SABBATICAL REPORT: MATHEMATICS IN REVIEW VIDEO SERIES

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Abstract

As the implementation of Assembly Bill 705 (AB 705 hereafter) looms, it is imperative that we, the mathematics educators, prepare for the onslaught of underprepared students in our transfer-level courses. While the wording of AB 705 left quite a bit to interpretation, many view it as a mandate requiring the placement of all but a few students into mathematics courses well-beyond their preparation and skill-level. The AB 705 placement schema is based upon high school transcripts – primarily on the last math class taken as long as it has been at most ten years since graduation; however, "algebra" and "precalculus" at the high school level are not equivalent to "algebra" and "precalculus" at the college level. We have already seen the devastation within our classrooms when it comes to students who have reached beyond their skill level due to AB 705 placement.

As educators, our students' success is our foremost concern. The student population at Cosumnes River College (CRC hereafter) is in particular peril as they traditionally come from challenging socio-economic and academic backgrounds. The skills they have obtained (or retained) from their high school experiences are lackluster and based not on understanding and critical thinking, but rote memorization and mimicry; however, mathematics is unlike most other subjects in that delicate scaffolding of theory and concepts is critically important for success. The scaffolding with which our students arrive is missing entire swathes of content and, as such, localized remediation within a classroom is impossible. Hence, a creative solution to remediation is necessary.

This sabbatical project involves the creation of a library of review videos in mathematics. The intent is to extend this library to a complete, modular treatment of all topics that a student entering transfer-level mathematics should have mastered before the first day of class. The design of each video fosters an understanding of the topic from a review perspective (assuming pre-exposure to the material) and contains both a theoretical and mechanical treatment of the topic. This is far from what any other video series in mathematics has ever attempted (yes, even Khan Academy). Each video has an embedded and hyperlinked table of contents for quick access to subtopics within the video. Moreover, each video contains a listed of hyperlinks that lead to other prerequisite videos within the series.

The number of topics that a student must have mastery with upon entering a transfer-level mathematics course is well into the hundreds (if not thousands). There is not enough time in a single-semester sabbatical to properly produce such a video series; however, this sabbatical allowed for the production of an initial group of 24 videos that have already been used as remediation tools for students.

The Sabbatical Details

In all, I spent 680 hours (and some change) on this project during the Spring semester. My time was spent doing the following activities.

- Researching fun or interesting topics to engage viewers for each topic
- Writing scripts for each video
- Recording narration (separately from video)
- Screen recording
- Editing (this was the lion's share of the work)
- Producing and uploading
- Editing the video for YouTube display

Having significant experience with video production from the past decade (I have over 200 videos on YouTube with millions of views), this project was right "up my alley." What I was not prepared for, however, was the difference the attention to quality was going to make in production time. The intent was to create videos that could withstand a decade of scrutiny and still be relevant, entertaining, and engaging.

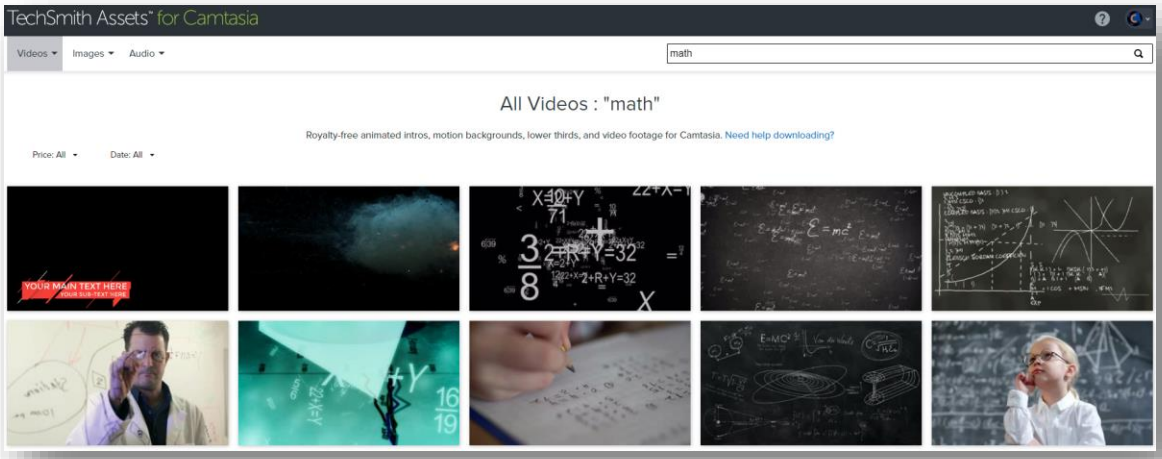
I spent quite some time initially defining (and redefining) a process for production. The final workflow mirrors what was listed above; however, an example might be best to understand the time scale. Within this example, I provide links and images of typical steps within the process.

