week 5	closed, answers available
☐	Week 8	closed, answers available
☐	Week 10	closed, answers available
☐	Week 12	closed, answers available

Download Hardcopy for Selected Sets

Email instructor

Course Info [edit]

READ THIS FIRST!

Before doing something that counts for marks, we highly recommend you practice using this system by taking the **WeBWorK tutorial**. It doesn't count for anything.

Tips and hints

- Work out your answer using pencil and paper, just like you would for normal homework.
- Use the "Preview" function before submitting to make sure that you entered your answers in a format that the system understands.

If you have any questions, please use the "Email instructor" button to send an email to your instructor.

https://fastres01.qut.edu.au/webwork2/2012S1_MAB122_127/Week_3/?effectiveUser=stebila&u

Google

WeBWorK

QUT Queensland University of Technology

▲ Up

Main Menu

Courses
Homework Sets
  ◦ Week 3
Password/Email
Grades
Instructor Tools
  ◦ Classlist Editor
  ◦ Hmwk Sets Editor
    ▪ Week 3
  ◦ Library Browser
  ◦ Statistics
    ▪ Week 3
  ◦ Student Progress
    ▪ Week 3
  ◦ Scoring Tools
  ◦ Email
  ◦ File Manager
  ◦ Course Configuration
  ◦ Help ❓
Report bugs

WeBWorK → 2012S1_MAB122_127 → Week_3

Week 3

This set is visible to students.

Download a hardcopy of this homework set.

Name	Attempts	Remaining	Worth	Status
Problem 1	1	4	1	0%
Problem 2	5	0	3	33%
Problem 3	5	0	2	100%
Problem 4	1	4	2	0%

Email instructor

Set Info [edit]

This problem set is due : 20/03/2012 at 12:00pm Australia/Brisbane.

Before submitting you answer to each problem, use the "Preview Answer" feature to see how WeBWorK interprets your answer.

The system will tell you if you got the question right or wrong. If you get it wrong, you can try again up to 2 more times (3 times total).

This set is visible to students.

Sets

WeBWorK tutorial
Week 3
Week 5
Week 8
Week 10
Week 12

Page generated at 28/06/2012 at 09:56pm Australia/Brisbane

WeBWorK © 2000-2007 The WeBWorK Project

Display Options

View equations as:
○ MathJax
● images
○ jsMath

WeBWorK

QUT Queensland University of Technology

Logged in as stebila.
Log Out

◀ Previous   ▲ Prob. List   Next ▶

Main Menu

Courses
Homework Sets
  Week 3
    Problem 3
Password/Email
Grades
Instructor Tools
  Classlist Editor
  Hmwk Sets Editor
    Week 3
      3
  Library Browser
  Statistics
    Week 3
  Student Progress
    Week 3
  Scoring Tools
  Email
  File Manager
  Course Configuration
  Help ❓

Report bugs

Week 3: Problem 3

This set is visible to students.

(2 pts) **local/setWeek_3/Anton.3.3.11,13.pg**

Let $\mathbf{u} = [-3, -4, 3]$ and $\mathbf{v} = [-5, 5, 8]$.

Find the distance between $\mathbf{u}$ and $\mathbf{v}$, and compute the cosine of the angle θ between $\mathbf{u}$ and $\mathbf{v}$.

You can enter square roots using the notation sqrt(1234)

$d(\mathbf{u}, \mathbf{v}) =$ `sqrt(110)`

$\cos(\theta) =$ `19/sqrt(34)*sqrt(114`

Note: *You can earn partial credit on this problem.*

Edit this problem

☐ Show correct answers ☐ Show Solutions

[Preview Answers] [Check Answers]

You have attempted this problem 5 times.
Your overall recorded score is 100%.
This homework set is closed.

[Show Past Answers]

[Email instructor]

Problems

Problem 1
Problem 2
Problem 3
Problem 4

Display Options

View equations as:
○ MathJax
● images
○ jsMath

This set is visible to students.

https://fastres01.qut.edu.au/webwork2/2012S1_MAB122_127/Week_3/3/

WeBWorK

QUT Queensland University of Technology

◀ Previous | ▲ Prob. List | Next ▶

Main Menu

Courses
Homework Sets
  Week 3
    Problem 3
Password/Email
Grades
Instructor Tools
  Classlist Editor
  Hmwk Sets Editor
    Week 3
      3
  Library Browser
  Statistics
    Week 3
  Student Progress
    Week 3
  Scoring Tools
  Email
  File Manager
  Course Configuration
  Help ⓘ
Report bugs

WeBWorK → 2012S1_MAB122_127 → Week_3 → 3

Week 3: Problem 3

This set is visible to students.

PREVIEW ONLY — ANSWERS NOT RECORDED

Entered	Answer Preview
10.4881	$\sqrt{110}$
34.791	$\frac{19}{\sqrt{34}}\sqrt{114}$

(2 pts) **local/setWeek_3/Anton.3.3.11,13.pg**

Let $\mathbf{u} = [-3, -4, 3]$ and $\mathbf{v} = [-5, 5, 8]$.

