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Research Article

Course-Related Student Anxiety During COVID-19: A Problem and Some Solutions

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Abstract
We examine the prevalence and sources of student anxiety during the rise of the COVID-19 pandemic (March 23 to May 10, 2020) and the implications for online course design and delivery. Using a standard screening tool (GAD-7) with supplemental open-response questions, we show that students had relatively high levels of anxiety based on a convenience sample of 266 undergraduate students enrolled at four U.S. institutions. In this sample, we find that 58 percent of students had clinically significant levels of anxiety in one or more weeks of the seven-week study period. Thirty-six percent of students sustained this level of anxiety on average over the entire period. These rates are high compared to published rates for the general population (1.6 percent to 8.5 percent) and even among college students (17 percent to 40 percent). Using content analysis, we identify five primary sources of student anxiety: traditional academic concerns (72 percent), online learning (67 percent), general uncertainty (38 percent), health and safety (27 percent), and financial issues (12 percent). We similarly identify four ways that students say instructors can help them reduce their anxiety: improve the course structure and organization (36 percent), improve communication (35 percent), improve course materials and assignments (33 percent), and continue expressions of care and support (27 percent). Finally, we look at how these four student recommendations connect more broadly to (1) the published academic literature, (2) our own experiences as instructors, and (3) suggestions from other practitioners.

1 Introduction

In the spring of 2020, college instructors across the United States were abruptly challenged mid-semester to convert their in-person courses to fully online distance learning courses. Instructors had to change their syllabi, change subject matter content, and change their lecture structures and modalities. They had to change the type, length, and due dates for assignments; change exams and other graded items; and change communication methods (e.g., email, phone, Canvas/Blackboard, and course webpage). Instructors also had to find new or additional ways to elicit feedback and monitor students' progress, including online surveys that ask students about course content, their access to technology, and their well-being.

At the same time that instructors were forced to adjust their courses, students were making significant adjustments to their personal and academic lives. Students faced stressful concerns such as moving away from campus, finding employment, caring for themselves, and caring for family members and friends who were also threatened by adverse health and economic risks. The conversion to distance learning during the COVID-19 pandemic required instructors to make radical and sudden pedagogical changes to their courses while students were dealing with major well-being challenges.

The concept known as "Maslow before Bloom" posits that basic physiological and safety needs must be met before a student can attempt even the first and most basic cognitive step (Mullen 2020). If students' responses to the COVID-19 pandemic elevated their stress and anxiety, instructors faced a

mixed task, demanding that instructors not only convert their courses to online delivery, but also do so in ways that are appropriately sensitive to students' mental health needs and anxiety. Further, when the sources of student anxiety are more course-related (e.g., focused on the course structure, organization, and conversion to distance learning), the instructor's responsiveness to student mental health issues is more complex than if the sources of student anxiety were more extracurricular (e.g., focused on financial issues or health concerns). If student anxiety is driven mostly by extracurricular concerns, instructors may respond to students simply by referring them to external resources such as the campus counseling center, career center, or student health center. When extracurricular sources of anxiety unexpectedly increase, they can crowd out student capacity to handle the academic stress normally associated with being a student.

Drawing on the "Maslow before Bloom" reasoning, we recognize that the optimal design and delivery of distance learning courses likely varies depending on the level and sources of student anxiety. If true, instructors and administrators need to know the level and sources of student anxiety in order to respond optimally. This need to know motivates our analysis. For example, an instructor's effort to provide flexible due dates will likely benefit students more if students have higher versus lower anxiety. Likewise, an instructor's decision to check-in with students each week—a costly activity for both instructors and students—may still nonetheless make sense if students are suffering from high levels of mental health impairment or anxiety. In short, if instructors can ascertain student conditions, instructors can design more appropriate learning experiences, determining the right mix, for instance, of high-level concepts versus technical details. If instructors do not, however, perceive or appreciate student stress and anxiety levels, instructors will not respond appropriately. Therefore, research like ours that provides empirical evidence on whether undergraduate students are experiencing elevated levels of anxiety provides a basis for instructor action or inaction.

An important motivation of our analysis is to establish empirically whether or not and to what extent undergraduate students experienced elevated levels of anxiety during the rise of the COVID-19 pandemic. Though not common in economics, descriptive research like ours that collects data and estimates a prevalence rate is both common and critical in many scientific disciplines. In public health, for instance, the collection of data to estimate a prevalence rate for health problems is used to inform public health guidance on whether or not to recommend a certain public health response or intervention (Hoelscher et al. 2004). According to the Centers for Disease Control, surveillance data are "crucially important to inform policy changes" and "guide new program interventions" (2018, p. 10). Our research on the prevalence of student anxiety provides an evidence-based justification for instructors to take action (or not) to address student anxiety when converting their in-person courses to distance learning, especially when coupled with adverse events. At the organizational level, evidence of student anxiety informs whether university administrators, committees, and department heads should have asked instructors to give greater priority to address student anxiety. If student anxiety is not elevated, then suggestions to prioritize that as a course design criterion are misguided.

Though the most dramatic institutional responses to COVID-19 may end in 2021, the prospect of other adverse and anxiety-provoking events will surely persist. Such events will continue to impact students' ability to learn. Our research study informs instructors who are considering whether adaptations to their pedagogy to address students' well-being is merited as well as what form such a response might take in their classrooms. Even though our sample of students from land-grant and regional colleges is not random, we document empirically that students have elevated anxiety levels, and we document the sources of that anxiety. These are the first steps in documenting the presence and severity of a problem and, therefore, the need for instructor action and further study to identify efficient and equitable responses.

Our study has three objectives. The first research objective is to estimate the prevalence of anxiety in our sample of agricultural economics students and compare it to anxiety levels measured among college students during nonpandemic times. The second research objective is to document the various

sources of student anxiety and, specifically, whether distance learning was a source of anxiety. A third objective is to offer commentary on, and discussion of, student suggestions for how instructors can help them be successful in times of heightened anxiety. We consult guidance from the literature, from our own experiences teaching these students, and from other practitioners to support our discussion and put student suggestions from the survey in context.

2 Context and Research Significance

The rise of COVID-19 in spring 2020 left many instructors with about 10 days to convert their courses from in-person delivery to distance learning. With this time constraint, instructors were forced to allocate their limited time between many competing tasks. A natural question is whether instructors' efforts to identify and accommodate student mental health challenges in their redesigned courses were justified given their associated costs. If students experienced only slightly higher anxiety, then the justification for an administrative mandate for instructors to prioritize and enact mental health accommodations would be weaker.