Video: Capstone – Linears (15 minutes, 58 seconds in length)

Research (3.5 hours)

The research for this video involved extensive searches for open-source images, sounds, and content as well as the development of an engaging topic (the search for extraterrestrial life). Typical resources I use for this are

- Techsmith Library (https://library.techsmith.com/): This is an annual subscription site ($199/year) that I paid for out-of-pocket. It is immensely helpful in video, image, and sound research.


TechSmith Assets™ for Camtasia
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Images
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All Videos : "math"
Royalty-free animated intros, motion backgrounds, lower thirds, and video footage for Camtasia. Need help downloading?
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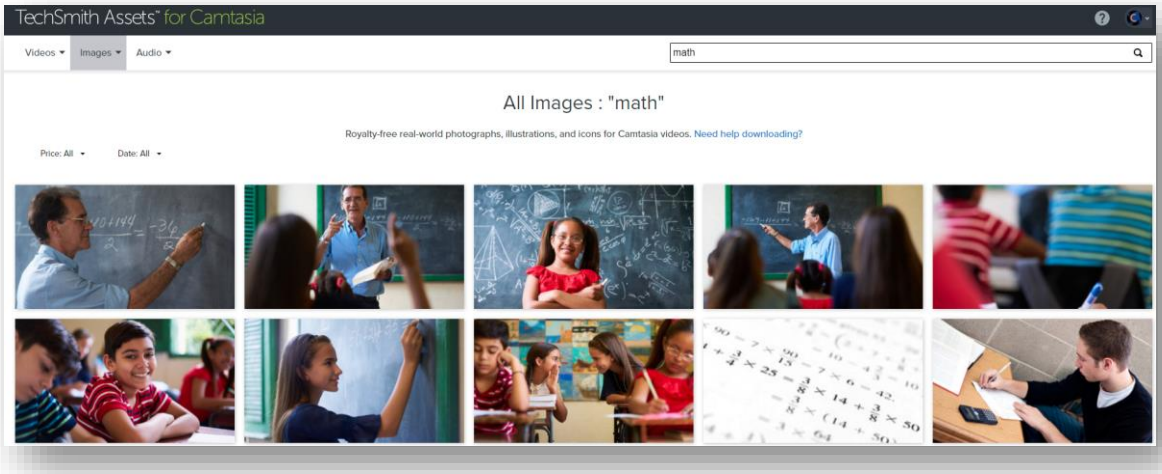
TechSmith Assets™ for Camtasia
Videos
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Audio
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All Images : "math"
Royalty-free real-world photographs, illustrations, and icons for Camtasia videos. Need help downloading?
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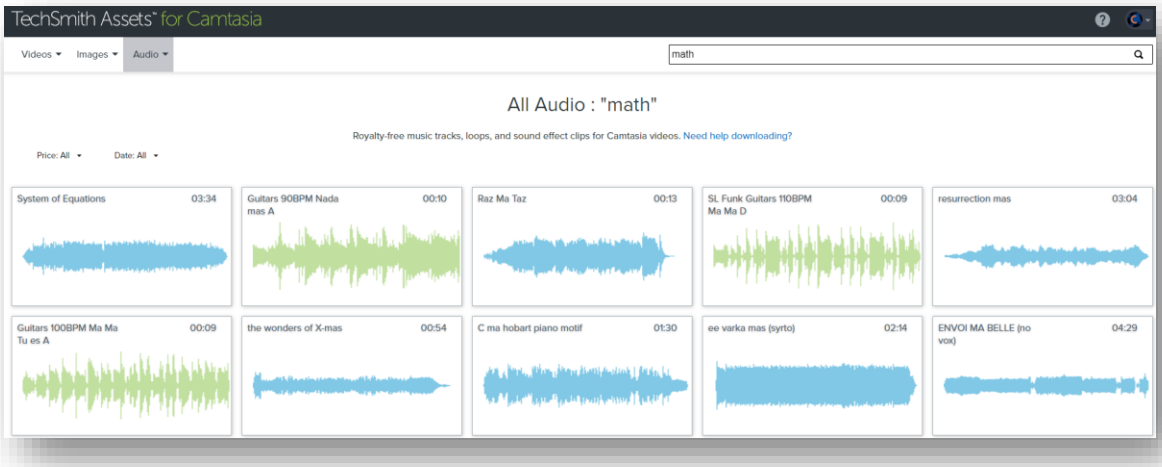
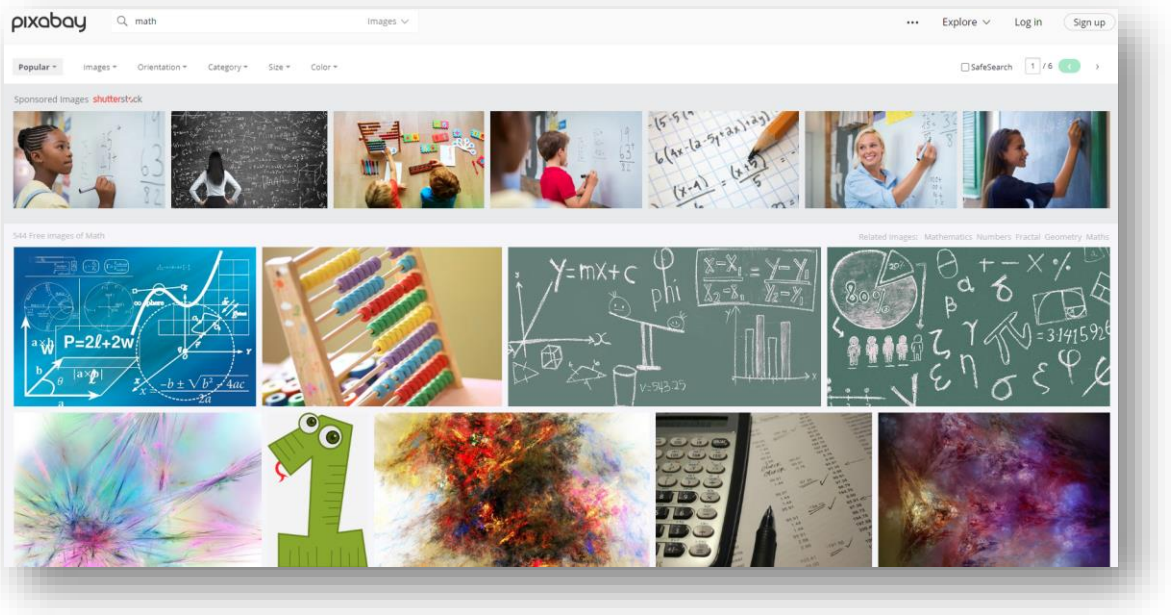
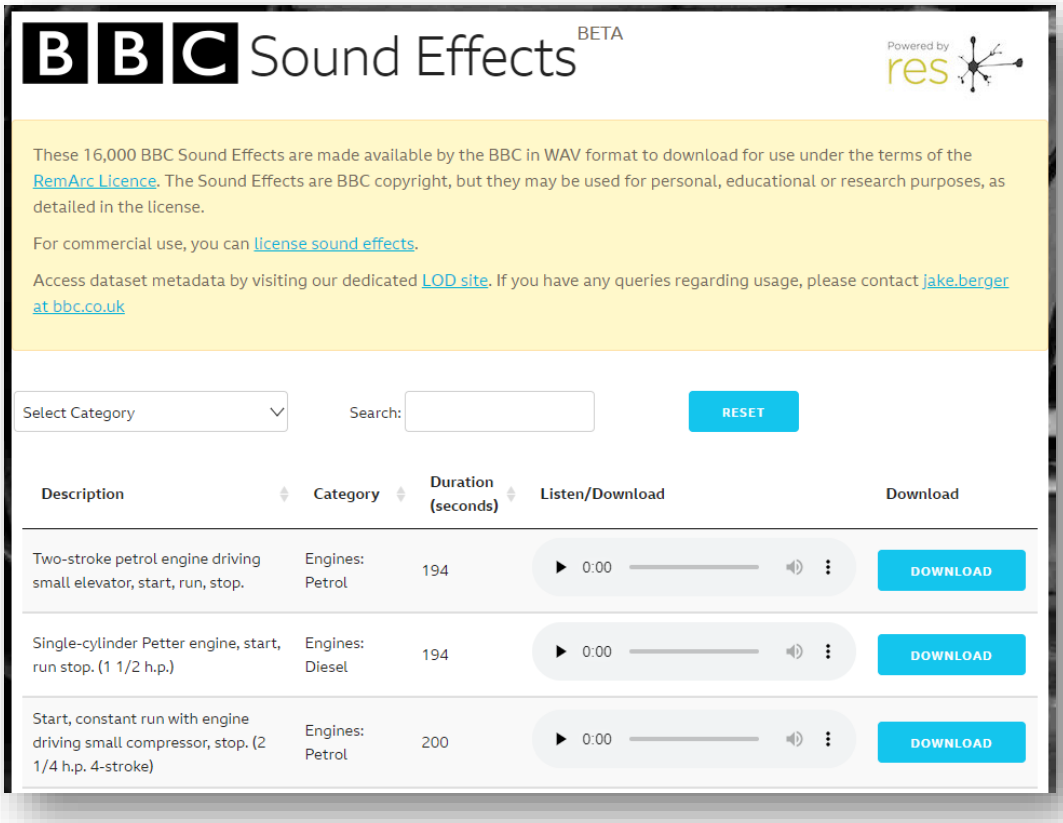

