**Math 4050 Project**

Select one topic from each of the four parts of this project, covering much of the secondary mathematics curriculum:

Part 1: Pre-Algebra and Probability/Statistics

Part 2: Algebra I and II

Part 3: Geometry

Part 4: Precalculus

Imagine that you are the teacher and that you are about to cover your topic. Answer any three of the following questions about your topic.

1. APPLICATIONS
2. What interesting (i.e., uncontrived) word problems using this topic can your students do now? (You may find resources such as www.spacemath.nasa.gov to be very helpful in this regard; feel free to suggest others.)
3. How could you as a teacher create an activity or project that involves your topic?
4. CURRICULUM
5. How can this topic be used in your students’ future courses in mathematics or science?
6. How does this topic extend what your students should have learned in previous courses?
7. CULTURE
8. How has this topic appeared in pop culture (movies, TV, current music, video games, etc.)?
9. How has this topic appeared in high culture (art, classical music, theatre, etc.)?
10. How has this topic appeared in the news?
11. HISTORY
12. What interesting things can you say about the people who contributed to the discovery and/or the development of this topic? (You might want to consult *Math Through The Ages*.)
13. How was this topic adopted by the mathematical community?
14. How did people’s conception of this topic change over time?
15. What are the contributions of various cultures to this topic?
16. How have different cultures throughout time used this topic in their society?
17. TECHNOLOGY
18. How can technology (YouTube, Khan Academy [khanacademy.org], Vi Hart, Geometers Sketchpad, graphing calculators, etc.) be used to effectively engage students with this topic? *Note*: It's not enough to say "such-and-such is a great website"; you need to explain in some detail why it's a great website.

The idea of these questions is to engage your students with the topic that you’ve selected. (You are not expected to write a full 5E lesson plan about your topic!) This list of questions is not comprehensive, and you may suggest a different question to your instructor if you think you have a good engagement activity that does fit any of the above questions.

While you only have to answer three questions for each part of this project (for a total of 12 responses), you must select at least one question from all five categories by the end of the semester.

**DUE DATES**: Part 1 of this project is due the second Friday of the semester. For the remaining parts of the project, see the class calendar at <http://www.math.unt.edu/~johnq/Courses/2014spring/4050/>.

**CHOOSING A TOPIC**: No two students may work on the same topic. Topics will be chosen on a first-come, first-served basis. Be sure to send your instructor your top 5-10 choices (in priority order), in case someone else has already taken your favorite topic.

**WHAT DOES A GOOD PROJECT LOOK LIKE?** Some excellent projects that have been submitted in past semesters can be seen on my personal blog by going to <http://www.meangreenmath.com/category/guest-presenter/>. (More on that later.)

Your answers are not expected to be long: just prepare a paragraph or two (total length 150-250 words) for each of your three responses.

You are not obligated to come up with anything original, as long as you cite your references. There’s one exception to this rule: you may not submit an idea that is substantially the same as something that’s already been published on <http://www.meangreenmath.com>. So, prior to submitting your work, you should do a quick search to check that your idea has not already appeared on my blog.

**SUBMITTING YOUR WORK**: Please submit your work by e-mail as a Microsoft Word document. Also, title your document according to the format “John\_Doe\_13.docx” if your name is John Doe and you've chosen topic #13. Your work should follow the sample outline below. (Of course, you’re not obligated to select Topic 3 or questions B1, C1, and C2. For this example, the student will need to answer at least one question from sections A, D, and E before the end of the semester.)

You are welcome to include pictures in your submission if appropriate. Otherwise, I’d prefer that you minimize the number of “special effects” that are possible in Microsoft Word so that, if your project is exemplary, it can be easily added to <http://www.meangreenmath.com>. (More on that later.)

Name Here

Math 4050

Project, Part 1

3. Powers and Exponents

B1. How can this topic be used in your students’ future courses in mathematics or science?

 <response here>

C1. How has this topic appeared in pop culture (movies, TV, current music, video games, etc.)?

<response here>

C2. How has this topic appeared in high culture (art, classical music, theatre, etc.)?