While most instructors may agree that COVID-19 increased student anxiety, the degree to which student anxiety increased and whether it merited significant attention from instructors is difficult to know. Even without empirical evidence, it seems reasonable to expect that the worst pandemic in 100 years and the unprecedented decision to force all students off-campus and all classes online in a matter of weeks could heighten anxiety among at least some students (Lazarevic and Bentz 2020). However, the revealed actions of some colleges and instructors to focus their course redesign efforts solely on technical considerations (e.g., how to deliver content and assess students remotely) suggests a different viewpoint or at least an under appreciation for how heightened anxiety limits student engagement and learning. But reasonable expectations can be wrong. Some evidence, for instance, suggests that mental health concerns among college students during COVID-19 were less severe than one might imagine (McMurtrie 2020). Additional evidence is needed to help colleges and instructors estimate more accurately student anxiety levels, so they can design and deliver optimal online learning experiences.

Anecdotally, Roaya Higazi, student government president at the Ohio State University states, "A lot of faculty members are coming from a good place, but there's still not that understanding of the scope and to what degree students are struggling right now" (McMurtrie 2020). Besides the regular stress of school, some students may face housing and food insecurity; increased social isolation; potential quarantine and isolation orders for themselves or peers; and greater uncertainty related to civil unrest or the economic outlook. Students like Higazi say that taking multiple classes online adds to student stress and anxiety, and that "in an effort to 'get back to normal,' faculty members are overlooking how abnormal it is for students to take an entirely online course load" (ibid). Such claims indicate discord between instructor and student expectations. They also indicate a likely benefit of additional empirical evidence and clarity about levels of student anxiety.

A related issue is, if anxiety levels are elevated, how should instructors respond? There is some guidance from studies evaluating student mental health and management responses. Huckins et al. (2020) report in their sample of 217 undergraduate students "a significant deterioration in mental health" with increased sedentary behavior and screen use (para 27), and they suggest increasing awareness to reverse such outcomes. In the late 2020 spring term, Perz, Lang, and Harrington (2020) found clinically significant anxiety (CSA) in 33 percent of their convenience sample of college students (n = 237), and they suggest interventions such as relaxation training and cognitive-based treatments. Ardan, Rahman, and Geroda (2020) surveyed 248 students between March and April 2020, and found 40 percent suffered from moderate to severe anxiety. They call for more crisis-oriented counseling to help students better manage their psychosocial well-being.

Although these studies suggest relevant practices for managing student mental health challenges, the suggestions do not help instructors make better decisions about the design and delivery of their distance learning courses. Letting students know about resources for crisis-oriented counseling and other

forms of therapy (e.g., exercise and relaxation techniques) is not the only action instructors can take to address student anxiety. Turning again to the interview in the *Chronicle*, Higazi says about instructors, "Students say they need help … and they hear, 'OK, go to therapy, go to counseling.' That's all good. But how does that show up directly in the classroom?" (McMurtrie 2020).

To our knowledge, there are no widely adopted or agreed upon best practices on how to reduce anxiety in the classroom. We seek to help fill this gap. Our first two objectives are to document the levels and sources of student anxiety using data we have collected. This serves as a starting point for our third objective, which draws upon qualitative research and our own expertise to provide a literature- and profession-based context for understanding student suggestions for how instructors can address student anxiety in their online courses.

3 Data Measurement and Collection

Numerous instruments exist to measure anxiety. These include the State Trait Anxiety Index instrument (Ramanaiah, Frazen, and Schill 1983); the Beck Anxiety Inventory instrument (Ulusoy, Sahin, and Erkmen 1998); the anxiety portion of the Hospital Anxiety and Depression Scale survey (Rose and Devine 2014; Julian 2011); and the GAD-7 survey (Spitzer et al. 2006). In general, each instrument generates a measure of anxiety by asking a series of Likert-type or similar questions. An overall score indicative of anxiety levels is typically generated by taking the sum of each question's assigned point values. Researchers have used several such anxiety measures to examine anxiety levels among university students (Beiter et al. 2015) and the effects of COVID-19 on anxiety (Lee et al. 2020; Ardan, Rahman, and Geroda 2020).

3.1 GAD-7 Measurement and Survey Design

In this study, we use the GAD-7 survey screening tool to measure anxiety. The standard GAD-7 survey was developed by Spitzer et al. (2006) and has been widely used by others (e.g., Perez, Lang, and Harrington 2020 and Cao et al. 2020) to screen for generalized anxiety disorder (GAD). GAD is a clinical term defined in part as "anxiety, worry, or physical symptoms [that] cause clinically significant distress or impairment in social, occupational, or other important areas of functioning" (American Psychiatric Association 2013). The GAD-7 questions ask respondents if they have been "bothered" over the past 2 weeks by various issues (e.g., "feeling nervous" or "trouble relaxing"). Each question has four answer choices ("not at all," "several days," "over half the days," and "nearly every day"), and responses are scored on a scale of zero to three, respectively. Thus, GAD-7 scores range from zero to 21 with higher scores indicating more anxiety. Anxiety levels are categorized into four levels, "minimal" (0 to 4), "mild" (5 to 9), "moderate" (10 to 14), and "severe" (15 to 21). Any GAD-7 score that is 10 or greater is considered clinically significant (Löwe et al. 2008).

The GAD-7 instrument has several advantages, including its consistency in the general population (Löwe et al. 2008), its consistency across demographic groups, its correlation to other measures of health (Löwe et al. 2008; Spitzer et al. 2006), its widespread adoption in psychiatric research and clinical practice (Johnson et al. 2019), and its simplicity and ease of use. The reliability of the GAD-7 is enhanced by its relatively short completion time versus other measures since it consists of only seven questions (Rose and Devine 2014). For these reasons, GAD-7 has been used in several other studies of COVID-19 (Huang and Zhao 2020), including studies of university students (Perz et al. 2020; Cao et al. 2020). These advantages consequently led us to select and use the GAD-7 to measure anxiety.