Find the distance between $\mathbf{u}$ and $\mathbf{v}$, and compute the cosine of the angle θ between $\mathbf{u}$ and $\mathbf{v}$.

You can enter square roots using the notation sqrt(1234)

$d(\mathbf{u}, \mathbf{v}) =$ `sqrt(110)`

$\cos(\theta) =$ `19/sqrt(34)*sqrt(114`

Note: *You can earn partial credit on this problem.*

Edit this problem

Problems

Problem 1
Problem 2
Problem 3
Problem 4

Display Options

View equations as:
○ MathJax
● images
○ jsMath

☐ Show correct answers ☐ Show Solutions

WeBWorK

QUT Queensland University of Technology

WeBWorK → 2012S1_MAB122_127 → Week_3 → 3

Main Menu

Courses
Homework Sets
  Week 3
    Problem 3
Password/Email
Grades
Instructor Tools
  Classlist Editor
  Hmwk Sets Editor
    Week 3
      3
  Library Browser
  Statistics
    Week 3
  Student Progress
    Week 3
  Scoring Tools
  Email
  File Manager
  Course Configuration
  Help ❓
Report bugs

Week 3: Problem 3

This set is visible to students.

Entered	Answer Preview	Result
10.4881	$\sqrt{110}$	correct
34.791	$\frac{19}{\sqrt{34}}\sqrt{114}$	incorrect

At least one of the answers above is NOT correct.

(2 pts) **local/setWeek_3/Anton.3.3.11,13.pg**

Let $\mathbf{u} = [-3, -4, 3]$ and $\mathbf{v} = [-5, 5, 8]$.

Find the distance between $\mathbf{u}$ and $\mathbf{v}$, and compute the cosine of the angle θ between $\mathbf{u}$ and $\mathbf{v}$.

You can enter square roots using the notation sqrt(1234)

$d(\mathbf{u}, \mathbf{v}) =$ `sqrt(110)`

$\cos(\theta) =$ `19/sqrt(34)*sqrt(114`

Note: *You can earn partial credit on this problem.*

Edit this problem

Problems

Problem 1
Problem 2
Problem 3
Problem 4

Display Options

View equations as:
○ MathJax
● images
○ jsMath

☐ Show correct answers ☐ Show Solutions

Scoring Tools
Email
File Manager
Course Configuration
Help

Report bugs

At least one of the answers above is NOT correct.

(2 pts) **local/setWeek_3/Anton.3.3.11,13.pg**

Problems

Problem 1
Problem 2
Problem 3
Problem 4

Display Options

View equations as:
○ MathJax
● images
○ jsMath

Show saved answers?
● Yes ○ No

Apply Options

Let $\mathbf{u} = [-3, -4, 3]$ and $\mathbf{v} = [-5, 5, 8]$.

Find the distance between $\mathbf{u}$ and $\mathbf{v}$, and compute the cosine of the angle θ between $\mathbf{u}$ and $\mathbf{v}$.

You can enter square roots using the notation sqrt(1234)

$d(\mathbf{u}, \mathbf{v}) =$ | sqrt(110)

$\cos(\theta) =$ | 19/sqrt(34)*sqrt(114

SOLUTION

The distance between $\mathbf{u}$ and $\mathbf{v}$ is given by

$$d(\mathbf{u}, \mathbf{v}) = \sqrt{(-3+5)^2 + (-4-5)^2 + (3-8)^2} = \sqrt{110}$$

Recall the formula

$$\mathbf{u} \cdot \mathbf{v} = \|\mathbf{u}\| \, \|\mathbf{v}\| \cos(\theta)$$

Hence, $\cos(\theta) = \dfrac{\mathbf{u} \cdot \mathbf{v}}{\|\mathbf{u}\| \, \|\mathbf{v}\|} = \dfrac{19}{\sqrt{34}\sqrt{114}}$.

Note: *You can earn partial credit on this problem.*

Edit this problem

☐ Show correct answers ☑ Show Solutions

Preview Answers   Check Answers

You have attempted this problem 5 times.
Your overall recorded score is 100%.

WeBWorK → 2012S1_MAB122_127 → Week_10 → 1

Week 10: Problem 1

This set is visible to students.

(2 pts) **local/setWeek_10/prob1.pg**

Suppose R is the solid bounded by the plane $z = 5x$, the surface $z = x^2$, and the planes $y = 0$ and $y = 5$. Write a triple integral in the form below to find the volume of the solid R.