 <response here>

References:

 <references here>

**GRADING RUBRIC**: Each of your three responses will be graded in three ways; each will be judged on a 4-point scale.

1. **Accuracy**. Is your information mathematically and logically correct? For example, if you give bacteria growth as an illustration of polynomials, that gets 0 points. (Bacteria growth is modeled by an exponential function.)
2. **Engagement**. Does your response have a reasonable chance of engaging a decent fraction of your future students?
3. **Understandability**. Will your peers in TNT be able to read, understand, and use what you’ve written for their future students? This includes citing the book(s) and/or website(s) that you use (which, by the way, do NOT have to be in APA format).

As noted above, you must select at least one question from all five categories by the end of the semester. You will have 10 percentage points deducted from your overall project grade if you fail to select a question from each of the five categories.

**AFTER THE SEMESTER IS OVER**

At the end of the semester, I will compile all submissions and give them back to you for your own use in your future classroom, and this will make it easier for me to compile the submissions. Writing out the names of each topic will make it easier for your classmates to read the compilation that is eventually produced.

Also, if I think your project is very, very good, I may ask to have your permission to share your Math 4050 class project on my blog <http://www.meangreenmath.com>, which I update daily with my thoughts on mathematics and education. You can be credited by name or else anonymously (though if you're credited by name, that's something that you can show to school districts when the time comes to get a job).

I’ve long since recognized that I do not possess a monopoly on excellent ideas for teaching. (Indeed, I gladly poach any good ideas that come my way.) For this reason, I have opened my blog to TNT students, in the hopes that your excellent work of our students — possible including essays, full lesson plans, and videos — can be a valuable resource for the broad community of mathematics and science educators. If you’ve written something in another TNT class that you think is worthy of publication, please visit <http://meangreenmath.com/student-submissions/>.

*Part 1: Pre-Algebra and Probability/Statistics*

1. ~~Order of operations~~
2. ~~Introducing variables and expressions, such as~~ *~~x~~* ~~+ 3 and 4~~*~~t~~*
3. ~~Powers and exponents~~
4. ~~Solving one-step algebra problems, such as~~ *~~x~~* ~~+ 4 = 8 and 4~~*~~x~~* ~~= 16~~
5. Using variables in formulas for area of a rectangle, circle, etc.
6. ~~Absolute value of integers~~
7. ~~Adding and subtracting a mixture of positive and negative integers~~
8. Multiplying and dividing a mixture of positive and negative integers
9. ~~The field axioms (commutative property, associative property, etc.)~~
10. ~~Finding points on the coordinate plane~~
11. ~~Solving two-step algebra problems, such as 4~~*~~x~~* ~~- 3 = 11.~~
12. ~~Solving word problems that are one- or two-step algebra problems.~~
13. ~~Solving for unknown parts of rectangles and triangles.~~
14. ~~Finding prime factorizations.~~
15. ~~Finding greatest common divisors.~~
16. Reducing fractions to lowest terms.
17. Finding least common multiples.
18. ~~Determining which of two fractions is greatest if the denominators are unequal.~~
19. Laws of exponents (with integer exponents)
20. Negative and zero exponents
21. ~~Scientific notation~~
22. ~~Adding and subtracting fractions with unequal denominators~~
23. ~~Multiplying fractions~~
24. Dividing fractions
25. ~~Writing fractions as decimals and decimals as fractions~~
26. ~~Adding and subtracting decimals~~
27. ~~Multiplying and dividing decimals~~
28. Solving multi-step algebra problems, such as *a* (*b* *x*+ *c*) + *d* (*e* *x* + *f*) = *g* *x* + *h*.
29. Solving multi-step algebra problems containing decimals.
30. ~~Ratios and rates of change, such as 60 miles per hour~~
31. ~~Writing and solving proportions of the form~~ *~~a~~*~~/~~*~~b~~* ~~=~~ *~~c~~*~~/~~*~~d~~*
32. Solving percent problems of the form *a*/*b* = *p*%, like “What percent of 25 is 17?”
33. Fractions, decimals and percents
34. ~~Expressing a rate of change as a percentage, such as "on sale 25% off"~~
35. Solving word problems of the form "*a* is *p*% of *b*"
36. ~~Square roots~~
37. ~~Rational and irrational numbers~~
38. Making and interpreting bar charts, frequency charts, pie charts, and histograms
39. ~~Expressing probabilities as fractions and percentages~~
40. ~~Scatter plots~~
41. Stem-and-leaf plots
42. Box-and-whisker plots
43. ~~Circle graphs~~
44. Line graphs
45. ~~Venn diagrams~~
46. The multiplication rule for counting
47. Permutations
48. Combinations
49. ~~Probability and odds~~
50. Independent and dependent events
51. Finding probabilities using permutations.
52. Finding probabilities using combinations.
53. ~~Finding probabilities of compound events.~~
54. ~~Computing the mean, median and mode of data.~~
55. Computing the standard deviation of data.
56. Constructing a box-and-whisker plot.
57. Constructing a histogram with bins of equal width.
58. Using a normal distribution to estimate probabilities
59. Using the binomial distribution to compute probabilities