The first seven questions of our survey (Table 1) reflect the standard GAD-7 screening tool identical to that developed by Spitzer et al. (2006). Our survey concludes with three additional open-response questions that ask students about their access to online course materials, their biggest current challenge or concern, and what their instructors could do to help them be more successful. We made these final three questions open-response rather than closed-response (e.g., multiple-choice) questions because we were unsure of what answer choices would match students' experiences and feedback. We

Table 1. Survey Questions[a]

(1)	Over the last 2 weeks, how often have you been bothered by feeling nervous, anxious, or on edge?
(2)	Over the last 2 weeks, how often have you been bothered by not being able to stop or control worrying?
(3)	Over the last 2 weeks, how often have you been bothered by worrying too much about different things?
(4)	Over the last 2 weeks, how often have you been bothered by trouble relaxing?
(5)	Over the last 2 weeks, how often have you been bothered by being so restless that it's hard to sit still?
(6)	Over the last 2 weeks, how often have you been bothered by becoming easily annoyed or irritable?
(7)	Over the last 2 weeks, how often have you bothered by feeling afraid as if something awful might happen?
(8)	How difficult will it be this week for you to access online materials for this course (e.g., PDF documents, lecture videos, Canvas, etc.)?
(9)	What is your biggest challenge or concern right now?
(10)	What can I do—suggestions, requests, or questions—to help you be more successful?

[a]The first seven survey questions are taken from the GAD-7 screening tool for GAD. Those seven questions each have four answer options: "Not at all," "Several days," "Over half the days," and "Nearly every day." The last three questions allow students to give open responses.

also wanted to have the opportunity to receive more nuanced responses with more specific details about how we might make meaningful contemporaneous changes in our courses.

3.2 Student Sample and Survey Implementation

We administered surveys weekly to students enrolled in seven agricultural economics courses at four universities (University of Arizona, University of Kentucky, Louisiana State University, and Illinois State University). The courses were taught at three land-grant universities in their colleges of agriculture and one other state university in its department of agriculture. The seven courses surveyed included two introductory, two mid-level, and three upper-level courses, including topics in agricultural economics, agricultural marketing, technical communication, world commerce, and natural resource economics. All seven courses were moved fully online during the spring semester with five courses taught asynchronously and two taught synchronously. Course titles, number of enrolled students, and course level details are provided (Table 2).

We surveyed a sample of students weekly during a 7-week period from March 23 to May 10, 2020.[1] This period corresponds with the initial and dramatic rise in COVID-19 cases nationally, a peak, and then a gradual decline.[2] We administered our surveys online via our institutions' learning management systems (e.g., Canvas, Moodle, Blackboard, and Desire2Learn). We provided marginal rewards (bonus points) to students who attempted each survey; students who elected not to participate were not penalized. In total, there were 278 students in the survey pool. Of these, 266 students

[1] The instructor at the Louisiana institution did not survey students in the first week (March 23 to March 29) because those students were on academic holiday. For all four institutions, the last week of the survey period was final exam week (May 4 to May 10).

[2] For context, the day the survey period began, the S&P 500 reached a local minimum (2,237 points). At that time or soon thereafter, governors of the four states in our analysis (IL, LA, KY, and AZ) issued statewide stay-at-home orders on March 21, 23, 26, and 31, respectively, pushing unemployment to Great Depression levels (Kochhar 2020). In the third week of our survey period on April 11, the United States reached a local maximum 7-day average number of new COVID-19 cases (Centers for Disease Control and Prevention 2020).

Table 2. Courses Surveyed

Course	Students Enrollment	Course Level[a]	Modality
Introductory Agricultural Economics	45	Introductory	Asynchronous Online
Agricultural Marketing	44	Upper	Asynchronous Online
Agricultural Marketing	73	Mid-Level	Asynchronous Online
Technical Communication	32	Upper	Asynchronous Online
Introduction to Resource and Environmental Economics	28	Upper-Level	Synchronous Online
Introduction to the World of Commerce	17	Introductory	Asynchronous Online
Natural Resource Economics	38	Mid-Level	Synchronous Online

[a]Introductory—primarily freshman/sophomore, Mid-Level—primarily sophomore/junior, Upper-Level—primarily junior/senior

(96percent) answered all 10 questions on at least one weekly survey. Students on average completed 5.2 weekly surveys (*SD* = 1.35) out of seven possible surveys.

4 Methods

In this section, we present the statistical methods used to analyze student GAD-7 data and the multistep content analysis methods used to analyze quantitatively two open-response survey questions.

4.1 Methods for Analyzing GAD-7 Data

To analyze student anxiety levels and rates, we calculated five descriptive measures of student anxiety: (1) mean GAD-7 score across weeks; (2) median GAD-7 score across weeks; (3) max GAD-7 score across weeks; (4) a binary variable designating whether a student ever had a GAD-7 score indicating CSA;[3] and (5) the percentage of completed surveys for which a student registered as having CSA. For all measures, we ignored weeks that a student did not complete all of the GAD-7 questions. Using the average of each student's weekly GAD-7 scores, we then identified the percent of all students and the percent of students by institution who had GAD-7 scores indicative of CSA (Table 3).

4.2 Methods for Analyzing Student Open Responses

We use content analysis methods to analyze students' open responses to two survey questions. The first of these questions asked students indirectly about the sources of their anxiety (i.e., "What is your biggest challenge or concern right now?"). The second survey question asked students to suggest ways that their

Table 3. Levels of Student Anxiety[a]

Location	N	Using Average of All Weekly Scores	Using Only Single Week Maximum Scores
Arizona	13	38	46
Illinois	89	49	64
Kentucky	131	31	58
Louisiana	33	22	42
All Four	266	36	58

[a]Percentage of students with CSA measured by GAD-7 scores (≥10).

[3] Löwe et al. (2008) define any GAD-7 score greater than or equal to 10 as clinically significant.

instructors could help them ("What can I do—suggestions, requests, or questions—to help you be more successful?").

Identification of the sources of anxiety is a challenge because sources and their effect on individual anxiety levels cannot be directly observed. We used a content analysis approach described by Morgan (1993), Ryan (1999), Mayring (2004), and Donath et al. (2011) for this analysis. The approach generally requires a pair of researchers, after training, to categorize independently each student response following clear rules that are exactly documented in advance. In cases of divergence, the two researchers must reach consensus on how to code the student's response.

More specifically, we began the analysis by collating each student's open responses over the entire survey period. We then entered the full text of all students' responses into an online text analysis application to identify frequently used words and phrases.[4] As a coauthor team, we discussed this frequency data and identified five major sources of student anxiety: (1) traditional academic issues, (2) online learning, (3) general uncertainty, (4) health and safety, and (5) financial issues. We then used comments from five students selected at random to train pairs of researchers who practiced binary coding (i.e., "Was this concern evident in the student's comments or not?"). After this training, each researcher individually coded all the remaining student responses to that question, then the pair jointly discussed and reconciled any coding differences. This process created a list of all students (n = 266) and a count of the number of students who expressed concern (1) or not (0) about each of the five identified sources of anxiety. Finally, we tallied the percent of all students and percent of students by institution who expressed concern about each of the five anxiety sources (Table 3).

