Meaningful, Motivating Online Assessments

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- **Brief overview of my online-assessment experiences**
  - **Some details—how I've conducted oral exams: their pros & cons**
    —how I've conducted written exams
  - **Ways to limit cheating on written exams**
    —I'll be sharing ways I've used and I'm hoping to learn more ways during today's seminar.

Spring '20

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Welcome, Tim, to your Oral-Exam-2 Meeting

1. Suppose that p, q, r and g are continuous on $(0, 8)$. What would the general solution of

$$y''' + p(t)y'' + q(t)y' + r(t)y = g(t)$$

look like on $(0, 8)$?

Courses:	Enrollments:	Number taking Orals:	
ODEs	45	34	
Math for Physics	25	25	
Survey of Calc I	246	105	Most opted for CR/NC
Calc I	51	20	

Told students choosing letter-grade: performance on oral final might result in a course-grade drop of no more than two-thirds of a letter (so, e.g., a pre-exam A average might drop to B+ but no lower).

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A weak performance on the final will result in a course-grade drop of no more than two-thirds of a letter (so, e.g., a pre-exam A average might drop to B+ but no lower).

Based on Oral-Final Performance Earned Letter Grade	
1/3 higher than that based on Pre-final average	28
The same as that based on Pre-final average	54
1/3 lower that based on Pre-final average	18
2/3 lower than that based on Pre-final average	5

Fall ‘20 14 Sections of Survey of Calc I, about 500 students

⊟ MATH 1190	**A Survey of Calculus I with Algebra**							
	Fall 2020	14783	100	**Lecture** (4 Units)	Closed D	40 / 40	**Paul Bourdon**	10/01 Th 8:30pm - 10:00pm OS Web-Based Course
							Paul Bourdon	11/12 Th 8:30pm - 10:00pm Web-Based Course
							Paul Bourdon	TuTh 12:30pm - 1:45pm Web-Based Course
	Fall 2020	14784	101	**Discussion** (0 Units)	Open D	39 / 40	**Paul Bourdon**	Fr 11:00am - 11:50am OS Web-Based Course
	Fall 2020	16167	200	**Lecture** (4 Units)	Open D	37 / 40	**Wendi Dass**	10/01 Th 8:30pm - 10:00pm OS Web-Based Course
							Wendi Dass	11/12 Th 8:30pm - 10:00pm Web-Based Course
							Wendi Dass	TuTh 9:30am - 10:45am Web-Based Course
	Fall 2020	16168	201	**Discussion** (0 Units)	Open D	37 / 40	**Eleanor Mcspirit**	Fr 12:00pm - 12:50pm OS Web-Based Course
⊟ MATH 1210	**A survey of Calculus I**							
	Fall 2020	13370	001	**Lecture** (3 Units)	Open D	33 / 36	**Anna Ying Pun**	10/01 Th 8:30pm - 10:00pm OS Web-Based Course
							Anna Ying Pun	11/12 Th 8:30pm - 10:00pm Web-Based Course
							Anna Ying Pun	TuTh 8:00am - 9:15am Web-Based Course
	Fall 2020	13371	002	**Lecture** (3 Units)	Closed D	36 / 36	**Neelay Dutta**	10/01 Th 8:30pm - 10:00pm OS Web-Based Course

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Taught by 10 grad students—7 first time primary instructors, 2 lecturers, 2 post-docs

Gave 3 Zoom-Proctored Written Exams through WebAssign

Fairly successful—little cheating on two midterms.
10-20% cheating rate on the final.

What was your strategy for online testing in the spring? Oral Exams

What were your concerns at the time?

- Testing in a way the promotes learning.
- Fairness: not giving dishonest students an advantage over honest students
- Integrity: I wanted the grades assigned to have meaning.

Donald McCabe
(1944-2016)

Professor of Management and Global Business at the Rutgers Business School.

"Founding father" of research on academic integrity

Important Announcement

Format of Test 2?

Two Flawed Possibilties:

(1) Open book and open notes—no other resources (e.g., collaborators, Mathematica, WolframAlpha)

(2) Open book and open notes—unlimited resources; e.g., collaboration allowed

Flaws

Possibility 1: Research suggests substantial cheating likely; thus, punishes honest students.