Hint: First find where $z = 5x$ intersects with the surface $z = x^2$.

$$\iiint\limits_{R} dV = \int_A^B \int_C^D \int_E^F \boxed{} \, dz \, dy \, dx$$

with limits of integration

A = [   ]

B = [   ]

C = [   ]

D = [   ]

E = [   ]

F = [   ]

Edit this problem

☐ Show correct answers

Preview Answers | Check Answers

Main Menu

Courses
Homework Sets
  Week 10
    Problem 1
Password/Email
Grades
Instructor Tools
  Classlist Editor
  Hmwk Sets Editor
    Week 10
      1
  Library Browser
Statistics
  Week 10
  Student Progress
    Week 10
Scoring Tools
Email
File Manager
Course Configuration
Help ❓

Report bugs

Problems

Problem 1
Problem 2
Problem 3
Problem 4

Display Options

View equations as:
○ MathJax
◉ images
○ jsMath

WeBWorK

QUT Queensland University of Technology

Main Menu

Courses
Homework Sets
  Week 12
Password/Email
Grades
Instructor Tools
  Classlist Editor
  Hmwk Sets Editor
    Week 12
  Library Browser
  Statistics
    Week 12
  Student Progress
    Week 12
  Scoring Tools
  Email
  File Manager
  Course Configuration
  Help 🔵
Report bugs

Student Progress

WeBWorK tutorial
Week 10
Week 12
Week 3
Week 5
Week 8

WeBWorK → 2012S1_MAB122_127 → Instructor Tools → Student Progress → Student Progress

Student Progress for 2012S1_MAB122_127 set Week_12.
Due 31/05/2012 at 11:59pm Australia/Brisbane

A period (.) indicates a problem has not been attempted, a "C" indicates a problem has been answered 100% correctly, and a number from 0 to 99 indicates the percentage of partial credit earned. The number on the second line gives the number of incorrect attempts. The success indicator, Ind , for each student is calculated as
$100*(totalNumberOfCorrectProblems / totalNumberOfProblems)^2 / (AvgNumberOfAttemptsPerProblem)$
or 0 if there are no attempts.

Click on student's name to see the student's version of the homework set.   Click heading to sort table.

Name First Last Email	Score	Out Of	Ind	Problems 1 2 3 4	Section	Recitation	Login Name
	0.00	10	0	. . . 0 0 0 0 1			
Administrator	0.00	10	0	. . . 0 0 0 0 0			admin
	0.00	10	0	. . . 0 0 0 0 0			
	9.29	10	38	C C 67 88 0 1 3 3			
	5.88	10	35	. C C 63 0 1 0 1			
	6.40	10	55	C 80 C . 0 1 0 1			
	9.81	10	55	C C . 94 1 0 2 1			

Problem categories

Algebra
  Basic Algebra
  Conic Sections
  Coordinates and Graphs
  Counting and Probability
  Equations and Inequalities
  Exponential and Logarithmic Functions
  Functions
  Linear Functions
  Linear Programming
  Polynomial and Rational Functions
  Power Functions
  Quadratic Functions
  Quadratic Functions, Expressions, and Equations
  Sequences and Series
  Systems of Equations and Inequalities
Calculus
  Applications of Differentiation
  Applications of Integration
  Approximating Functions Using Series
  Complex Variables
  Constructing Antiderivatives
  Differential Equations
  Differentiation
  Functions and Models
  Infinite Sequences and Series
  Integrals
  Limits and Derivatives
  Multiple Integrals
  Parametric Equations and Polar Coordinates
  Partial Derivatives
  Second-Order Differential Equations
  Techniques of Integration

  Using Definite Integrals
  Using the Definite Integral
  Using the Derivative
  Vector Calculus
  Vector Functions
  Vectors and the Geometry of Space
Complex Analysis
  Elementary Functions
Discrete Mathematics
  Algorithms
  Combinatorics
  Logic
  Number Theory
  Set Theory
Financial Mathematics
  Annuities
  Bonds
  Equations of Value
  Introduction to Interest
  Options
  Probability and Contingent Payments
Intermediate Algebra
  Algebra, Mathematical Models, Problem Solving
  Functions and Linear Functions
  Systems of Linear Equations
  Inequalities and Problem Solving
  Polynomials, Polynomial Functions, Factoring
  Rational Expressions, Functions, Equations
Introduction to Statistics
  Exploring Data
Linear Algebra
  Matrices
  Systems of Linear Equations and Matrices

  Vector Spaces
Precalculus
  Compositions, Inverses, Combinations Of Functions
  Exponential Functions
  Functions
  Linear Functions and Change
  Logarithmic Functions
  Polynomial And Rational Functions
  Transformations of Functions and Their Graphs
  Trigonometric Functions
  Trigonometry
Probability
  Discrete Probability
  Distributions
  Theory
Statistics
  Confidence Intervals
  Continuous Random Variables and
  Their Probability Distributions
  Correlation/Regression
  Descriptive Statistics
  Estimation
  Experiment Design
  Hypothesis Testing
  Multivariate Techniques
  Sampling Distributions, Central Limit Theorem
  Simple Linear Regression
  What is Statistics?
Trigonometry
  Analytic Trigonometry
  Trigonometric Functions of Angles
  Trigonometric Functions of Real Numbers

Problem categories

```
Calculus
  Partial Derivatives
    Directional Derivatives and the Gradient Vector
    Functions of Several Variables
    Graphs and Level Surfaces
    Lagrange Multipliers
    Limits and Continuity
    Maximum and Minimum Values
    Partial Derivatives
    Tangent Planes
    The Chain Rule
```

Key features of WeBWorK

- ► Students had to enter answers in appropriate syntax.
- ► "Preview answers" function shows how answers are interpreted.
- ► Authentication integrated with QUT single sign-on.