In our coding of this question, we characterized *traditional academic concerns* as those relating either to in-person learning specifically or not unique to online learning (e.g., final exams). We characterized *online learning concerns* as academic concerns relating specifically to changes in course design, expectations, or learning environments associated with online learning and study from home. We characterized *general uncertainty concerns* as those relating to an unknown future outcome but not specifically related to another category of concern. We characterized *health and safety concerns* as those relating to the mental or physical health or safety of the students or the student's family or close friends and arising from or exacerbated by the pandemic. Finally, we characterized *financial concerns* as those relating to employment, employment opportunities, and payment obligations (e.g., utility and loan bills) and arising from or exacerbated by the pandemic. Using the coded responses for each of the five sources of anxiety reported by students, we identify the percent of all students reporting concerns in each category (Table 4). We also perform the same calculation for each institution.

Similarly, we used the same content analysis method to analyze students' weekly survey responses to the question: "What can I [the instructor] do—suggestions, requests, or questions—to help you be more successful?" Our objective was to identify ways that instructors could help anxious students. Students often responded to this question by thanking their instructor who was administering the survey

Table 4. Sources of Student Anxiety[a]

Location	*N*	Traditional Academic	Online Learning	General Uncertainty	Health and Safety	Financial
Arizona	13	54	62	31	31	8
Illinois	89	72	64	42	29	15
Kentucky	131	72	70	40	30	11
Louisiana	33	79	67	21	12	15
All Four	266	77	67	38	27	12

[a]Percentage of students expressing concern about particular sources of anxiety.

[4] Text Analyzer. https://www.online-utility.org/text/analyzer.jsp Accessed: August 23, 2020.

and by describing what more they wished their other instructors would do to help them be more successful. We treat all responses to this question as signals of how to help.

We coded responses to this survey question using the same method that we used to code the previous question. From the word and phrase frequency data and subsequent coauthor discussion, we identified four major ways to help anxious students: (1) improve the course structure or organization, (2) improve communication, (3) improve course materials or assignments, and (4) continue expressions of care and support. Following the process described previously, we created a list of all students (n = 266) and a binary indication of whether each student suggested help strategies (1) or not (0) in each of the four identified categories of help. We then tallied the percent of all students and percent of students by institution who offered suggestions in each of these four areas (Table 5).

In our coding of this question, student suggestions to *improve course structures or organization* included calls for changes to assignment deadlines and expectations, course format or delivery, and ease of finding course materials. Student calls to *improve communication* included improvements to the frequency or clarity of verbal or written communication not related to changes or improvements in other categories. Student calls to *improve course materials or assignments* included changes to or improvements in the quality, number, or length of handouts, video lectures, exams, homework, and quizzes and instructor feedback on the same. Student calls to *express care and support* included requests for instructors to provide understanding, flexibility, or extra assistance not related to changes or improvements in other categories and student expressions of thanks or appreciation for the same.

5 Results

This section presents the GAD-7 survey results and summarizes the responses from students to the two open-response survey questions. Those two questions asked students about the challenges they faced in spring 2020 and about how instructors could help them be more successful.

5.1 How Anxious Were Students Based on GAD-7 Scores?

Figure 1 shows the distribution of student average GAD-7 scores in a histogram. The mean student average GAD-7 score was 8.2 (SD = 4.2). The median student average GAD-7 score was 7.5. Overall, using students' average weekly GAD-7 scores, 36 percent of students in our sample had CSA. Average scores for individual students over multiple weeks can mask weeks when an individual student might have a GAD-7 score that is higher or lower than that student's mean score. Therefore, we measure the proportion of all students who experienced CSA at any time during the survey period using students' lowest weekly scores (minimum) and their highest weekly scores (maximum). Looking at students' minimum weekly GAD-7 score, 20 percent of sampled students presented with CSA sustained throughout the 7-week period. Using

Table 5. Ways to Help with Student Anxiety[a]

Location	*N*	Improve Course Structure or Organization	Improve Frequency or Clarity of Communication	Improve Course Materials or Assignments	Express Care or Support of Student
Arizona	13	8	15	15	8
Illinois	89	49	37	43	18
Kentucky	131	32	38	27	37
Louisiana	33	30	27	33	18
All Four	266	36	35	33	27

[a]Percentage of students suggesting particular ways for instructors to help them.

