Mathematics Tutorial Series
Differential and Integral Calculus

Video 1: Introduction to Studying Calculus

This series of video presentations covers differential and integral calculus.

Calculus can be studied in a variety of ways and depths.

Calculus as a toolbox: Calculus is a set of tools for building mathematical models. The models can be in science, business, economics, medicine, climate change – in fact, any situation where the system is changing continually needs a tool like calculus.

Single variable and multi-variable: Complex models, such as climate models, use functions of more than one variable. Students typically start with one variable then move on to two and more variables in later courses.

Rigorous Calculus: Calculus was used as a tool for about 250 years before a logical basis for calculus was developed, through careful, precise definition of "limit". Those interested in this rigorous basis for calculus can find many sources.

Abstract Calculus: With the flourishing of abstract mathematics in the 20th century, calculus became "analysis". No longer a toolbox, mathematical analysis looks at much more general concepts. For example, rather than build one particular model and use it to make predictions, in mathematical analysis one might study what models are possible and what general common properties will these models have.

These video tutorials will stress

Calculus as a Toolbox for Building Models

We want to look at each tool in four ways: ALL ARE IMPORTANT

1. What it **does**
2. What it **means**
3. What the **geometry** looks like
4. How the tool is **used** to solve problems

You should be able to answer a question on any of these four aspects about any tool we develop.

You will find videos that present examples for each topic

There is not much point in talking about tools without looking at the job they do. We would not bother with calculus at all if it didn't give us useful and powerful mathematical models.

You will find videos in this series that explore a variety of mathematical models:

- Climate models
- Weather models
- Why there is a rainbow
- Spread of disease
- Impact of monetary policy
- *And many more*

Lesson 0: Studying and Learning Mathematics

1) Find your own optimum way of learning.
   a) By listening
   b) By reading
   c) By watching people do mathematics
   d) By doing practice problems
   e) By asking questions
   f) By taking your own notes
   g) From people
   h) From mistakes
   i) From the Internet
   j) By moving in a spiral
   k) At the last minute
2) Find the resources available to support this style of learning.
3) There is no substitute for sustained, focused thinking.
4) Practice is the key to mastering techniques.
5) Try to see each problem as a special instance of a general problem.
6) Always look for meaning and significance as well as technical correctness.

Technology

You can now get software for your smart phone that can do all the technical problems in any university calculus or linear algebra course.

Most of graphics in this video series were created on my iPhone.

Once you know how to use it, technology can take care of all the technical aspects of calculus. It replaces the purely technical skills.

What technology of this sort can't do is replace your understanding, insight and motivation. You have to provide the meaning.

Summary

1. The series is about calculus as a tool for building models
2. Each topic will be considered from four perspectives:
    a. What it does
    b. What it means
    c. What it looks like
    d. What it is used for
3. Students must develop their own optimal strategy for learning
4. Technology can do all the calculations but provide none of the meanings

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