Applied Economics Teaching Resources

Teaching and Educational Methods

Insights from Asynchronous Lecture Viewing Behavior

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Abstract
The COVID-19 pandemic forced many applied economics courses to switch from synchronous, face-to-face instruction to an online format. A strategy for some instructors is to pre-record lectures for asynchronous viewing by students. I provide commentary on observed viewing behavior of pre-recorded lectures in an applied economics course and suggest ways to improve construction of asynchronous material. I observe students delaying viewing until assignments are due, skipping over lecture material and scrubbing to the "hands-on" portions of the videos, losing attention after approximately 20 minutes, and watching primarily on larger screens. Instructors may wish to consider posting lecture notes separately, with shorter videos covering only hands-on activities to improve student engagement.

1 Introduction

An asynchronous learning network (ALN) is a type of instruction where students consume learning materials and communicate or collaborate with each other from a distance (Wieland 2012). The defining characteristics of ALNs are the ability for students to listen to a lecture, for example, at different times and to communicate with each other and the instructor. Traditional courses may have synchronous lecture delivery, with the expectation that students collaborate on their own time. An ALN "flips" the traditional classroom[1] so that the opposite occurs: students enjoy asynchronous lecture delivery with potentially synchronous opportunities for collabroation. Flipping the classrom has received much attention, with high-profile evidence that student learning may drastically improve with the different format (Berrett 2012; Khan 2012).

There are several benefits to the asynchronous course structure. For students that may struggle to understand the language of instruction, ALNs offer the ability to re-watch or slow down instruction to improve understanding (Simpson 2006). For courses that emphasize data access or management, ALNs can help students get hands-on experience (Jaffee 1997). ALNs can also encourage student-to-student collaboration (Arbaugh 2000; Marmon, Gordesky, and Vanscoder 2013) and improve student satisfaction (Wu, Bieber, and Hiltz 2019).

During the COVID-19 outbreak in the spring semester of 2020, many universities abruptly shifted to online instruction as campuses were closed to prevent the spread of the virus. While the timing of the pandemic did not allow for full development of a new ALN, instructors faced the decision whether to continue with synchronous instruction on digital platforms, or develop prerecorded material for asynchronous consumption.

This paper reveals insights from student viewing data on ansynchronous lecture videos to learn more about student engagement with classroom material. Specifically, the paper explores the duration, timing, and engagement with lecture videos that consist of a traditional lecture and a hands-on portion

[1] The traditional classroom in this context is one with synchronous lecture delivery. Many other classroom formats exist along the gradient from totally synchronous to totally asynchronous, but those distinctions are not explored here.

with a data analysis tool. Analytic viewing data from lecture videos is used to understand when and how students watch prerecorded material, and what parts of the lecture were skipped or replayed. Several lessons are apparent and are explored in the last section.

2 Initial Synchronous Course Structure

The course analyzed in this paper is a junior undergraduate level course in econometric analysis taught at a large four-year public university (hereafter referred to as "the course"). There were 76 students enrolled in the course. Prerequisites include calculus, economic theory, and a class on economic analysis held in a local computer lab. Students are introduced to basic data management and analysis using Microsoft Excel (Microsoft Excel 2020).

The course has a modular structure that covers mathematic and statistical reviews, linear regression, multivariate regression, basic nonlinear regression, application of regression analysis optimization to demand and supply analysis, and personal finance and forecasting. Specifically, the modules are:

1. Statistics Review
2. Mathematics Review
3. Linear Regression
4. Multiple Regression
5. Advanced Model Specification
6. Applied Production Economics
7. Applied Demand Analysis
8. Personal Finance and Forecasting

Modules 1–5 are designed to be technical in nature, with small applied problems accompanying mathematical derivations. Modules 3–5 focus on the derivation of ordinary-least-squares (OLS) estimators using principles from calculus and linear algebra. Students are exposed to the Gauss-Markov Theorem and are taught how to spot potential endogeneity problems. There are eight problem sets corresponding to each module. With the exception of problem set 2 (focused on calculating derivatives and solving systems of equations), the problem sets are completed in Excel and submitted to a secure course management site.

The course initially met twice a week, for 1 hour and 15 minutes each session. Lectures were face-to-face and synchronous. Examples of regression or data analysis were performed in Excel using a projector system in a traditional classroom. Students were expected to either own laptops and follow along themselves, or to take notes and perform the analysis later at their convenience.