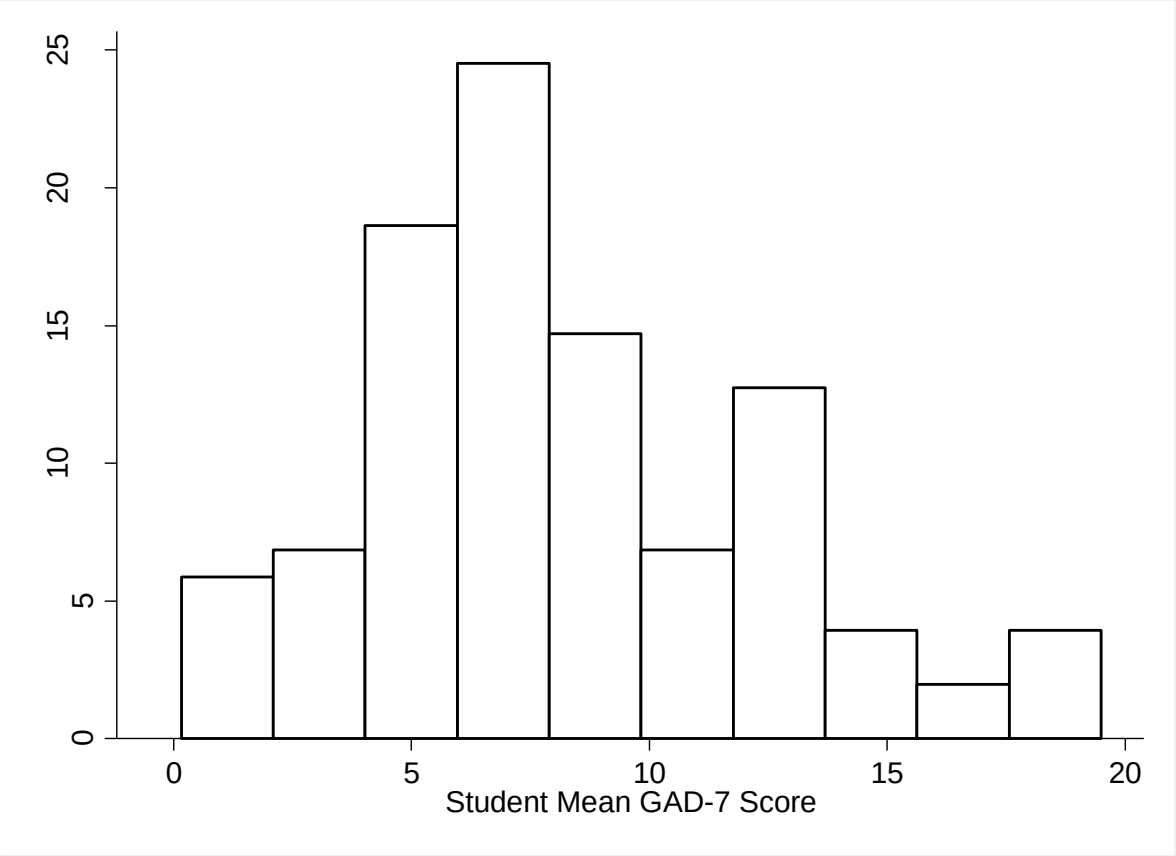

Figure 1. Histogram of Student Average GAD-7 Scores

the latter measure, 58 percent of students in the sample reported CSA at some point during the 7-week study period.

Rates of CSA in our sample are higher than those from the existing literature. Spitzer et al. (2006) report that rates of CSA typically range from 1.6 to 5.0 percent in the general population and 2.8 to 8.5 percent in general medical practice. Among first-year college students at 19 colleges and universities in eight mostly high-income countries (n = 14,373), Auerbach et al. (2018) report a one-time CSA rate of 17.7 percent. CSA rates from the existing literature that utilize data from single institutions often have greater variation, mirroring our findings.. From a random sample of 328 undergraduate and graduate students at one Australian university, Farrer et al. (2016) report a one-time CSA rate of 17 percent. At a single university in Ohio, Beiter et al. (2015) report a one-time CSA rate of 25 percent among a sample of 374 undergraduate students. Duffy et al. (2020) examines 1,530 entering undergraduate students at a single Canadian university and reports a one-time CSA rate of 33 percent. Perz, Land, and Harrington (2020) found—during COVID-19—the same CSA prevalence (33 percent) in their sample of students at a small public university (n = 237). Ardan, Rahman, and Geroda (2020) also surveyed students (n = 248) during COVID-19 at an Indonesian university and found a one-time CSA rate of 40 percent. And, surprisingly, Cao et al. (2020) report without explanation an unexpectedly low one-time CSA rate of 3.6 percent among medical students at a single university in China during COVID-19.

Table 3 summarizes levels of student anxiety across institutions using the percentage of students with CSA measured by GAD-7 scores greater than or equal to 10. We report these percentages using three different GAD-7 statistics: (i) a student's average GAD-7 score across all weeks, (ii) a student's minimum GAD-7 score across all weeks, and (iii) a student's maximum GAD-7 score across all weeks. Using the first measure, 36 percent of students in our sample experienced CSA. Looking at single week minimum GAD-7

scores reveals that CSA percentages were not uniform across institutions during the study period. For example, many more students from Arizona (31 percent) experienced CSA every week they responded to the survey, while many fewer students from Louisiana (3 percent) persistently experienced CSA throughout the study period. Looking at single week maximum GAD-7 scores reveals that 58 percent of students in our sample met the definition of having CSA at some point during our study window. Even in Louisiana, which had a very low percentage of students exhibiting persistent CSA, had 42 percent of their students experience CSA at least one week during the study period.

Beyond this descriptive presentation, we formally test for temporal and spatial heterogeneity in students' weekly GAD-7 scores using regression analysis (full regression results are not reported to save space). Using a student fixed effects estimator, we regress students' weekly GAD-7 scores on week dummy variables excluding Week 1. Based on Huber-White robust standard errors, we find no statistically significant variation across weeks, although there was a general downward trend in GAD-7 scores with the Week 7 average GAD-7 score being 1.09 points less than the Week 1 average. On an overall sample average GAD-7 score of 8 points, Week 3 is 0.57 points lower than Week 1 with marginal statistical significance; however, a joint *F*-test fails to reject the null hypothesis that all weeks are equal with an *F*-statistic of 0.80. In contrast, we find evidence of spatial heterogeneity across students from different states. Using an Ordinary Least Squares (OLS) estimator with week dummy variables and no intercept, we find that in Week 1 students from Louisiana, Kentucky, Illinois, and Arizona have average GAD-7 scores of 6.84, 8.21, 8.61, and 9.31, respectively. We re-estimate this OLS estimator removing the Kentucky dummy variable and adding in a constant to conduct hypothesis tests between the GAD-7 scores of students from Kentucky and each of the other states. Louisiana has an average GAD-7 score that is 1.38 points (s.e. 0.50) lower than Kentucky; Illinois has an average GAD-7 score that is 1.09 points higher (s.e. 0.35); and Arizona's average GAD-7 score is 0.39 points higher, though statistically insignificant. A joint *F*-test rejects the null hypothesis that all states are equal with an *F*-statistic of 7.57.

Consistent with all of the above regression results, we observe no qualitative differences in our results when we estimate a limited dependent variable model using a student's weekly CSA designation (i.e., CSA or not) as the outcome variable instead of a student's GAD-7 score. Overall, we observe statistically significant spatial variation across states in student anxiety, though not across time. However, the most significant finding from our data collection efforts was the high prevalence rate of CSA, namely that 58 percent of students in our sample experienced CSA at some point during our study period.

5.2 What Were Potential Sources of Student Anxiety?

Table 4 summarizes the results of the content analysis for the question, "What is your biggest challenge or concern right now?" Overall, sources of student anxiety from most to least prevalent are traditional academic concerns (72 percent), online learning (67 percent), general uncertainty (38 percent), health and safety (27 percent), and financial issues (12 percent). Looking at individual institutions, there was remarkable congruity with a few exceptions. Students in Illinois and Louisiana were relatively more concerned about financial issues (15 percent) than students in Kentucky (11 percent) and Arizona (8 percent). Students in Louisiana were relatively unconcerned about health and safety (12 percent) compared with students in Arizona (31 percent), Kentucky (30 percent), and Illinois (29 percent). Students in Louisiana were also relatively unconcerned about general uncertainty. Students in Arizona were relatively unconcerned about traditional academic issues (54 percent) compared to students in Louisiana (79 percent), Kentucky (72 percent), and Illinois (72 percent).

