Math 300: Junior Colloquium
Spring 2017
Calculus 1 Topics List

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Your talk should have a clear statement of what you're talking about, an explanation of the topic, and at least one or two quick examples; it's especially nice to have an example where something doesn't work properly if that applies.

I will want to have a copy of your notes/plans for the talk by 10:30 AM Wednesday–you can email to me a LaTeX file, or email me a scan/photo of your notes, or drop them off in the basket outside my office. If you're late on this, you will lose points. (Feel free to send it in on Tuesday or Monday). Once you enter your name on the Doodle poll you are responsible for that topic.

I will give you feedback Wednesday evening—probably a few pointers, and also making sure you have nothing outright false in your talk plans. Then on Thursday morning you will present your talk in the room (I will let you know when we find out where).

1. Limits and limit laws

   Talk about the conceptual idea of a limit, and also the limit laws that allow us to compute limits.

2. Computing limits and indeterminate forms

   How do we compute limits in practice? Cancellation, possibly the small angle approximation. What are the indeterminate forms? (Make sure you get all six). Why are they important?

3. Infinite limits and L'Hôpital's rule

   Limits at infinity, and limits whose output is infinity. How do we use L'Hôpital's Rule to compute limits easily? What do we need to be careful of that keeps it from working?

4. Continuity, types of discontinuities, IVT

   What is the formal definition of a continuous function? Informally what does this mean—what should we expect to see on the graph? What are different ways that a function can fail to be continuous? Which functions are continuous?

5. Derivative, meaning and definition

   What is the derivative? How should we think about it—talk about increasing and decreasing here. What is the formal limit definition of a derivative, and how can we use it to calculate derivatives?

6. Computing basic derivatives

   What are the basic rules we use to compute the derivative? Sum, product, quotient, chain rules.

7. Trig, inverse trig, exponential, and logarithm derivatives

   Look at some other functions with tricky derivatives. Cover the trig functions, define the inverse trig functions and talk about their derivatives. Derivatives of the exponential and logarithmic functions—and what happens if the base is not e?

8. Tangent line approximations

   This is the important application of the derivative: using it to approximate function values. Talk about the geometry, where you can find the equation of the tangent line; also talk about using this

to approximate the values of functions where they're hard to compute exactly—$\sqrt{x}$ can be a good example here.

9. Implicit differentiation

   What is implicit differentiation? What can we do with it? Tangent lines to implicitly defined curves.

10. Optimization–max and min; extreme value theorem

    What are absolute extrema, and what are relative extrema? We can find relative extrema using the derivative. The Extreme Value Theorem allows us to find absolute extrema on a closed interval. (Don't cover the first and second derivative tests).

11. Curve sketching–increasing/decreasing, concavity

    How can we use the derivative (and second derivative) to determine the shape of a graph? Putting together information about all the maxima and minima to sketch the graph. We can use the first derivative and second derivative tests to classify extrema.

12. Differential equations and exponential growth

    What is a differential equation, and how do we check that a function is the solution to one? Discuss the exponential growth model $f'(x) = rf(x)$ as a model for population growth, radioactive decay, and othe related phenomena.