TS Mathematics Syllabus

Fall 2015

Instructor: Paul Gafni, gafnip@uw.edu
Instructor Office Hours: Tuesdays 1:30-2:30. Thursdays 2:30-3:30

TA: Caroline Cannistra,
TA Office Hours:

Course Schedule
M T Th: 12:30-1:20
Wednesday 10:30-12:20
Mandatory Math Study Hour Wednesday 2:30-3:30

Course Website: www.paulgafni.com/transition-school

Text References

- *Thinking Mathematics, Vol 4: Functions and Graphs* by James Tanton. This book is my main guide in structuring fall quarter. It is not required, but you can get a PDF copy for under $20 or a hard copy for under $30 from Lulu.com.
- *Precalculus: A First Course in Problem Solving* by Collingwood, Prince, and Conroy. This is a text written by UW professors for Math 120. You can get a PDF for free or get a hard copy on the Ave for about $20.

Online Mini-courses
The following three short courses will be a major part of our classwork this fall and are available for free online at www.gdaymath.com

- Tanton's Area Course
- Tanton's Exploding Dots Course
- Tanton's Quadratics Course

Video References
This class will feature very little lecture. Lecture is a valuable learning tool that you should plan to make use of outside of class. Relevant lectures can be found on the course website.

1 Learning Objectives

The primary learning objective of the Transition School Mathematics class is to ensure your readiness to succeed in university level mathematical work. What does that mean?

1. It means you're ready to crush high school level mathematical work you'll encounter on ALEKS.
2. It means you're able to tackle problems that take hours or days rather than seconds or minutes.
3. It means you're able to effectively use mathematics as a practical tool to describe and analyze problems.
4. It means that you ask questions and seek help in order to clarify your understanding and dive deeper.
5. It means you're self-aware of how clearly you understand what you are saying, writing, and doing.
6. It means you're able to reflect critically on the clarity and precision of what you are are saying, writing, and doing.
7. It means you're ready to maturely accept and make use of input, criticism, and advice from peers and instructors.
8. It means you're able to guide a peer's problem solving process without spoiling their Aha's!–i.e. without providing direct help or explanations, and you're able to apply these techniques to your own own problem solving process as well.
9. It means you're able to teach by direct explanation.
10. It means you're able to teach with the Socratic Method.
11. It means you're able to converse meaningfully about how to solve a problem before, while, and after you solve it.
12. It means you're able to explain, argue, and defend your work orally to individual peers, small groups of peers, the entire class, and to your instructors.
13. It means you're able to work effectively independently, in pairs, in small groups, and in class wide discussion.
14. It means the work you turn in is careful, precise, polished, and rigorous.
15. It means you're ready to speak meaningfully about mathematical matters as they relate to real world applications.

16. It means you are capable of producing meaningful written work to both cursory and deep questions in varying degrees of detail.
17. It means you're ready to maturely and tactfully give input, criticism, and advice to peers.
18. It means that you can effectively balance the workload of a time consuming and challenging math class with the rest of your responsibilities.
19. It means that you complete all assignments on time and can keep up with the pace of Transition School.
20. It means that you take notes effectively.
21. It means that you can show your work effectively.
22. It means that you can write both argumentative and explanatory essays about mathematical content.
23. It means that you are able to err gracefully and learn from your errors.
24. It means that you are ready and willing to take risks with mathematics in front of peers and instructors.

These learning objectives are very much in line with the Common Core State Standards for Mathematical Practice, which are listed here:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

2 Course Philosophy

As much as possible, this course is designed to give you agency over your own learning. My role is to enable you to learn, rather than to teach you directly.

2.1 ALEKS

In this course, we'll rely on ALEKS to provide up-to-date analysis of your individual progress as well as personally catered problem selection. ALEKS will choose problems one-by-one in real time according to what they call your Knowledge State. In this way, none of you will end up with knowledge gaps due to the accelerated pace of the class, and none of you will be asked to do undue amounts of busy work.