Possibility 2: Either scores will be meaningless—everyone submits A work; or better-collaborators = better score. Is that fair?

I see only one possibility that I consider fair and valuable for students: **Oral Exams**

Some Details about Oral Exams for Math 3250

I. For each exam, there will be an exam-prep folder containing

- An exam "study guide"
- A sample oral exam (with key)
- Description.of types of questions you should expect.
- A list of student generated questions from which three of your 7–9 exam questions will be drawn. You get to choose the first question drawn (from the student-generated list).

Remark: I hope that you take the task of formulating questions—both in Piazza and for oral exams—very seriously.

> *Once you have learned how to ask questions—relevant and appropriate and substantial questions—you have learned how to learn and no one can keep you from learning whatever you want or need to know.**

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* *Teaching as a Subversive Activity*, Neil Postman and Charles Weingartner

II. Here are some exam-administration details. [**These are details that are clarified with examples relevant to the first oral exam.**] You'll sign up for a 20 minute exam window via a Google spreadsheet. A few minutes before your exam period begins, you'll join the exam session through "Online Meetings" at our Collab site. When you join the meeting, you'll be in a waiting room. I'll admit you at your appointed time.

Remarks:
(1) During follow up questioning I might ask for additional statements [Definitions, Theorems].

...

(2) There are certain basics that will be discussed during any exam meeting . . . ; however, specific questions will vary significantly from student to student. . . .

Nevertheless, your sense of fairness and mine both suggest that that all students should have access to the same exam-prep resources. . . .

(3) You should have a notepad or note-book at hand for working out simple computational problems. Ideally you'd be explaining as you compute. (E.g, I'm factoring to find the equilibrium points; they are -1 and 3. I'm now plotting them on a phase line. . . .)

(4) It's fine to have notes (on paper) and/or your book lying around but there's little chance they will be helpful to you. As I indicated in the syllabus, if you get stuck on a problem, I'll provide a hint to help you get unstuck. You'll lose some credit, but the initial hint will cost at most 1 point (of 10). There will be additional "charges" for additional hints. I'll be sharing questions on screen through Zoom. *There will be no need for you to interact with Zoom (your computer) or any other electronic device during the exam session.* As I indicated above, I'll be asking you to state an important definition or theorem. That request will be made orally and I'll know if you are reading the statement (and you won't receive any credit for it),

Pros of Oral Exams:

(A) As I told students last spring, "If you consider the skills you'll rely on in your future career, you're much more likely to need to communicate technical information orally than to take some sort of written exam. Thus, I'll claim that you'll derive a greater practical benefit from taking an oral final exam than from completing a written one."

(B). No cheating (ODEs and Math for Physics). I had several different exams "in circulation" during each day of the exam period. It worked; I don't believe any student effectively cheated--it's very hard to fake understanding of how to solve a problem when you have to explain your reasoning as you are solving it.

- **Remember preventing cheating = more learning, honest students not punished by assessments, grades assigned have meaning.**

(C) Want your students to be sharing their thinking in small breakout room groups?

Remind them they are practicing for the next oral exam.

Pros of Oral Exams:

(D) An oral exam can be much more educational than a written exam. E.g., one of the problems on some of the Math 1210 (A Survey of Calculus I) finals is

Is there a point on the graph of

$$f(x) = x^6 + 5x^3 + x^2 - 7x$$

at which the tangent line to the graph has slope 1?

Here's a possible rubric for this problem:

10 points

7 points if student conveys the need to solve f'(x) = 1.
1 additional point if student has idea of using the IVT
2 additional points for description of how to apply the IVT (only 1 additional point if description flawed)

If student conveys the need to solve f'(x) = 1 and is stuck then say

"You've learned a theorem that can help you determine whether an equation has a solution or whether a function assumes a certain target value. Do you remember that theorem?"

If student can name theorem, then 0.5 pt additional credit; 2 additional points for description of how to apply the IVT (only 1 additional point if description flawed).

If student can't name the theorem then, tell student IVT. Student can earn 1.5 points additional credit …

(E) Giving oral exams is much more fun/interesting uplifting than giving written exams.