TechSmith Assets™ for Camtasia
Videos
Images
Audio
math
All Audio : "math"
Royalty-free music tracks, loops, and sound effect clips for Camtasia videos. Need help downloading?
Price: All
Date: All
System of Equations 03:34
Guitars 90BPM Nada mas A 00:10
Raz Ma Taz 00:13
SL Funk Guitars 110BPM Ma Ma D 00:09
resurrection mas 03:04
Guitars 100BPM Ma Ma Tu es A 00:09
the wonders of X-mas 00:54
C ma hobart piano motif 01:30
ee varka mas (syrto) 02:14
ENVOI MA BELLE (no vox) 04:29

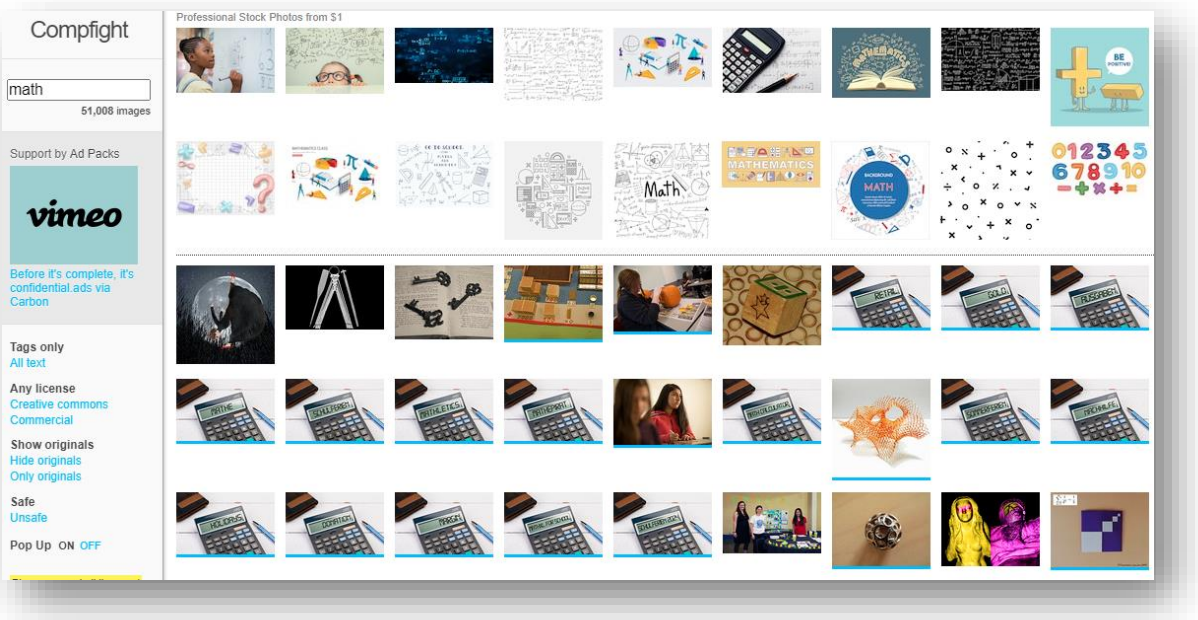
- Pixabay (https://pixabay.com/). This is a great site for royalty-free images.