Our findings match evidence from the pre-pandemic literature showing that students are anxious at modest levels about financial issues and health concerns. From a sample of 374 undergraduates at one midwestern U.S. university, Beiter et al. (2015) found that 26 percent and 23 percent of students were anxious about financial and health issues, respectively. Our students reported anxiety about those two concerns at similar rates (12 percent and 27 percent, respectively). This comparison suggests that students have a fairly stable baseline of concern in these two areas that is relatively unresponsive even to

significant changes in external factors, including near-record unemployment and a global pandemic.

However, regarding their academic lives, students seem far more sensitive to pandemic-related disruptions. The existing literature suggests that less than one-third of students are typically concerned about online learning. Kira, Nebebe, and Saadé (2018), for example, find in a sample of 1,365 first-year undergraduate business students at one university in Canada that 29 percent of respondents either "agreed" or "strongly agreed" that "I am anxious while taking an online course" (p. 84). By contrast, as all of their classes suddenly switched to online delivery, a much higher proportion of our students (67 percent) reported in at least one week that online learning was their "biggest" concern.

Consistent with observed heterogeneity in our estimates of student anxiety, heterogeneity in potential sources of anxiety also exists across institutions in our sample. Students in Arizona, for instance, were relatively less concerned about traditional academics (54 percent) and financial issues (8 percent) while students in Louisiana were relatively less concerned about general uncertainty (21 percent) and health and safety (12 percent).

5.3 What Help Did Students Suggest?

Looking at all students together, we find (Table 5) that, to be more successful, students want their instructors to improve the course structure or organization (36 percent), improve communication (35 percent), improve the course materials or assignments (33 percent), and increase expressions of care and support (27 percent). Looking at student suggestions for help by institution, we find that students in Arizona were relatively less likely to suggest improvements to course structure or organization (8 percent) or to course materials or assignments (15 percent) compared to other institutions (27 percent to 49 percent). Students in Kentucky most often highlighted the value of communication (38 percent) and caring (37 percent). In Illinois, students emphasized the benefits of thoughtful course structures and organization (49 percent), course materials and assignments (43 percent), and communication (37 percent). In Louisiana, students focused on the usefulness of course-related features, namely materials and assignments (33 percent) and structure and organization (30 percent).

Students most frequently offered suggestions for improvements about course organization and structure (36 percent). Chief among students' requests in this area was for instructors to be flexible about due dates. "If you can just bear with us students as we try to gather supplies, rehome ourselves, and find employment throughout this crisis it would be greatly appreciated," wrote one student. Students said that the course layout online is critically important. Students recommended using online "checklists," making sure the "videos and assignments are super organized," and "ensuring every assignment is easy to find and clearly marked with a due date." Students also desired consistency. One student, over a 4-week period, commented only, "Just keep everything routine," and the next week, "Just keep everything routine," and then, "Just keep the routine," and last, "Keep everything structured and routine." Another student said similarly, "Keep everything the same from week to week as far as the layout, when things are due, and types of assignments." Students had some very specific suggestions too, like posting assignments online "early and ahead makes me less stressed and worried" and "posting video lectures or having Zoom meetings" is better than "just giving us stuff to turn in and expecting us to figure it out on our own."

The second-most popular category of suggested improvements was communication with recommendations from 35 percent of our survey respondents. Students wanted communication, especially via email, that was frequent (daily is good, but at least weekly), regular (same time and same format), specific (e.g., a list of tasks), concise, and personal. "Continuously send out emails," one student advised, "Fill them with reminders, encouraging words, or suggestions on what you have done to cope with what has been happening." As due dates approached, students wanted more frequent emails. One student requested "as many emails as possible to help remind us when things need to be done," while another wrote, "It would be helpful if you emailed us with more reminders; there's a lot going on, a lot to keep track of." Most campus learning management systems allow students to indicate their preferences for how to receive course announcements, prompting one student to write, "I get them as notifications to

my phone, helping me to stay on track." During this time, one student said, "I have been checking my email every couple of hours to see if anything has changed." However, clear and concise messaging, even if less frequent, is preferred by other students. One wrote, "I feel like you are communicating with us clearly [which] helps me; some professors have been sending me what feels like 20 messages per day so please don't do that." Students also frequently commented on the benefit of quick responses to their questions. In one representative comment, a student wrote, "I am beyond pleased with the way this class has been set up. I am good with everything, as long as I know you are just an email away if any issue arises."

Unsurprisingly, many students recommended improvements to course materials and assignments related to grades or grading (33 percent). This finding is consistent with our other observation that the greatest number of students were anxious about traditional academic concerns (72 percent), chiefly their grades. "Be understanding and lenient," one student said, "Many students have families going through this, and our main concern isn't school right now, hate to say it, but it's not." More substantive suggestions included practices with clear parallels to in-person teaching. "Post the lecture slides online" as opposed to distributing them in class. Send me "a recorded audio critique of my paper" instead of meeting with me in your office. "Make the video clips shorter and more numerous" like when instructors take breaks during their 50-minute in-person lectures. "Do a Zoom session every once in a while" rather than having on-campus meetings "just so we can ask questions and catch up with the entire group." Students were clear that lecture videos do not need to be highly produced; students instead liked "the stories that make professors seem more real and approachable." Many other student comments in this category would seem commonplace in any semester, such as "give us a really good study guide for the final exam."

The final category of recommendations revealed that students (27 percent) desired and appreciated expressions of care and support from their instructors. Some comments highlighted the therapeutic value of the survey itself, noting for instance, "Thanks for letting me rant and 'listening' to me. I didn't realize I needed that!" A second student similarly wrote, "It is nice to 'talk' things out and have a professor who cares about their students during this weird time," while a third wrote, "I just wanted to thank you for taking time to give these surveys. It shows us students you actually care, and we are not just a number in a class." Even a student who had nothing to suggest, "Honestly, I have no idea," still valued the instructor's interest, "but I appreciate the concern!" One student said it most succinctly perhaps, "Thank you for really genuinely caring."