Online assignments

Online assignments

- Used WeBWorK online mathematics software.
- 5 biweekly online assessments; best 4 of 5 count for 20% of student's final grade.
- 4–5 questions per biweekly assessment.
- Each question had randomly generated values.
- Students can download PDF version of their questions to work out offline if they want.
- Transfer marks from WeBWorK to Blackboard at end of semester by downloading CSV files from both and then doing 5 minutes of spreadsheet kung-fu to copy them over.

Helping students get oriented

- Tutorial available before first online assessment to help students learn to use the system.
- Practice questions online some weeks as well to try before going to the real homework.

Persistence

- ► Students had 5 attempts per question; changed to 3 attempts per question part way through semester.
- ► 70% of students reported "I would keep trying a question until I got it right our ran out of attempts" "all the time" or "almost all the time".
- ► Online assessment average: 85.1%; 84.2% submission rate
- ► Written assessment average: 75.7%; 82.8% submission rate

Effectiveness?

How effective were the different types of assessment for helping you learn the material?
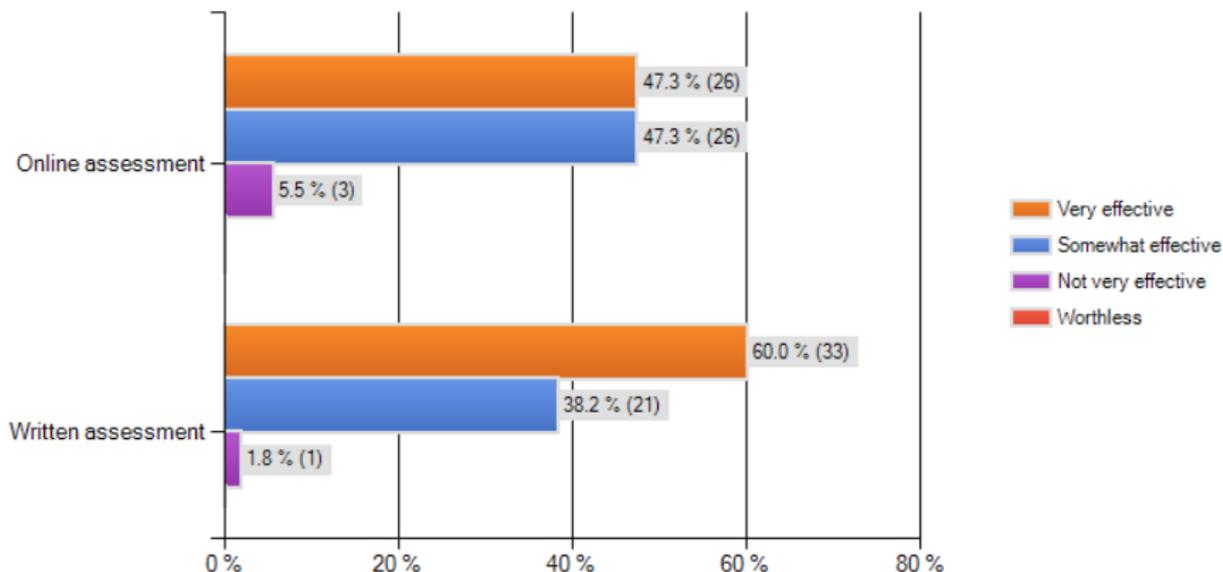
Effectiveness?

Effectiveness?