In the spring of 2020, the rapid spread of COVID-19 resulted in the closure of campus. Instructors across the university were given a week to prepare material to switch to an online format. The course had just concluded Module 5. Based on midterm feedback I received from the students, I had decided to focus more on hands-on examples in Excel to improve the learning process. With the forced move to an online structure, I decided to change the format of the class from a synchronous to an asynchronous format. The next section describes the asynchronous course structure and methods for gathering information from student consumption of classroom material.

3 Asynchronous Course Structure

The new asynchronous course structure changed how students consume the lecture material and interact with each other. Specifically, I prerecorded a single lecture video for each remaining module and expected the students to watch the video prior to coming to a synchronous class session. The synchronous portion of the class still met at the normal time as set by the university, though virtually through a popular web conferencing service. However, the synchronous session was split into three groups to decrease the likelihood of bandwidth issues, and to encourage discussion by keeping the number of peers on the call capped at one third of the original class size. During the synchronous session, I answered questions from students, addressed any confusing material from the lecture videos, or introduced tangential or additional material to supplement the learning process. After watching the prerecorded videos and attending the sessions for clarification, students were expected to be able to complete the problem set corresponding to the week's module. Students had one week to complete the problem set and were given a window of 24 hours to complete the final exam. Both the problem sets and the exam were Excel-based, and were submitted to a secure course management site.

I uploaded recorded lectures to YouTube,[2] which provides a variety of analytic measures.[3] YouTube gathers information on views, watch time, engagement, audience retention, and ad performance metrics. The owner of any video hosted on the platform is automatically provided with this core set of metrics, and the data can either be visualized on the platform or downloaded for further analysis.

Uploading the lecture videos to YouTube provides the benefit of data collection, which is explored in the next section. However, there may be some legal considerations for individual instructors. Some departments or universities might wish to keep lecture videos private and available only to registered students. A simple solution may be to keep the uploaded videos "unlisted," which only allows people with the video link to watch the video; it is not searchable or discoverable to the general public. For courses entirely online, unlisted videos may be desirable. With only three modules left in the course, I kept my videos as "listed," to encourage students to access the material in whatever way they chose. The following section provides insights from data collected by YouTube on viewer behavior.

4 Insights from Viewing Behavior

I focus on three videos in particular: the lecture material for Modules 6, 7, and 8. These videos are similar in format, in that they cover the lecture notes and one or two hands-on examples in Excel. The data I focus on are number of unique viewers, device type, timing and duration of views, and audience retention over time. As mentioned above, the videos are listed on YouTube, so it is possible that viewers outside the course accessed the material throughout the window of analysis. I assume the number of viewers outside the course are negligible, since a direct search of the exact video title does not yield the video on the first page of results.[4]

Table 1 summarizes general viewing patterns for the 76 enrolled students across the three lecture videos. The total number of views for a video is the number of times it was played, but there may be instances where the video is played multiple times on one device. The number of *unique* views is the count of views from unique individuals.[5] It may be possible that a student watches the video once on a laptop, and again on a tablet. It may also be possible that a student does not consistently stay logged onto a single YouTube/Google account, which would increase the number of unique views.[6] A useful metric is the total views for a video divided by the number of unique views: the average number of views per viewer. Students viewed Module 6 an average of 1.75 times, Module 7 an average of 2.01 times, and Module 8 an average of 2.50 times. The increasing trend over the three lectures could likely be a function of video length: Module 6 is just over 46 minutes long, and more consumable in one sitting than the 93-minute Module 8.

Despite the fact that students may be splitting their viewings into multiple sessions, the average view duration also increases with the longer lecture videos. The average student watched Module 6—a 46-minute video—for an average of 14 minutes before navigating away or closing the video. The average student watched the 93-minute Module 8 for a longer 25 minutes before navigating away. Importantly,

[2] https://www.youtube.com
[3] https://developers.google.com/youtube/analytics/metrics
[4] To find the lecture videos, the search term must include the exact name of the video, plus my name. Otherwise, the video is buried on the second page or higher on YouTube search results.
[5] https://support.google.com/youtube/answer/7577916?hl=en
[6] There were 76 students enrolled in the course; the larger number of unique views suggest students were either not consistently logged onto a single YouTube/Google account, consumed the videos across platforms, or some views originated from individuals outside the class. Given the difficulty of finding the video without the link, the latter is unlikely.