*Part 2: Algebra I and II*

1. Defining a function of one variable
2. ~~Equations of two variables, such as~~ *~~x~~* ~~+ 4~~*~~y~~* ~~= 16~~
3. ~~Graphs of linear equations~~
4. ~~Finding~~ *~~x~~*~~- and~~ *~~y~~*~~-intercepts of lines~~
5. ~~Finding the slope of a line~~
6. ~~Slope-intercept form of a line~~
7. ~~Using the point-slope equation of a line.~~
8. ~~Using the general linear equation~~ *~~A~~**~~x~~* ~~+~~ *~~B~~**~~y~~* ~~=~~ *~~C~~*~~.~~
9. ~~Find equations of parallel and perpendicular lines.~~
10. ~~Approximating data by a straight line.~~
11. Solving one- or two-step inequalities.
12. Solving inequalities that involve multiplying both sides by a negative number
13. Solving multi-step inequalities
14. ~~Word problems involving inequalities~~
15. Solving inequalities, such as *a* (*b* *x*+ *c*) < *d* (*e* *x* + *f*)
16. Solving compound inequalities, such as “*a* *x* + *b* < *c* or *d* *x* + *e* > *f*”
17. Solving absolute-value equations, such as *a* |*b* *x* + *c*| + *d* = *e*
18. Solving absolute-value inequalities, such as *a* |*b* *x* + *c*| + *d* < *e*
19. Graphing linear inequalities, such as *A* *x* + *B* *y* > *C*
20. ~~Solving linear systems of equations, such as~~

*~~a~~**~~x~~* ~~+~~ *~~b y~~* ~~=~~ *~~c~~*

*~~d~~**~~x~~* ~~+~~ *~~e y~~* ~~=~~ *~~f,~~*

~~by either substitution or graphing~~

1. Solving linear systems of inequalities, such as

*a* *x* + *b y* < *c*

*d* *x* + *e y* > *f*

1. Multiplying binomials, such as (4*x* + 1)(3*x* - 8)
2. Multiplying polynomials, such as (*a* *x* + *b*)(*c* *x*2 + *d* *x* + *e*)
3. Factoring quadratic polynomials, such as *a* *x*2 + *b* *x* + *c*
4. ~~Factoring the difference of two squares~~
5. ~~Factoring a perfect-square trinomial~~
6. ~~Graphing parabolas~~
7. ~~Completing the square~~
8. ~~The quadratic formula~~
9. ~~Fitting data to a quadratic function~~
10. Graphing square-root functions, such as 
11. Simplifying radical expressions, such as 
12. Solving radial equations, such as 
13. Graphing a rational equation, such as 
14. Dividing polynomials
15. Finding the asymptotes of a rational function
16. Simplifying rational expressions, such as and
17. Multiplying and dividing rational expressions
18. Adding and subtracting rational expressions
19. Solving rational equations
20. ~~Solving linear systems of equations, such as~~