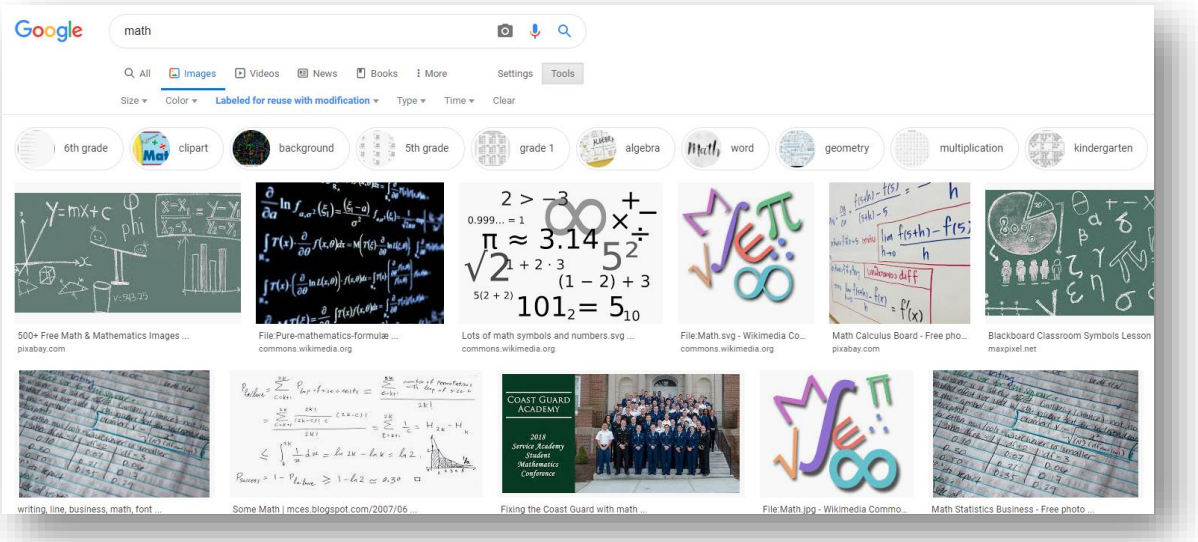
- BBC Sound Effects (http://bbcsfx.acropolis.org.uk/). This is a wonderfully useful site for brief sound effects.



- CompFight (http://compfight.com/). This is a good resource, but can result in many privately-owned images.



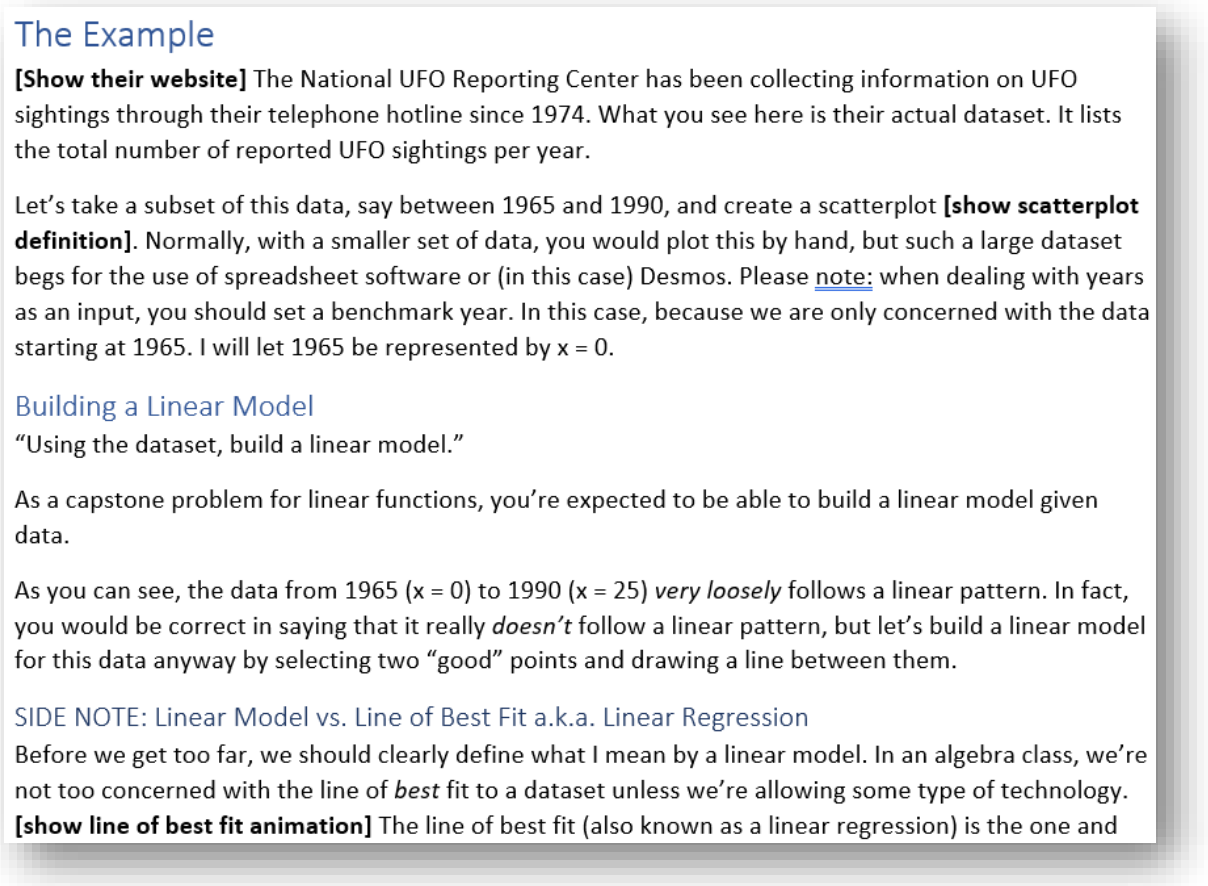
- Google. Finally, a Google image search with the condition that the usage rights be labeled for reuse with modification can be helpful.