Table 1. Viewing Behavior for Lecture Videos

	Module 6: Applied Production Economics	Module 7: Applied Demand Analysis	Module 8: Personal Finance and Forecasting
Total Views	217	219	258
Unique Views	124	109	103
Video Length	46:15	1:11:22	1:33:03
Average View Duration	14:13	17:25	25:00
Device Type (percent of views)			
Computer	92.6	94.1	98.1
TV	0.9	0.9	0.8
Mobile Phone	4.2	4.1	0.8
Tablet	2.3	0.5	0.4

multiplying the average view duration by the average number of views per student falls short of the full video length. For example, the average number of views per student for Module 6 is 1.75, and when multiplied by 14, we see that the average total viewing duration across the multiple viewing attempts is approximately 25 minutes: half the length of the full lecture video. For Module 8, the corresponding metric is 62.5 minutes, still significantly shorter than the full lecture length.

Across all three lecture videos, a large majority of students watched the lecture videos on a computer (over 92 percent for all videos). A small share of approximately 4 percent viewed the video on their mobile phones, which is a more popular device than either TVs or tablets.

The aggregated viewing data suggests that students are not, on average, viewing the entire lecture video. The lecture videos are long, but still shorter (with the exception of Module 8) than a single traditional class period. Each Module took 2–4 class periods to cover, so the asynchronous lecture videos are significantly shorter than their face-to-face alternatives would have been, should they have occurred. In line with midterm survey feedback, I see evidence that students are skipping to key sections of video and are delaying viewing until a related assignment is due.

Information on audience retention is shown in Figure 1. For any given point in the video, measured by percent of the video completed, the vertical axis measures audience retention: the number of views at a given position as a percentage of total views.[7] A measure of 25 percent at video position 50 percent means that 25 percent of views occurred at the halfway point of the video. Audience retention below 100 percent means some students did not watch a particular part of the video and skipped or scrubbed to other parts of the video. Audience retention above 100 percent means that on average, all students watched that moment of video, plus some students skipped or scrubbed *back* to that position. In Figure 1, the shaded regions of the video indicate the Excel portion of the video. For each lecture video, I read over the lecture notes, and then added a hands-on example in Excel. The vertical green line indicates when I started the Excel portion of the video, and the vertical red line indicates when I ended the Excel portion of the video. In Modules 6 and 7, there was only one Excel portion, while in Module 8, there were two Excel portions. The trends across the videos are striking; audience retention drops significantly at the start of each video and remains low during the lecture notes portion of the video. During the Excel portions, audience retention jumps significantly and, in some cases, exceeds 100 percent. These results suggest that most viewers are skipping directly to the Excel portion(s) of the video and skipping over the part of the video where I discuss the lecture notes.