Pros of Oral Exams:

(F) Dealing with cheating on written exams is time consuming (and the opposite of uplifting)

This fall: 450 students completed the final exam in Math 1210 (Survey of Calc I): These exams are graded in common (10 grad students—7 first time primary instructors), 2 lecturers, 2 post-docs).

Graders reported to me names of about 50 students they suspected may have used unauthorized resources. I had to review each these exams.

For the 1st midterm NO suspected cheaters were reported.

For the 2nd midterm ONE suspected cheater was reported.

Course Grade

Your course grade will be determined as follows:

Class-Prep	10 points
Piazza	8 points
In-class Polling	10 points
WebAssign Homework	10 points
Collected Classwork	10 points
Quizzes	16 points
Exam 1	12 points
Exam 2	12 points
Final Exam	12 points
	100 points possible

Cons of Oral Exams

(A) More time-consuming than writing and grading a written exam.

(B) You can't give the same exam to all your students (without giving an advantage to those who take it later).

(C) Students in lower-level classes are likely to complain (initially) about the exam format.

Time comparison. ODEs. 40 students

Oral Exam:

Creating Exams: 3-4 hours

Delivering Exams: Exams are advertised as 15-20 minutes in length, given 3 per hour 13.33 hours

Grading: 30 minutes—tallying and recording scores.

Total Time: 17-18 hours (over 2-3 days)

Wtten Exam:

Composing Exam: 3-4 hours

Delivering Exam: 1.25 hours

Grading: 4-5 hours

Dealing with Cheaters: 0-4 hours

Total Time: 8-14 hours

- **Because of instructor inexperience, I had to give written exam in Calculus I this fall.**

1. 0/1 points — Honor Code Certification Exam [4824287] -

Honor code certification

Cheating on course assessments is not a victimless crime: honest students are victims, learning is a victim, and institutional integrity is a victim. You may use printed resources during this exam—e.g, study guides (printed), a physical book, notes you have written down, or classwork assignments that you have printed out. You may not use any other resources; in particular no electronic resources (outside of the WebAssign & Gradescope environments) and no collaboration with any other person or entity is permitted. If we have clear and convincing evidence that you have used any unauthorized resources (e.g., electronic ones) , you will be assigned a score of 0 on this exam.

✓ *On my honor, I pledge I will not use unauthorized resources on this exam. I acknowledge that the only authorized resources I may use are printed, physical resources, WebAssign (for question delivery and entering answers), and, of course, pencil/pen and paper for recording my answers.*

One of our Learning Assistants offered the following advice:

"It's actually pretty easy for an LA, TA, or professor to spot cheating, so no matter how clever you think you are—it's not worth the risk."

Reminding students of honor/integrity does have an impact:

Dan Ariely, James B. Duke Professor of psychology and behavioral economics at Duke University. Reported, July 2012, on the following experiment.

- Class of 500 students prepping for final. Half received an e-mail message from "a classmate" containing a link to "answers to past year's final" (and the message containing the link suggested the professor doesn't change questions and answers every semester).

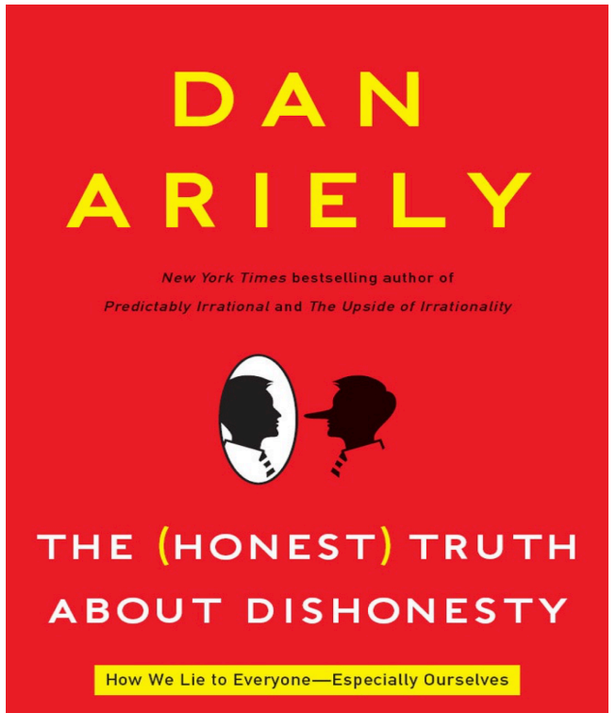
- Half received the same message but with the following

P.S. I don't know if this is cheating or not, but here's a section of the University's Honor Code that might be pertinent. Use your own judgment:

"Obtaining documents that grant an unfair advantage to an individual is not allowed."