6 Discussion

Our analysis provides empirical evidence of heightened student anxiety during the shift to distance learning at the start of COVID-19. This evidence should help college administrators and instructors justify consideration of student anxiety from all sources when teaching. Our analysis also provides evidence that distance learning was a likely source of anxiety. Taken together, this evidence supports the adoption of actions to address course-related student anxiety when there is an abrupt and mass conversion of in-person courses to a distance learning format. We find that student anxiety levels were high during COVID-19 and see that as justification for instructors to take this concern seriously specifically when designing and teaching online courses.

Beyond measuring the level of student anxiety, we also sought to identify the sources of this anxiety and to understand the kinds of help students wanted. This raises a natural question, "What should instructors do to respond to student anxiety?" We have presented the content analysis results of student responses and a selection of individual student comments, but these are only able to hint at answers to this question. Indeed, our analysis was neither designed nor intended to answer this question.

In the remainder of the discussion, we aim to place these students' suggestions for help in a more comprehensive and professional context. As a starting point to inform this discussion, we searched the literature and found no clear evidence-based summary to guide instructors in how to respond to student

anxiety. We do find some guidance from the general literature on distance learning, which might also help address student anxiety in online courses. We also find relevant to our discussion a webinar panel discussion with faculty and students published in the *Chronicle* (McMurtrie 2020). This webinar and its summary details how instructors can improve the distance learning experiences under mass conversion to distance learning in response to COVID-19. A third source we draw on is our own instructional experiences teaching during COVID-19. Finally, we draw on guidance from a popular mental health first aid curriculum (Kitchener and Jorm 2002). Table 6 summarizes what we see as the important best practices from each of these sources.

6.1 Context for Improving Course Structure and Organization

In a review of predictive factors for student success in and satisfaction with online learning, Kauffman (2015) describes "course/instructional design" being "of great importance" (p. 2). Eom, Wen, and Ashill (2006) find in a survey of 397 university students that course structure is the most significant determinant of student satisfaction in online courses with instructor feedback also being statistically significant. Van Wart et al. (2019) also stresses the importance of pre-planning so the course structure is clearly organized and consistent. According to Van Wart et al. (2019), students prefer online course organizations that are modular and repetitive. McMurtry (2016) echoes this stating, "Exemplary online instructors also maintain a clearly structured environment that is logically organized, delivered in small chunks, and sufficiently repetitive to keep each student focused on the content." Jung (2011) points out that while online courses are much more challenging to organize, students tend to be very critical of what they perceive as any confusion or unclear structure in the distance learning setting.

An overarching theme in the webinar panel is that anxiety occurs when students experience uncertainty. Course structure and organization is an avenue through which instructors can work to reduce uncertainty. Organizational consistency is key. Panel members encourage instructors to post assignments and grades at the same times each week and align due dates where possible to help reduce uncertainty. Regarding asynchronous versus synchronous activities, one recommendation was to pre-record lectures for asynchronous learning in order to leave synchronous class time for discussion, office hours, and other activities that require students to engage with one another in real time.

As a coauthor group, we also have insights from our experiences teaching during COVID-19 about how instructors can respond to students with elevated course-related anxiety. At the onset of COVID-19, we all revised our syllabi in significant ways to accommodate the switch from in-person instruction to distance learning. To provide transparency, one instructor posted their new syllabus using "track changes," so students could clearly identify the course changes. While we each made our own revisions, we all built additional flexibility into our revised syllabi and course schedules.

6.2 Context for Improving Communication

Moore (1993) calls for online instructors to reduce the "transactional distance" between them and their students by increasing the instructor's social presence. Kucuk and Richardson (2019) say that social presence, in fact, is the "dominant determinant of the satisfaction of teaching" in online courses. Van Wart et al. (2019) suggest approaches to reduce transactional and social distance may include prompt responses to email questions, increased communication frequency and quality, hosting video conference office hours, posting grades quickly, providing customized feedback on assignments using audio, video, or text responses, and providing an ungraded social forum on a course discussion board. Consistent with this, others in the literature suggest posting grades and feedback on assignments in a timely manner, emailing students frequently, holding regular online office hours, and developing personal touches in the online environment (Jackson, Jones, and Rodriguez 2010; Shook, Greer, and Campbell 2013). Even using the learning management system software to provide automatic class notices either to individual students or groups of students can increase social presence (Oncu and Cakir 2011).

Table 6. Summary of Sources on Practices to Address Student Anxiety in Distance Learning Courses

Content Analysis of Student Suggestions	**Literature on Distance Learning**	**Webinar Panel** (McMurtrie 2020)	**Coauthor Practices**	**Mental Health First Aid** (Kitchener and Jorm 2002)
– Improve materials or assignments. – Improve course structure and organization. – Improve communication. – Offer expression of care and support.	– Clarify course structure. – Invest time in pre-planning. – Build Flexibility into the course. – Reduce transactional and social distance. – Check in on mental health and safety, and that basic needs are being met. – Support growth mindset.	– Eliminate significant group projects. – Utilize group work in small, synchronous doses. – Flip the classroom with feasible. – Use consistent mode(s) and frequency of communication. – Use consistent deadlines, grading style, and timing. – Establish connections between instructor, student, and class to ensure accessibility	– Invest more time and effort in course. – Relax group project requirements. – Emphasize quality over quantity. – Offer flexibility in deadlines, grading schemes. – Codify communication frequency, regularity, and style. – Offer expressed concern for student well-being. – Remind students of mental health resources. – Offer encouragement and optimism. – Acknowledge the circumstances. – Seek feedback.	– Assess risk of self-harm. – Listen without judgement. – Give reassurance and information. – Encourage appropriate professional health help. – Encourage self-help.

In the webinar panel, members also touched on the importance of communication in the distance learning setting under COVID-19. According to McMurtrie (2020) who provides a summary of the webinar, if instructors make a connection with their students through regular outreach via email, virtual office hours, and some synchronous class time, then this establishes trust among students that instructors are accessible when uncertainty arises. Panel members likewise noted that consistency in communication frequency, content, and style can reduce uncertainty.

As a coauthor group, we believed communication was so important that we codified communication style, frequency, and regularity into our revised syllabi and schedules for our courses. For example, more than one of us modified our course homepage to make it easier to find and access links to lecture videos, readings, and assignments. Similarly, instructors posted materials for their courses at the same time each week and alerted students with an email announcement that explained any new materials and reminded students of upcoming deadlines. Our announcements were often formatted to highlight key information (e.g., using bold red text for assignment names and due dates and using hyperlinks to help students easily locate assignments and related materials). These weekly emails also served as touchpoints for instructors to offer encouragement and remind students of their availability and accessibility. These touchpoints were another opportunity to remind students about the importance of mental health and the availability of campus-based counseling resources.