[7] https://support.google.com/youtube/answer/9314415?hl=en

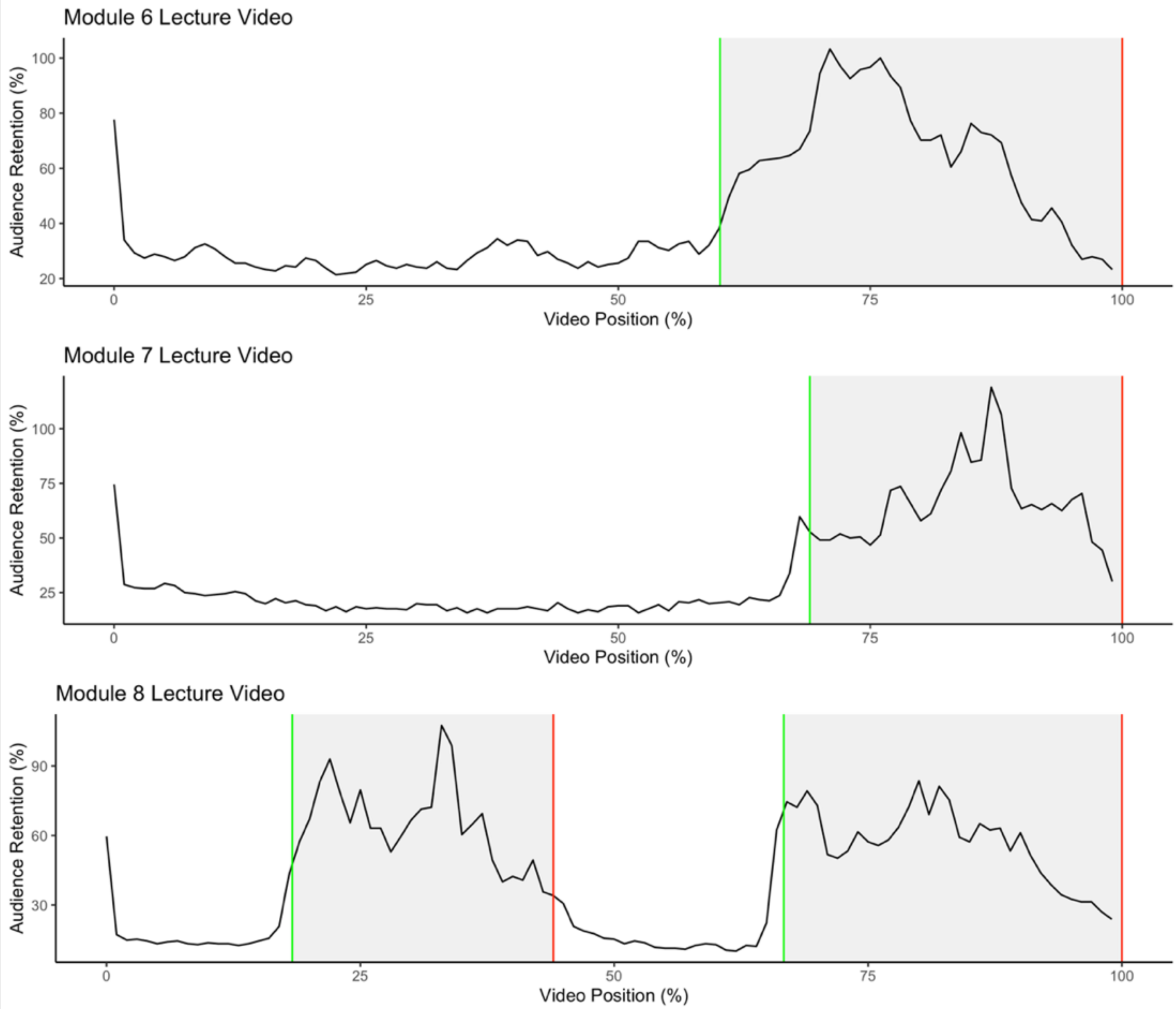

Figure 1. Audience Retention

Information on the timing of views is shown in Figure 2. The horizontal axis is the date, and the vertical axis is the number of *unique* views. As mentioned above, a unique view is a measure of the number of new viewers of the video. The vertical dashed line indicates when the problem set for that module was due, and the vertical solid line indicates the day of the exam. There is a spike in unique views the day a problem set is due, and again during the final exam. There is also a smaller spike soon after the video is posted, which suggests three general categories for students: (1) those who watch the video prior to the due date of the assignment; (2) those who watch the video on the due date of the assignment; and (3) those who watch the video on the day of the final exam. Remember these are unique views, so the third type of student is watching the video for the first time on the day of the final exam. This suggests that this group submitted their problem set without having watched the lecture material at all.