- 69 % of the students from the half not having the P.S. add attempted to access the answers.

- 41 % of the students from the half having the P.S. add attempted to access the answers.



To discover whether honor codes work, we asked a group of MIT and Yale students to sign such a code just before giving half of them a chance to cheat on the matrix tasks. The statement read, “I understand that this experiment falls under the guidelines of the MIT/Yale honor code.” The students who were not asked to sign cheated a little bit, but the MIT and Yale students who signed this statement did not cheat at all. And that was despite the fact that neither university has an honor code (somewhat like the effect that swearing on the Bible had on the self-declared atheists).

This Fall—Zoom proctored written exams delivered through WebAssign, beginning with honor certification.

Instructions begin: "Have your video on during the Exam--we want to help you make the right decision to uphold your honor pledge."

Spring Term in Math 1210 : "Have your mic and video on during the Exam (and speakers off)—we want to help you make the right decision to uphold your honor pledge."

Limiting time to complete exams limits cheating.

Two parts—Part 1: 20 minutes long, randomized questions (all custom-coded by me), many multiple choice, graded by WebAssign).

Part 2: Available to student only after the student submits Part 1 (conditional release). If student completes Part 1 in less than 20 minutes, the student has more time on Part 2. All problems required submission of at least one answer in WebAssign while work was submitted through Gradescope at the end of the exam period.

Midterms (two given) duration: 1.25 hours (total)

Final Exam duration: 1.5 hours

From ”Part 1” of Fall 20 Survey of Calc I Written Final Exam Delivered Through WebAssign

Multiple Choice

(a) Which one of the following is true for $\int_{-3}^{-1} \frac{1}{x}\,dx$?

It's a positive number. It's a negative number. It's equal to zero. It does not exist.

(b) Which one of the following definite integrals shares the same value with

$$\int_0^{\ln 3} e^{2x}\sqrt{1+e^{2x}}\,dx?$$

- $\int_2^9 \sqrt{u}\ du$
- $\int_2^{10} \sqrt{u}\ du$
- $\frac{1}{2}\int_2^9 \sqrt{u}\ du$
- $\frac{1}{2}\int_2^{10} \sqrt{u}\ du$

From ”Part 2” of Fall 20 Survey of Calc I Written Final Exam Delivered Through WebAssign

Suppose that $f(1) = e$ and $f'(1) = 2$. Let $g(x) = f(x) \cdot \ln(f(x))$. Find an equation of the line tangent to the graph of g at the point on the graph having x-coordinate 1.

The requested tangent line has equation

$y =$ 4a [ ] $4x - 4 + e$.

Record all your work on this problem on your template answer-sheet; your work must justify your answer.

The population of bacteria in a culture t hours after 1 p.m. is modeled by

$$P(t) = 90\, e^{t \ln\left(\frac{5}{3}\right)}.$$

(a) According to this model, what is the bacteria population at 3 p.m. (the same day)?

9a [ ] 250 (Your answer should be a positive integer.)

Justify your answer to part (a) on your template answer-sheet.

(b) What is the average population over the time interval $[0, 2]$; that is, what is the average value of the function $P(t) = 90\, e^{t \ln\left(\frac{5}{3}\right)}$ over the interval $[0, 2]$? Please simplify your answer as much as you can.

Record all your work for part (b) of this problem on your template answer-sheet—there is no WebAssign submission for part (b).

(c) Use $\ln\left(\frac{5}{3}\right) \approx \frac{1}{2}$ and your answer to (b) to approximate the average population over $[0, 2]$.