Script Writing (3 hours)

This is done in conjunction with the research, but requires a significant attention to detail, phrasing, and entertainment. Moreover, as a capstone video, it was critical to hit as many topics as possible that a student should know when they successfully pass an algebra course. Adherence to the script is also important as it is eventually uploaded for closed captioning. I have included an image of part of the script used for this specific

video below.



The Example

[Show their website] The National UFO Reporting Center has been collecting information on UFO sightings through their telephone hotline since 1974. What you see here is their actual dataset. It lists the total number of reported UFO sightings per year.

Let's take a subset of this data, say between 1965 and 1990, and create a scatterplot **[show scatterplot definition]**. Normally, with a smaller set of data, you would plot this by hand, but such a large dataset begs for the use of spreadsheet software or (in this case) Desmos. Please note: when dealing with years as an input, you should set a benchmark year. In this case, because we are only concerned with the data starting at 1965. I will let 1965 be represented by x = 0.

Building a Linear Model

"Using the dataset, build a linear model."

As a capstone problem for linear functions, you're expected to be able to build a linear model given data.

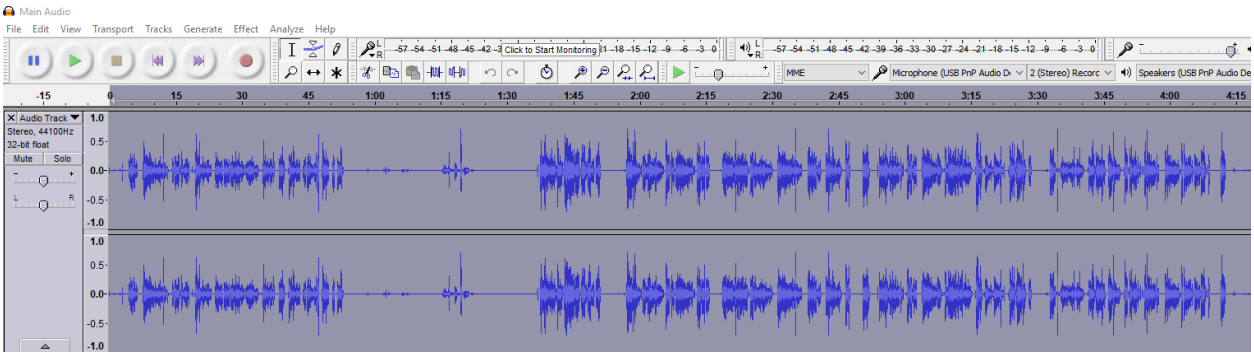
As you can see, the data from 1965 (x = 0) to 1990 (x = 25) *very loosely* follows a linear pattern. In fact, you would be correct in saying that it really *doesn't* follow a linear pattern, but let's build a linear model for this data anyway by selecting two "good" points and drawing a line between them.