Although you will not turn in homework daily, you **need** to work on math outside of class daily. In the university, you will be responsible for managing these study habits on your own. In Transition School, you are expected to demonstrate that you are able to effectively implement such a study regimen without the imposed structure of daily homework.

2.2 Classwork

In accordance with the notion that mathematics is learned by doing, classtime will aim to put students in as active a role as possible.

After learning by *doing*, this learning is then solidified by *explaining*, *contextualizing*, *generalizing*, *applying*, and ***teaching***. This part of the learning process is collaborative, and collaborative groupwork will be a major component of TS Mathematics.

Note that this interest in reserving classtime for active learning means that you will need to watch lectures outside of class. Relevant lectures are available on the course website.

3 Student Accountability

Each week, you'll be responsible for meeting your ALEKS benchmarks, turning in a written portfolio, and being active on a daily basis in class. We will have regular quizzes, and there will be a final exam that will make up a small portion of your grade.

3.1 ALEKS Benchmarks

25% of your grade will be based on ALEKS work. On Benchmark Dates, I will check your progress on ALEKS against your current Objective. Your first benchmark is October 11th, and your mission is to master the Preliminaries Objective–this objective consists of topics from what ALEKS describes as Algebra and Geometry Review. As soon as possible, you should take the Pre-Calculus Initial Knowledge Check and calculate roughly how many topics per day you will need to learn to hit this first Benchmark. You should then consider your Topics Learned Per Hour from your ALEKS Algebra work, and make sense of how much time you will need to devote to your ALEKS work each day. If this calculation shows a number that seems impractical or if you otherwise find

yourself unable to meet this Benchmark, please contact me as soon as possible so that we can plan accordingly.

Tentative plan for Benchmark Days is October 11, October 25, November 9, November 23, and December 14th. These dates are the beginnings of Weeks 3, 5, 7, 9, and Finals Week. Note that these dates are Sundays, which means that you should come to class on Monday with this material under your belt.

3.2 Weekly Portfolio

30% of your grade will be based on your weekly portfolio, to be turned in to the Math Homework box by 8:30AM on Friday. In putting together this portfolio, you should aim to be demonstrating your best work. This work should be clean and neat. At a minimum, the following items must be present in your portfolio:

1. A current worksheet, from ALEKS. (every week)

2. One write-up of an involved problem from the Collingwood Text which is relevant to your current ALEKS work OR one write-up describing both the solution and the problem solving process you undertook either independently or collaboratively to solve a problem from Tanton, Art of Problem Solving, Math Pickle, etc. (every week).

3. All quizzes from the week, with original work and corrections. (Friday quizzes are turned in the following week)

4. A minimum of two pages of written work, using proper English. This writing should be analytical, inquisitive, or reflective in nature, and should demonstrate your ability to communicate about Mathematics. Examples include a written lesson about a concept you've mastered, an analysis of the costs/benefits of buying a home versus renting a home, or an account of your hunt for numbers other than 36 that are both Square Numbers (1, 4, 9, 16, ...) and Triangle Numbers (1, 3, 6, 10, 15, ...). In general, you will be able to choose a topic that sparks your interest for this work. (even weeks only)

5. A one page reflection. The over-arching topic will alternate between reflecting on curricular mathematical concepts on even weeks (i.e. making connections between content areas and describing what concepts are giving you trouble) and reflecting on [other stuff] on odd weeks. Other stuff includes your progress toward Learning Objectives, issues with collaborating with peers, concerns with course structure, etc. (odd weeks only)

Other examples of portfolio items include take home tests, extended reports, groupwork, essays, notes from class, notes from video lectures, etc. Extra portfolio items are always welcome and will be required at instructor discretion.

You will receive feedback on your portfolio based on how well you are meeting the Learning Objectives established above. Your course grade will be based both on your ability to create a high quality portfolio and on your ability to respond

to feedback about your portfolios, which may either ask you to re-submit items or to make adjustments in future submissions.