Final Grade versus Written Assessment
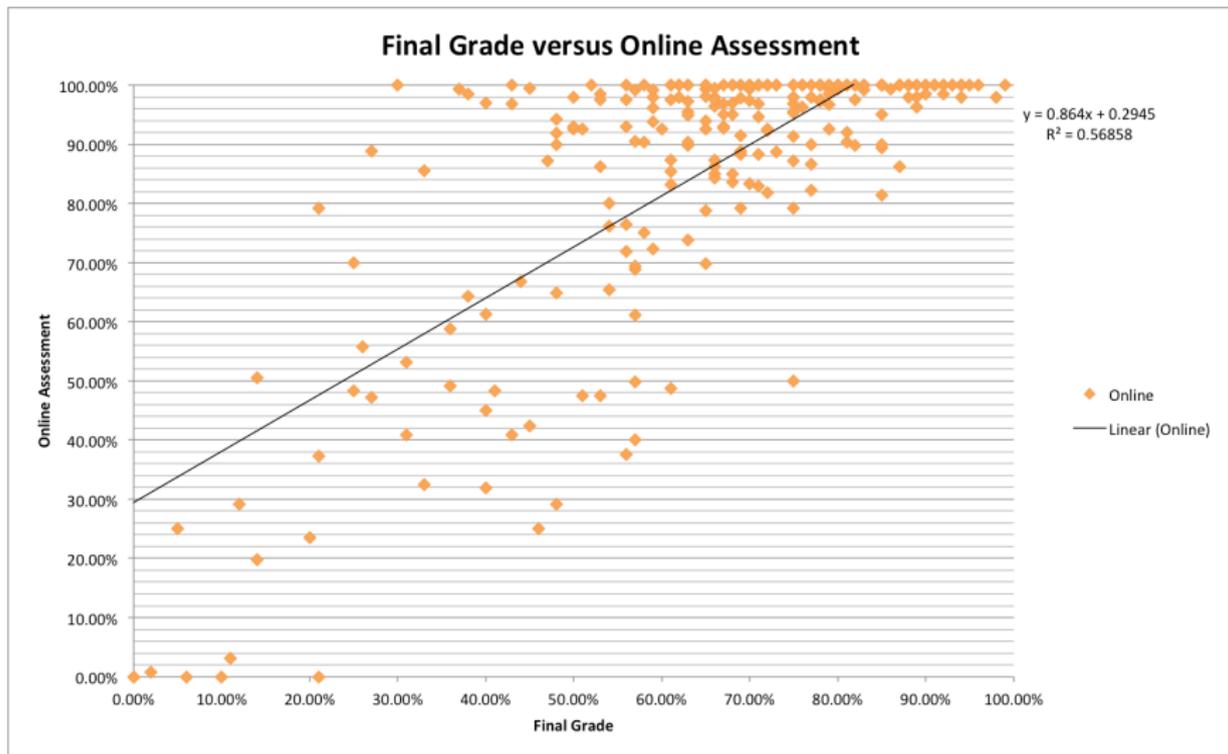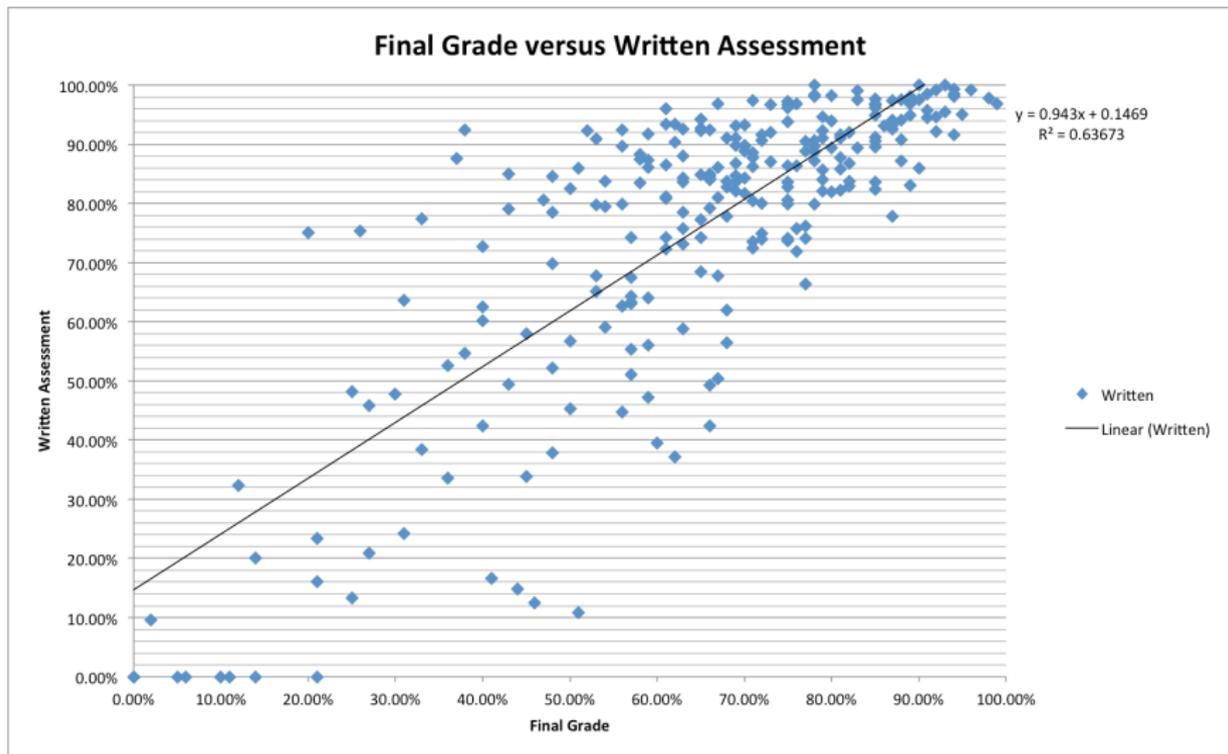
Ease of use