SIDE NOTE: Linear Model vs. Line of Best Fit a.k.a. Linear Regression

Before we get too far, we should clearly define what I mean by a linear model. In an algebra class, we're not too concerned with the line of *best* fit to a dataset unless we're allowing some type of technology. **[show line of best fit animation]** The line of best fit (also known as a linear regression) is the one and

Narration (1 hour)

This, along with screen recording, is the fastest step. I record audio using Audacity, apply a series of effects and filters, and save the narration. I record using a HyperX Gaming Headset (see image below) on a HP Spectre x360 laptop.



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Screen Recording (1 hour)

The screen recording, done using Camtasia, entails the handwritten segments. This is the capturing of the mathematics that I am writing during the video, but not the screen clips or graphics used within the editing phase.

Editing (10.5 hours)

This is definitely the longest process in any video production. During this phase, the screen recording and the narration are imported into a Camtasia template I have created for the CRC Mathematics in Review Series. Once imported, the painstaking task of cutting the video and audio begins. This process is followed by adding section transitions and titles. Throughout this process animations, pan effects, time-scaling, and audio improvements are applied. Next, external video snippets, images, and audio (from the Research section) are added). Finally, a thorough pass-through for any inconsistencies is required.

Production and Upload (3 hours)

This is the "set and forget" time. The production phase occurs within Camtasia and results in an HD video ready for upload. The upload takes anywhere from an hour to, in one case, 10 hours (I live out in the sticks).

Final Editing in YouTube (2.5 hours)

This phase is where the hyperlinked table of contents is created on YouTube, the search terms are embedded, and the prerequisite hyperlinks are edited/added.

The Time-to-Video Rule of Thumb

As you can see, it took 24.5 hours to create the 16-minute Linear Capstone video. In general, I found that each minute of produced video took approximately 1.5 hours of work. In the end I created 24 professional

quality videos, each *roughly* 15 minutes in length. Hence, around 540 hours was spent on video creation. The remainder of the time is detailed in the next section.

Learning as I Go

Despite my extensive experience with video creation, I continually learned from newly found mistakes during this sabbatical. My templates served me well and saved me a lot of time; however, the bane of my existence was the lack of a prerequisite topic list. I continually refined the one I started with, but it eventually morphed so much that I had to remove all my videos from YouTube and reupload them with updated prerequisite listings and links. The following is the new prerequisite model.