Show your calculation for part (c) on your template answer-sheet—there is no WebAssign submission for part (c).

Ways you have discovered to give meaningful, motivating online assessments?

A Sample Oral Final for Survey of Calculus I, Spring '20

Grace

(1) Which sample exam question from the Study Guide for the Oral Final Exam would you like to answer? Please give the question's number and letter; e.g., Q9(a) and then describe your solution.

2. Let $P(t) = 100e^{0.1t}$ be the population of bacteria in a culture at time t (measured in hours). What is the rate of change in the the culture's population at time $t = 0$? Include units.

Problem 2A is to be completed ony if the preceding question was already answered in response to the prompt on slide 1.

2.A If $f(x) = \dfrac{e^{2x}}{x^2+1}$, what is $f'(x)$?

3. State the definition of horizontal asymptote and use it to find the horizontal asymptotes of the graph of

$$f(x) = \begin{cases} \dfrac{3x^2+1}{x^2+2} & \text{if } x < 0 \\ \dfrac{1}{x^2+2} & \text{if } x > 0. \end{cases}$$

Problem 3A is to be completed ony if the preceding question was answered in response to the prompt on slide 1.

3A. Explain how to use an appropriate sign line to locate points of inflection on the graph of a function f.

4. Pictured below right is the graph of a function f. How would you fill in the blank **using the information provided by the graph**? If the answer doesn't exist, enter DNE.

(a) The domain of f is _____.

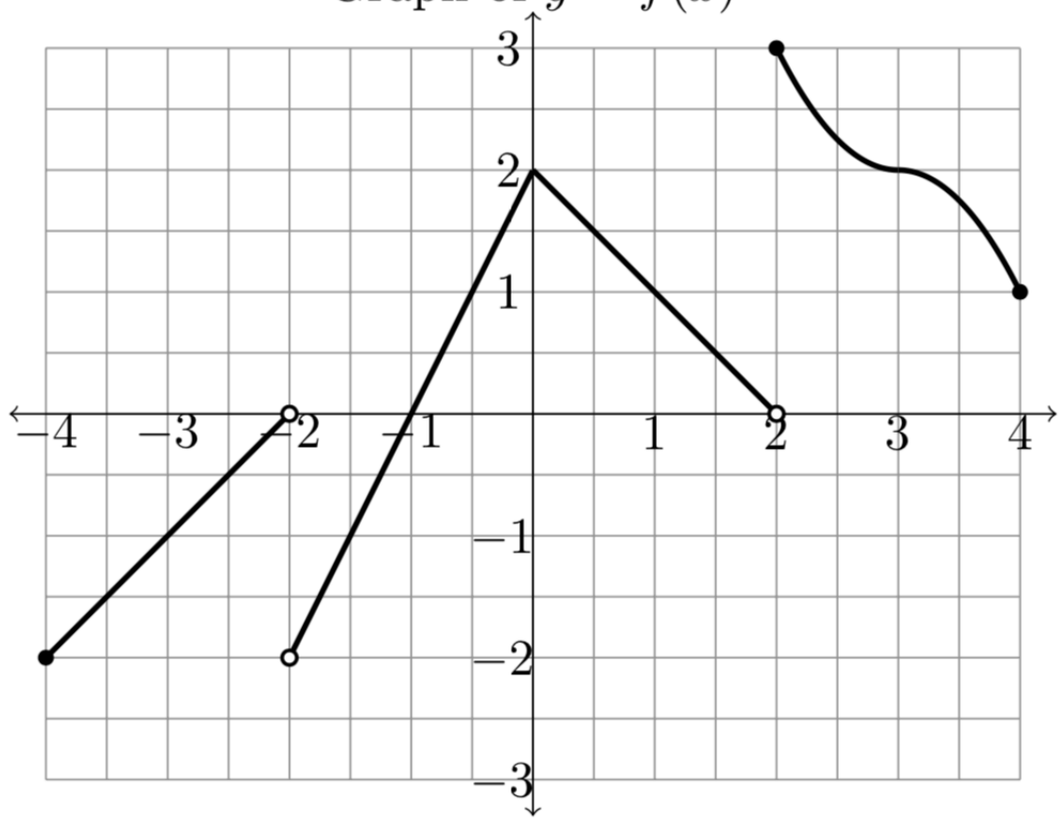
(b) $f'(1) =$ _____.