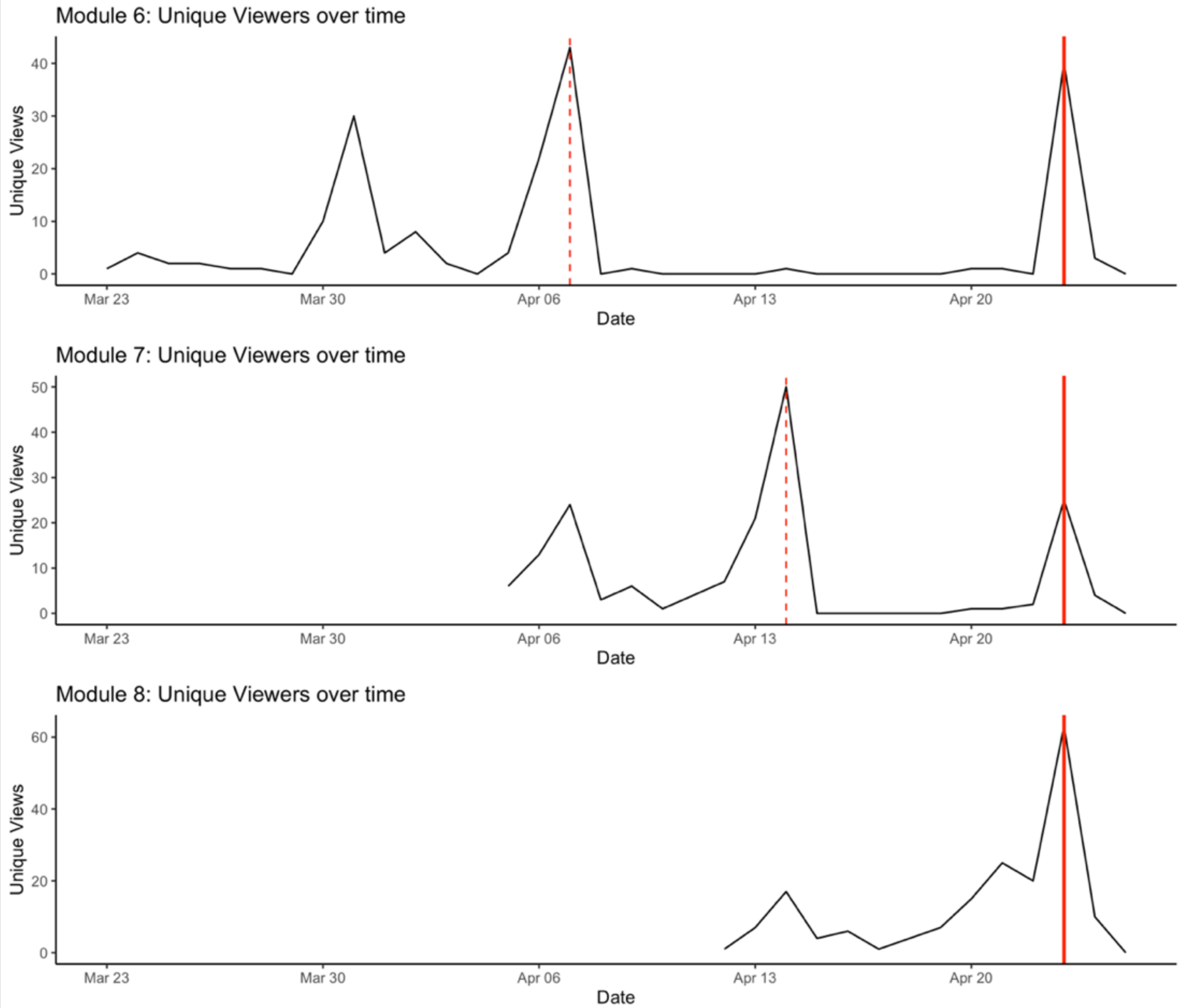

Figure 2. Views Over Time

5 Conclusions

For an applied economics or statistics course that is taught asynchronously, the insights from YouTube viewing behavior can be useful. I have several suggestions for instructors considering the switch to an asynchronous format. First, consider the length of the lecture video. My lectures were approximately one hour on average, though the average duration of a single viewer was significantly less than that. The average duration was approximately 20 minutes, so students may not have the patience to "sit" through an asynchronous lecture with the same length as its synchronous counterpart. While there may not be a single optimal length for a lecture video, evidence from similar work suggests that audience retention consistently declines over time (Lau et al. 2018), so in general shorter videos should be preferred to longer videos. Second, the vast majority of students in the course watched the videos on computers. Despite the variety of devices available to view the material, students opted for the largest screen. However, there is no data on how large the viewing pane for the viewers was. There are several options ranging from the default to theatre to full-screen mode, so even with the larger screens there is still unobserved heterogeneity in the size of the actual viewing window. Third, most viewers skipped the portions of the video covering the technical lecture notes. Most viewers jumped to the hands-on Excel portions of the video. For courses with available lecture notes or slides, it may be worth considering only posting videos of hands-on activities, with the expectation that students simply read through the lecture notes on their own. It appears they are doing this already. Instructor-provided self-guided notes for students may be preferable to videos for portions of the lecture that are not hands-on. Fourth, viewers are apparently delaying their views of the course videos until an assignment or test is due. Coupled with the fact that most viewers are skipping to the hands-on portions of the video, this reinforces the idea that the students are reading the lecture notes on their own and using the videos to learn about how to *apply* tools like regression and optimization to real-world examples. Finally, hosting lecture videos on YouTube provides substantial benefits in the form of analytic information. The free information provided by YouTube can tell instructors how, where, and when students are listening to lectures. Instructors can also see when students lose attention or get stuck within a lecture by analyzing audience retention rates. For instructors who are willing and able to adapt their lessons to serve student learning outcomes, YouTube is a powerful partner.

Instructors should be cautious to interpret the results presented here as causal or even rigorous. The data is from three lecture videos for a single course during a particularly tumultuous period of uncertainty for students. The behavior shown here may not extend to other courses, departments, or universities. It may also be unique to this period when students are seeking to minimize time spent on classroom activities. Nonetheless, the patterns are clear and worth considering for any instructor who is interested in establishing an asynchronous course structure.

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