Did you have any difficulties entering answers into WeBWorK?
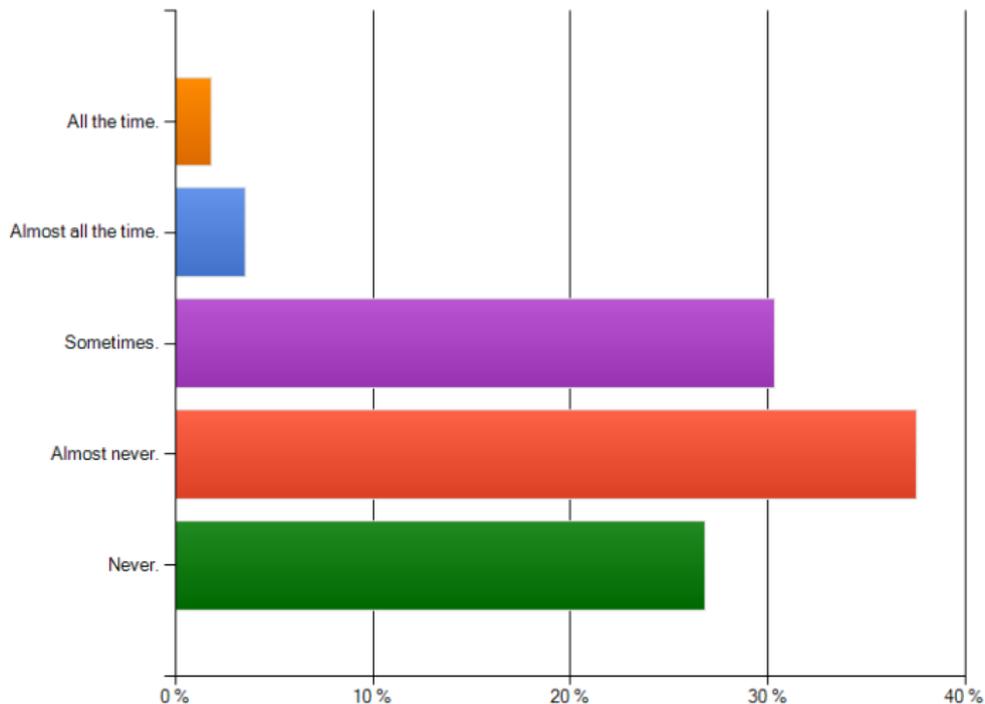
Ease of use

- ▶ Providing examples of answer syntax directly in question text was helpful.
- ▶ Some types of notation are hard to enter (e.g., inequalities).
- ▶ Confusion around number of decimal places when students chose to use decimals.
- ▶ Students don't automatically know which functions are available and what syntax to use.
- ▶ More attempts seen as a way to mitigate syntax problems.

Feedback (end-of-semester survey)

What did you **like** about using the WeBWorK online assessment tool?

- ▶ "Practice quizzes gave me a chance for 'trial and error' style of learning."
- ▶ "Convenient, easy to submit the quiz."
- ▶ "I could see immediately what is right or wrong. Don't have to wait for weeks to receive an answer."
- ▶ "The fact that it was accessible everywhere."
- ▶ "It was generally easier than the normal questions."
- ▶ "1000 times better than old Blackboard assessment tools."

Feedback (end-of-semester survey)

What did you **like** about using the WeBWorK online assessment tool?

- ▶ "Practice quizzes gave me a chance for 'trial and error' style of learning."
- ▶ "Convenient, easy to submit the quiz."
- ▶ "I could see immediately what is right or wrong. Don't have to wait for weeks to receive an answer."
- ▶ "The fact that it was accessible everywhere."
- ▶ "It was generally easier than the normal questions."
- ▶ "1000 times better than old Blackboard assessment tools."
- ▶ "Can use it without wearing pants."

Feedback (end-of-semester survey)

What did you **dislike** about using the WeBWorK online assessment tool?

- ▶ "Not very forgiving in terms of notation used." (19/45 responses)
- ▶ "Limited attempts for the actual online assessment." (11/45 responses)
- ▶ "The ease for people to cheat."
- ▶ "The inability to earn part marks on many questions."
- ▶ "Nothing." (15/45 responses)

Feedback (end-of-semester survey)

Which type of assessment would you prefer?