*~~a~~**~~x~~* ~~+~~ *~~b y~~* ~~=~~ *~~c~~*

*~~d~~**~~x~~* ~~+~~ *~~e y~~* ~~=~~ *~~f,~~*

 ~~using matrices~~

1. ~~Adding, subtracting, and multiplying matrices~~
2. ~~Computing the determinant of a matrix~~
3. Computing the inverse of a matrix
4. Adding, subtracting, multiplying and dividing complex numbers
5. ~~Polynomials and other nonlinear functions~~
6. ~~Adding and subtracting polynomials~~
7. Monomials and powers
8. Finding the rational roots of a polynomial
9. Factoring polynomials
10. Computing inverse functions
11. Using the Laws of Exponents with rational (non-integer) exponents

*Part 3: Geometry*

1. ~~Using the undefined terms of~~ *~~point~~*~~,~~ *~~line~~*~~, and~~ *~~plane~~*
2. Defining the term *collinear* or *coplanar*
3. ~~Defining the terms~~ *~~line segment~~* ~~and~~ *~~ray~~*
4. Defining the term *intersection*
5. ~~Distinguishing between axioms, postulates, theorems, and corollaries~~
6. ~~Defining the term~~ *~~midpoint~~*
7. Defining the term *segment bisector*
8. ~~Deriving the Midpoint Formula~~
9. ~~Deriving the Distance Formula~~
10. ~~Define the term~~ *~~angle~~* ~~and the~~ *~~measure~~* ~~of an angle~~
11. ~~Defining the terms~~ *~~acute~~*~~,~~ *~~right~~*~~, and~~ *~~obtuse~~*
12. ~~Using a straightedge and compass to bisect segments and angles~~
13. ~~Defining the terms~~ *~~complementary~~* ~~angles,~~ *~~supplementary~~* ~~angles, and~~ *~~vertical~~* ~~angles~~
14. Defining the terms *corresponding angles*, *alternate interior angles*, and *alternate exterior angles*
15. ~~Classifying polygons, such as triangles, quadrilaterals, pentagons, etc.~~
16. ~~Finding the perimeter of a polygon~~
17. ~~Finding the area of a square or rectangle~~
18. ~~Finding the area of a right triangle~~
19. Distinguishing between inductive and deductive reasoning
20. Writing conditional statements in if-then form
21. Finding the converse, inverse and contrapositive
22. ~~Defining the terms~~ *~~perpendicular~~* ~~and~~ *~~parallel~~*
23. Defining the term *congruent*
24. Recognizing equivalent statements
25. Introducing indirect proof
26. ~~Using truth tables~~
27. Introducing postulates about points, lines and planes (e.g., if two lines intersect, then their intersection is exactly one point)
28. Introducing the two-column, statement-reason paradigm of geometric proofs
29. Proving that vertical angles are congruent
30. Introducing the Parallel Postulate
31. Introducing “taxicab” geometry
32. ~~Defining the terms~~ *~~scalene~~* ~~triangle,~~ *~~isosceles~~* ~~triangle,~~ *~~equilateral~~* ~~triangle~~
33. ~~Defining the terms~~ *~~acute~~* ~~triangle,~~ *~~right~~* ~~triangle, and~~ *~~obtuse~~* ~~triangle~~
34. Proving that the measures of a triangle’s angles add to 180 degrees
35. Proving that the acute angles of a right triangle are complementary
36. Identifying congruent parts of two different triangles
37. Proving that two triangles are congruent using SSS
38. Proving that two triangles are congruent using SAS
39. Proving that two triangles are congruent using ASA and AAS
40. Proving that two triangles are congruent using HL
41. Proving that the base angles of an isosceles triangle are congruent
42. Introducing the term *perpendicular bisector*
43. Introducing the terms *incenter* and *circumcenter*
44. Using straightedge and compass to find the incenter of a triangle
45. Using straightedge and compass to find the circumcenter of a triangle
46. Introducing a *median* of a triangle
47. Introducing the terms *altitude* and *orthocenter*
48. Introducing the geometric mean of two numbers
49. ~~Introducing proportions~~
50. Introducing similar polygons
51. Proving that two triangles are similar using AA
52. ~~Deriving the Pythagorean theorem~~
53. Deriving the proportions of a 30-60-90 right triangle
54. Deriving the proportions of a 45-45-90 right triangle
55. Defining sine, cosine and tangent in a right triangle
56. Introducing the term *convex polygon*.
57. ~~Proving that the angles of a convex~~ *~~n~~*~~-gon sum to 180(~~*~~n~~*~~-2) degrees.~~
58. Introducing the terms *parallelogram, rhombus, trapezoid* and *kite.*
59. Proving the midsegment theorem for trapezoids
60. ~~Introducing translation, rotation and reflection of figures~~
61. Identifying axes of symmetry in a figure
62. ~~Identifying dilations~~
63. Defining the terms *circle*, *center*, *chord*, *radius*, *diameter*, *secant* and *tangent*
64. ~~Radius, diameter and circumference of circles~~
65. Defining the terms *central angle* and *inscribed angle*
66. ~~Finding the area of a triangle~~
67. ~~Finding the area of a parallelogram~~
68. Finding the area of a trapezoid
69. Finding the area of a kite
70. ~~Finding the circumference of a circle~~
71. ~~Finding the area of a circle~~
72. Finding the area of regular polygons
73. Using polyhedral nets to construct polyhedra
74. Using Euler’s theorem for polyhedra
75. Defining the terms *prism*, *cylinder*, *cone*, *pyramid*, and *sphere*
76. ~~Finding the volume and surface area of prisms and cylinders~~
77. ~~Finding the volume and surface area of pyramids and cones~~
78. ~~Finding the volume and surface area of spheres~~