3.3 Classwork

35% of your grade will be based on your classroom performance. In my commentary on your portfolio, I will also give commentary on your classroom performance. Again, this feedback will be based on how well you are meeting the Learning Objectives established above. I'm particularly focused on how actively you are pursuing knowledge, how willing you are to take risks, and how able you are to communicate clearly. The classwork participation and engagement is the largest component of your grade: passive participation in my class will not be enough to succeed.

3.4 Exams

Our Final Exam will be our only major exam this quarter, and it will constitute 10% of your grade. We will place greater emphasis on exams later in the year, as they are a key element of success at the university.

4 Fall Content Focus

Our focus for the fall will be on developing a clear and flexible picture of functions.

4.1 Preliminaries

We will start the year with some time on some critical elementary concepts.
References: Tanton's courses on Exploding Dots and Area on www.gdaymath.com, TM Vol 4 Ch 1, Collingwood Ch 1-4
Historical Context: Our focus on a geometric interpretation for arithmetic is a tribute to the Greek perspective on Mathematics. Our focus on place value is a tribute to the Arabic numeral system.

4.2 Functions in General and Graphs of Functions

Functions are by far the most important concept of the year.
References: TM Vol 4 Ch 2, Collingwood Chapter 5,8,9
Historical Context: The notion of a function was first presented by Lebniz in the late 1600s as we entered into the era of modern mathematics. Modern mathematics revolves around functions of a variety of types, most of which you won't see for quite some time. Our primary focus this fall will be on functions that receive one input and return one output. These functions have particularly simple graphs associated with them, and one of our primary objectives will be to understand the relationships between functions and graphs.

4.3 Quadratic and Polynomial Functions

Quadratics are useful for describing motion and for modeling other simple behavior.
References: Tanton's course on Quadratics on www.gdaymath.com, TM Vol 4 Ch 3-4, Collingwood Chapter 7.
Historical Context: Quadratics are central to our understanding of motion both on and off of Earth.

4.4 Polynomial and Rational Functions

Polynomials are useful because they can approximate just about any function and are easy to manipulate.
Rational functions include dividing by x, which has interesting behavior as x approaches 0.
References: TM Vol 4 Ch 4-5, Collingwood Ch 14
Historical Context: Much like the jump from integers to rational numbers greatly expands our ability to represent real world numbers, the jump from polynomials to rational functions greatly expands our ability to model real world relationships.

4.5 Exponential and Logarithmic Functions

Exponential and Logarithmic Functions are all over the place. They're particularly useful for describing growth patterns, and they have a particular symmetric property that makes them very important in Calculus.
References: TM Vol 4 Ch 6, Collingwood Ch 10-12 Historical Context: Logarithms arose out of a practical need to ease the computational difficulty of multiplying multi-digit numbers. And although exponentiation dates back to at least the Greeks, our modern idea of exponents has some serious complications.

4.6 TBD

We should have enough time for a bit more this fall. I'm open to suggestions here, but we'll stick with a focus on functions. Possible topics include:

- Computer Graphics, Multivariable functions, and Matrices
- Infinity, Set Theory, and Cantor
- Functions in Programming
- Other ideas?

5 Academic Honesty

There is a clear line between collaborating and cheating: **all submissions must be *written* independently, and sharing written solutions is strictly**

prohibited. Peer-to-peer help on ALEKS assessments is strictly prohibited. Helping peers is highly encouraged, but the emphasis in peer-to-peer learning should be in *furthering understanding* and not *sharing solutions*. Help should generally be sought and offered in the form of a question–too many statements are a red flag that your help or your requests are likely inappropriate

Failing to adhere to this policy is grounds for a zero on any assignment and/or escalation to more serious disciplinary consequences at the discretion of the Transition School faculty.

6 Living Document

This syllabus and all course expectations are a work in progress and are subject to change at any time for any reason.