All written assessment.	
Mix of written assessment and online assessment.	72.7 %
All online assessment.	27.3 %

0 %   20 %   40 %   60 %   80 %
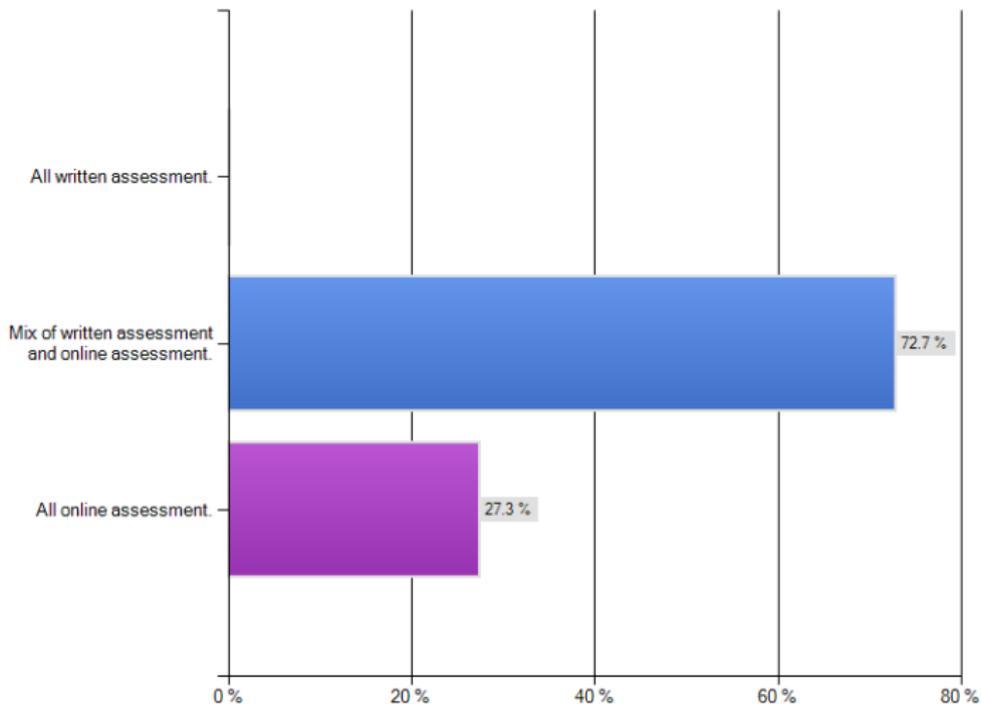
Recommendations

- ▶ Don't decrease the number of attempts part way through the semester.
- ▶ Providing examples of answer syntax directly in question text is helpful.
- ▶ Students appreciate practice questions similar to the actual assessment question.
- ▶ Advertise to students that they can "appeal" a syntactical problem after they exhaust their attempts using the "email instructor" button, and be willing as an instructor to grant an additional attempt for obvious syntactic mistakes.

My opinion

- ▶ Writing your own questions can be hard work.
  - ▶ If you're a perfectionist, the existing questions might not be exactly what you want.
  - ▶ Existing questions often lack worked solutions.
  - ▶ But 45% reported "almost never" or "never" looking at worked online solutions, and another 33% only did "sometimes".
  - ▶ 20–60 minutes for coding question and worked solution depending on complexity of answer checking.

- ▶ Quality of service from QUT IT / LETS was not ideal — server performance sometimes became unacceptable due to poor resource management of virtual server infrastructure.

- ▶ I was surprised how few problems there were and how well students responded to it.

- ▶ I would definitely use it again, but perhaps need to increase mathematical difficulty a little bit.

Should the school adopt it?

- ▶ I am favourable towards the system.
- ▶ No conclusive evidence that it improves student outcomes. (How would we measure this?)
- ▶ Ongoing use would require an administrator to handle basic start-of-semester setup.
- ▶ First-time usage in a unit would be eased by having a dedicated TA to help instructors learn the system, identify questions from library, and/or write new questions or solutions.
- ▶ Reusing questions in subsequent semesters less problematic than with reusing written questions since (a) questions are randomized and (b) solutions only online, not downloadable as PDFs.
- ▶ Ongoing costs would probably be quite low.
- ▶ Discussion required...

Online diagnostic tests

Online diagnostic tests

- ▶ Goals?
    - ▶ Help students decide which unit they should be enrolled in.
    - ▶ Help students determine what they need to review in terms of assumed knowledge.
- ▶ Run in week 0 and week 1 of semester 1, 2012.
- ▶ Advertised to all students enrolled in MAB120/125, MAB121/126, and MAB122/127 via Blackboard email and in-class announcements.
- ▶ Used WeBWorK system.
- ▶ Tutorial available before tests to help students learn to use the system.
- ▶ Tutor available in QUTMAC for help using system; no visits.

Test structure

- 3 separate tests, one for each unit.
- Each test has 13–14 questions, selected to cover assumed knowledge for that unit.
- Questions selected by Beth Addison-Smith and myself, then reviewed by unit coordinators, Dann Mallett, Therese Wilson.
- Students could take test as many times as they wanted.