(c) $\lim_{x \to 0} f\big(f(x)\big) =$ _____.

(d) The absolute maximum value of f on $[-1, 1]$ is _____. The absolute minimum value of f on $[-1, 1]$ is _____.

(e) What is a point of inflection on the graph of f? _____.

Graph of $y = f(x)$



5 The population of bacteria in a culture at time t is modeled by a function $p(t)$, where t is measured in hours. Suppose that the rate of change of p with respect to time is modeled by

$$p'(t) = 300\sqrt{t} + 50$$

and the initial population is given by $p(0) = 10$. Find a formula for $p(t)$.

6. Suppose f is a continuous function defined on a closed interval $[a, b]$.

   (a) What theorem guarantees the existence of an absolute maximum value and an absolute minimum value for f?

   (b) What steps would you take to find those absolute maximum and minimum values?

Make your choice! Sharing of thinking optional!

7. (a) Circle the one correct choice for the definite integral $\int_{-1}^{1} \frac{1}{x^2}\, dx$

(a) $= -2$ (b) $= 2$ (c) DNE (c) $= 0$

(b) **True** **False** If $f''(a) = 0$, then $(a, f(a))$ is an inflection point of the graph of f.

(c) **True** **False** If f' is a decreasing function on the interval $(-1, 3)$ and $f'(2) = 0$, then f has a relative maximum value at $x = 2$.

8. As a spherical balloon is inflated, its volume V is changing with respect to time t. If the radius r of the balloon is measured in inches and t is measured in seconds, what are the units of

$$\frac{dV}{dt}?$$

9. . A particle travels along the x-axis such that its position at t seconds is given by the function $s(t)$ (where $s(t)$ is measured in centimeters). Which of the following expressions gives the average velocity of the particle over the time interval from $t = 0$ to $t = 2$ seconds? **More than one expression may work; select all that apply.**

(A) $s'(2)$

(B) $\dfrac{s(2) - s(0)}{2 - 0}$

(C) $\dfrac{1}{2}\displaystyle\int_0^2 s'(t)\ dt$

(D) $\dfrac{1}{2}\displaystyle\int_0^2 s(t)\ dt$

(E) $\dfrac{s'(2) - s'(0)}{2 - 0}$

THE END!

A Sample Oral Test 2 Ordinary Differential Equations, Spring ‘20

Welcome Casia To Your Oral Exam 2 Meeting

1. **Would you give me a specific example of an equation**

$$y'' + p(t)y' + q(t)\,y = g(t)$$

for which the Annihilation Operator Method could not be used to obtain a particular solution.

2. **Find the general solution of**

$$y'' - 6y' + 9y = 9$$

3 On what interval can we be certain that the IVP

$$ty'' + 2y = \tan t, \quad y(1) = 1, y'(1) = 4$$

has a unique solution?

4. Are the functions $y_1 = 1, y_2 = t, y_3 = t\ln(t)$ linearly independent on $(0, \infty)$?

5. How would you try to find a particular solution of

$$3y'' - 3y = \ln t?$$

6 Suppose that you have found a series solution of the form $y = \sum_{n=0}^{\infty} a_n(x+4)^2$ for

$$(x^2+9)y'' + 3xy' + y = 0?$$

Must your solution series converge at $z = -6$?

7. Suppose that p, q are r are continuous on $(0, 8)$. What would the general solution of

$$y''' + p(t)y'' + q(t)y' + r(t)y = g(t)$$

look like on $(0, 8)$?

8 Suppose that $y_1(t) = t$ and $y_2(t) = t^2$. Can $\{y_1, y_2\}$ be a fundamental set of solutions on the interval $(-2, 1)$ of an equation of the form

$$y'' + p(t)y' + q(t)y = 0$$

where p and q are continuous on $(-2, 1)$?

9. What would be the amplitude, circular frequency, and phase angle for the oscillation modeled by f(t) = 2 cos(5t) - 3 sin(5t).

THE END!