ALGEBRA - EXPRESSIONS - FACTOR (DIFFERENCE OF SQUARES)	3.2.1.05.2	https://youtu.be/FeER2sl2DK4
ALGEBRA - EXPRESSIONS - FACTOR (TRINOMIALS WITH UNIT LEAD COEFFICIENT)	3.2.1.05.3	
ALGEBRA - EXPRESSIONS - FACTOR (TRINOMIALS WITH NON-UNIT LEAD COEFFICIENT: GUESS-AND-CHECK METHOD)	3.2.1.05.4	https://youtu.be/nmqHwmYLSyQ
ALGEBRA - EXPRESSIONS - FACTOR (TRINOMIALS WITH NON-UNIT LEAD COEFFICIENT: ALGORITHMIC METHOD)	3.2.1.05.5	
ALGEBRA - EXPRESSIONS - FACTOR (GCF FROM NON-POLYNOMIALS)	3.2.1.05.6	
ALGEBRA - EXPRESSIONS - FACTOR (FACTORING OVER THE COMPLEX NUMBER SYSTEM)	3.2.1.05.7	
ALGEBRA - EXPRESSIONS - RATIONALS (UNDEFINED VALUES)	3.2.1.06.1	
ALGEBRA - EXPRESSIONS - RATIONALS (LOWEST COMMON DENOMINATOR)	3.2.1.06.2	
ALGEBRA - EXPRESSIONS - RATIONALS (SIMPLIFYING)	3.2.1.06.3	
ALGEBRA - EXPRESSIONS - RATIONALS (ADDITION & SUBTRACTION)	3.2.1.06.4	
ALGEBRA - EXPRESSIONS - RATIONALS (COMPOUND FRACTIONS)	3.2.1.06.5	https://youtu.be/vwhK3b3KwLc
ALGEBRA - EXPRESSIONS - RADICALS	3.2.1.07.0	
ALGEBRA - EQUATIONS - OVERVIEW (DEFINITION)	3.2.3.01.1	https://youtu.be/cqvGsl8JGMg?t=48
ALGEBRA - EQUATIONS - OVERVIEW (EQUIVALENT EQUATIONS)	3.2.3.01.2	https://youtu.be/cqvGsl8JGMg?t=207
ALGEBRA - EQUATIONS - OVERVIEW (CONTRADICTIONS)	3.2.3.01.3	https://youtu.be/cqvGsl8JGMg?t=350
ALGEBRA - EQUATIONS - OVERVIEW (IDENTITIES)	3.2.3.01.4	https://youtu.be/cqvGsl8JGMg?t=454
ALGEBRA - EQUATIONS - LINEAR (DEFINITION)	3.2.3.02.1	https://youtu.be/odYQJRjSrKA?t=48
ALGEBRA - EQUATIONS - LINEAR (SOLVE)	3.2.3.02.2	https://youtu.be/odYQJRjSrKA?t=212
ALGEBRA - EQUATIONS - RATIONAL (DEFINITION)	3.2.3.03.1	
ALGEBRA - EQUATIONS - RATIONAL (SOLVE)	3.2.3.03.2	
ALGEBRA - EQUATIONS - RATIONAL (EXTRANEOUS SOLUTIONS)	3.2.3.03.3	
ALGEBRA - EQUATIONS - RADICAL	3.2.3.04	
ALGEBRA - EQUATIONS - QUADRATIC (EXTRACTION OF ROOTS)	3.2.3.05.1	
ALGEBRA - EQUATIONS - QUADRATIC (ZERO FACTOR PRINCIPLE)	3.2.3.05.2	https://youtu.be/n09LYtV9EnE
ALGEBRA - EQUATIONS - QUADRATIC (QUADRATIC FORMULA)	3.2.3.05.3	
ALGEBRA - EQUATIONS - POLYNOMIAL	3.2.3.06	
ALGEBRA - EQUATIONS - EXPONENTIAL (SOLVE)	3.2.3.07	
ALGEBRA - EQUATIONS - LOGARITHMIC	3.2.3.08	
ALGEBRA - EQUATIONS - FORMULAS (SOLVE FOR SPECIFIC VARIABLES)	3.2.3.09	https://youtu.be/ydTDmLdDyak
ALGEBRA - INEQUALITIES - OPERATIONS (OVERVIEW)	3.2.4.01	
ALGEBRA - INEQUALITIES - LINEAR (SOLVE)	3.2.4.02	
ALGEBRA - INEQUALITIES - QUADRATIC (SOLVE)	3.2.4.03	
ALGEBRA - INEQUALITIES - POLYNOMIAL (SOLVE)	3.2.4.04	
ALGEBRA - INEQUALITIES - RATIONAL (SOLVE)	3.2.4.05	
ALGEBRA - GRAPHS - OVERVIEW	3.2.5.01.0	
ALGEBRA - GRAPHS - OVERVIEW (THE CARTESIAN COORDINATE SYSTEM, AXES, AND ORDERED PAIRS)	3.2.5.01.1	

Results

We are still in the beginning stages of the AB 705 implementation; however, the videos have seen use in several classes. We are beginning to develop implementation strategies to get the most use of these in an effort to help remediation. Our plan is to use them within our support courses for the BSTEM students (pending approval of our BSTEM support course).

Video List

The following is a list a "Greatest Hits" of *some* of the videos created during this sabbatical. The entire list can be found at http://bit.ly/crcmathinreview.

- Linears Capstone (https://youtu.be/Z51i2QoFyDY)

- Quadratics Capstone (https://youtu.be/RU6_TIRzNSs)
- Quadratics – Zero Factor Principle (https://youtu.be/n09LYtV9EnE)
- Factoring – Difference of Squares (https://youtu.be/FeER2sI2DK4)

A Retrospective

The original intent of this video series was to create a resource to help students fill in gaps in their education while keeping them on track to pass a transfer-level mathematics course within one year of entering college. With the light implementation we have had so far, it is painfully obvious that the amount of remediation students are requiring would take *at least* an entire dedicated course (which we in academia would call a… wait for it… prerequisite course). Unfortunately, "just-in-time" remediation offered by strategies such as implementing these videos, offering co-requisite courses, or building labs to ride "alongside" a course is not a feasible strategy for success with the vast majority of our students.