MAB121/126 questions

problem	testing	% correct
Expand $(x^2 - 4)^2$.	expansion	72%
Factorise the expression $2x^2 + 5x - 12$.	factorization	65%
Given the function $f(x) = x^2 + 3x + 2$, give an expression for $f(3x^2)$.	functions	43%
For what values of x is the following function defined? $f(x) = 1 + \sqrt{2x + 1}$?	domain	20%
Find the solution to the following two simultaneous equations: $y = -4x + 11$ and $y = x + 1$	solving simultaneous equations in 2 var	69%
What is the derivative of $f(x) = 2x^3 - 2\sqrt{x}$?	differentiation of polynomials	61%
What is the derivative of $f(x) = 3\cos(x) + 1$?	differentiation of trigonometric functions	77%

MAB121/126 questions (continued)

problem	testing	% correct
What is the derivative of $f(x) = x^7 \sin(x)$?	differentiation using product rule	55%
What is the derivative of $f(x) = \frac{x^6+5x+1}{2x+1}$?	differentiation using quotient rule	32%
Given the functions $f(t) = \ln(2t)$ and $t(x) = x^2 + 1$, find the derivative $f'(x) = \frac{df}{dx}$.	differentiation using chain rule	29%
Evaluate the integral $\int (2x^7 + 1)\, dx$. Don't forget the constant of integration, C.	integration of polynomials	68%
Evaluate the integral $\int e^{3x}\, dx$. Don't forget the constant of integration, C.	integration of exponentials	30%
Evaluate the integral $\int \frac{e^{3x}}{e^{3x}+5}\, dx$ using the substitution $u = e^x$. Don't forget the constant of integration, C.	integration by substitution	12%

This email has been automatically generated to send results of your recent Maths Diagnostic test. The diagnostic test covered some of the areas of assumed knowledge for your chosen subject, and your results are shown below, beside the Maths topic that was tested. An incorrect or partially correct result can indicate that some preparatory work in that topic area might help with your studies.

Support resources are available in the QUT Maths Access Centre (QUTMAC) in GP-O-304. These include over 70 "First Aid Kit" sheets which explain various aspects of arithmetic, algebra, functions, trigonometry, matrices, vectors, complex numbers, and calculus, and include sample problems and solutions. There are also 20 "QUT Maths Worksheets" available in the MAC and on the QUT MAC Blackboard site at http://bit.ly/x6NG08.

If you struggled with many of these questions, you may wish to make an appointment with your unit coodinator or Dr Therese Wilson in the QUT Maths Access Centre to discuss the best approach for your success in this unit.

Douglas Stebila email: stebila@qut.edu.au

username   : stebila
Test ID   : MAB122_127_diagnostic,v1
Test started at : Tue Feb 28 11:03:28 2012
Total Score   : 0.00

Question	Comment	Topic
5	Not attempted or incorrect.	Algebra - Factorization (First Aid Kit 2.5-2.6, Maths Worksheet 2, 6)
6	Not attempted or incorrect.	Functions - Domain and range of a function
7	Not attempted or incorrect.	Functions - Solution of simultaneous equations (First Aid Kit 2.10-2.13, Maths Worksheet 4, 5)
8	Not attempted or incorrect.	Linear Algebra - Inverse of a 2x2 matrix (First Aid Kit 5.4-5.5)
9	Not attempted or incorrect.	Linear Algebra - Vector dot product and norm (First Aid Kit 6.1-6.2)
10	Not attempted or incorrect.	Algebra - Complex number multiplication (First Aid Kit 7.1-7.2)
11	Not attempted or incorrect.	Derivatives - Derivative of polynomial and exponential (First Aid Kit 8.1-8.3, Maths Worksheet 13)
12	Not attempted or incorrect.	Derivatives - Derivative of a trigonometric function with chain rule (Maths Worksheet 14, First Aid Kit 8.5)
13	Not attempted or incorrect.	Derivatives - Quotient rule (First Aid Kit 8.4)
14	Not attempted or incorrect.	Derivatives - Chain rule (First Aid Kit 8.5)
15	Not attempted or incorrect.	Integrals - Indefinite integral of polynomial (First Aid Kit 8.6-8.8, Maths Worksheet 15)
16	Not attempted or incorrect.	Integrals - Integration by substitution (First Aid Kit 8.11, Maths Worksheet 19)
17	Not attempted or incorrect.	Integrals - Integration by parts (First Aid Kit 8.10, Maths Worksheet 18)

Discussion

- ▶ More investigation required to determine how to proceed.
- ▶ Notation problems need to be minimized, especially since this is students' first use of system; more of an issue here than in a semester-long unit.
- ▶ Are questions good representation of required knowledge?
- ▶ Should we make all incoming students take it? When?
- ▶ Should the results be used for review/remedial advice, or for streaming?
- ▶ How do we make streaming recommendations?
- ▶ How do we analyze the effectiveness of the test?
- ▶ Who would run it on an ongoing basis?

Conclusion

My conclusions

Facebook group
Online consultation hours
Online assessment
Online diagnostic tests

My conclusions

Facebook group ☺

Online consultation hours ☹ ☺

Online assessment ☺

Online diagnostic tests ...?

Demo of WeBWorK system

`http://fastres01.qut.edu.au/`

Try it out yourself:
MAB122_127_Practice → Week12_Practice