*Part 4: Precalculus*

1. ~~Graphing exponential growth and decay functions~~
2. ~~Compound interest~~
3. ~~Half-life of radioactive elements~~
4. ~~Introducing the number~~ *~~e~~*
5. Computing logarithms with base 10
6. Computing natural logarithms
7. ~~Solving exponential equations~~
8. Solving logarithmic equations
9. Applying logistic equations
10. ~~Finding the domain and range of a function~~
11. ~~Finding symmetry when graphing a function~~
12. ~~Computing the composition of two functions~~
13. Graphing rational functions
14. Finding the partial fraction decomposition of a rational function
15. Graphing parametric equations
16. Factoring polynomials over the complex plane
17. ~~Using synthetic division~~
18. Solving equations with rational functions
19. Finding the focus and directrix of a parabola
20. ~~Finding the equation of a parabola using the focus and directrix~~
21. Finding the foci of an ellipse
22. ~~Finding the equation of a circle~~
23. ~~Graphing an ellipse~~
24. Finding the foci and asymptotes of a hyperbola
25. ~~Graphing a hyperbola~~
26. Determine the eccentricity of conic sections
27. Using sequences
28. Using a recursively defined sequence
29. Using factorials and binomial coefficients
30. ~~Using arithmetic sequences~~
31. ~~Using geometric sequences~~
32. Using an arithmetic series
33. Using a finite geometric series
34. ~~Using an infinite geometric series~~
35. ~~Using right-triangle trigonometry~~
36. ~~Using radians to measure angles instead of degrees~~
37. ~~Computing trigonometric functions using a unit circle~~
38. ~~Evaluating inverse trigonometric functions~~
39. ~~Applying the Law of Sines~~
40. Applying the Law of Cosines
41. Deriving Heron’s formula
42. ~~Graphing the sine and cosine functions~~
43. ~~Verifying trigonometric identities~~
44. ~~Solving trigonometric equations~~
45. Deriving and using the sum and difference formulas for sine, cosine and tangent
46. Deriving the double angle formulas for sine, cosine and tangent
47. Deriving the power-reduction formulas for sine and cosine
48. Deriving the half-angle identities for sine, cosine and tangent
49. Deriving the sum-to-product and product-to-sum identities for sine and cosine
50. ~~Using vectors in two dimensions~~
51. ~~Computing the dot product of two vectors~~
52. Computing the cross product of two vectors (in three dimensions)
53. ~~Graphing with polar coordinates~~
54. Computing *n*th roots using DeMoivre’s theorem
55. ~~Using Pascal’s triangle~~
56. ~~Using mathematical induction~~