6.3 Context for Improving Course Materials or Assignments

From the literature on distance learning, instructors should when possible design their courses to have flexible due dates for assignments and exams. Distance learners face a unique set of hurdles, and online courses tend to attract students who have relatively high time and financial constraints (Xu and Jaggars 2014). "The stress, disconnection, and technical difficulties associated with the online classroom require unique accommodation and understanding from instructors," writes Raley (2016, p. 52).

The webinar panel members made more explicit and substantive recommendations on course materials and assignments. They suggested that instructors avoid significant group projects because, they said, coordinating group work time outside of class is a notoriously difficult and stressful task. At the same time, the panel indicated that small group work for short discussions or exercises can be beneficial if scheduled during synchronous learning times.

Consistent with these remarks, we modified our planned group projects, either eliminating them or reducing them to smaller disparate exercises. In the latter case, students worked together during class time in synchronous online meeting spaces (i.e., Zoom breakout rooms). We also either reduced the number of assignments and the length of assignments, or gave students significantly more time to submit their assignments by adjusting deadlines. We justified these course changes, in part, by indicating to our students that we preferred quality over quantity.

6.4 Context for Increasing Expressions of Care and Support

Mullen's (2020) teaching mantra "Maslow before Bloom" states that even the first and most basic cognitive step (i.e., knowledge) described by Bloom requires that students must first meet Maslow's physiological and safety needs (e.g., for food, water, shelter, and security). In a traditional classroom setting, the instructor can visually observe students to perceive mental health warning signs and respond directly in real time (Barr 2014). As a substitute, online instructors should make regular inquiries or "check-ins" with their students (Sitzman 2016; Qadir 2020). Young (2006) finds in a survey with 199 respondents that anxious students, in particular, desire regular expressions of care and support from their online instructors. To communicate caring in online courses, Plante and Asselin (2014) recommend that instructor messages be "respectful, positive, encouraging, timely, and frequent" (p. 219).

Relatedly, Xu and Jaggars (2014) find that all types of students suffered decrements in performance in online courses. Invoking Dweck (2006), students' can have a "fixed mindset" (e.g., "I can't possibly do this class online") regarding distance learning rather than a "growth mindset" (e.g., "I can be

successful doing this class online"). One way to support a growth mindset is to make the course schedule and assignments clear so that students see the way forward for them to be successful, which we cite as an example of how implementing a suite of practices can synergistically enhance student benefits versus employing practices in isolation.

Members on the webinar panel emphasized making connections with students through consistent interactions or even directly asking students what is working and what is not. According to the panelists, if students do not have regular opportunities to check in with their instructors, express their concerns and challenges they are facing, and ask questions or provide feedback on what is working and what is not in a course, then significant sources of course-related uncertainty and anxiety will persist.

Our actions and experiences as instructors to express care and support during the rise of COVID-19 largely conform to those described in these other sources. We may have actually emphasized the role of expressing support and concern to an even greater degree. For example, more than one of us signaled our availability and accessibility through individualized outreach. We did this through personalized email messages with each student. Our email content sought to reassure students that they were performing well in the course. Some email check-ins referenced personal details that the student shared during class introductions (e.g., "I recall you are an ice skater. Have you been able to keep going or find some other exercise or stress release?"). Other emails followed up on students' questions from a synchronous class or poor performance on a homework assignment and ended by offering the student a supplemental resource related to the concept. Besides email, some instructors requested phone or video call appointments if a student appeared to have a particular need, for example, if a student missed class due to illness. One instructor offered an extra credit assignment inviting students to meet with the instructor for a 15-minute advising appointment to discuss the student's concerns or advising needs related to the course, professional development, or even listening to challenges at home or work that were impacting the student's school or professional development.

Perhaps the most significant way we, as a co-author group, expressed concern to our students was sending our students a weekly survey inquiring about their mental health (the GAD-7 questions), their access to internet and technology for coursework, and the challenges they were facing. We asked them what we could do to help them be more successful. This was a salient, concrete action that we all took to express our concern for our students.

Many of our students specifically expressed appreciation to us for our interest in their mental health. They commented positively about our regular expressions of care and support. One student wrote that the instructor's "concern and caring-ness has really been comforting during these past few weeks." Some student comments highlighted the therapeutic value of the survey itself, noting for instance, "Thanks for letting me rant and 'listening' to me. I didn't realize I needed that!" A second student similarly wrote, "It is nice to 'talk' things out and have a professor who cares about their students during this weird time," while a third wrote, "I just wanted to thank you for taking time to give these surveys. It shows us students you actually care, and we are not just a number in a class." A student who had nothing to suggest wrote, "Honestly, I have no idea, but I appreciate the concern!"

In addition to finding support for expressions of care and support in the distance learning literature, the webinar panel, and our own classroom experiences, expressing care and support is a key element of the mental health first aid curriculum developed by Kitchener and Jorm (2002). This 9-hour training aims to increase mental health literacy and responsiveness (2002). Their program identifies five key steps: (1) assess risk of suicide or harm, (2) listen nonjudgmentally, (3) give reassurance and information, (4) encourage the person to get appropriate professional help, and (5) encourage self-help strategies. These experts call for instructors, as first responders, to listen carefully to students' concerns, reassure and encourage students, and help them find ways to help themselves. This guidance provides a succinct summary not only of these authors' mental health first aid curriculum; it also nicely summarizes how, in part, instructors should respond to students who are experiencing heightened anxiety in any instructional setting, remote or in-person. However, compared to the other sources of guidance

considered here, the mental health first aid curriculum offers relatively little specific guidance about how instructors can design and teach their courses.

7 Conclusion

The significant shift toward online learning prompted by COVID-19 will doubtlessly usher in many pedagogical improvements, particularly as instructors gain more experience with that modality, learn more, and have more preparation time. Student anxiety will likely remain a part of what we do as instructors. However, we hope that the lessons from this unique time will strengthen the foundation from which we launch new efforts and fine-tune the directions we need to go in higher education.

In our view, one direction we likely need to go is to encourage instructors to do more than just recognize that students are struggling with mental health issues with a referral to the campus counseling center. Specifically, we encourage instructors to consider student mental health concerns when instructors are designing and adapting their courses, particularly for online delivery. Emblematic of this, we see an important distinction between the guidance given by Kitchener and Jorm (2002) on mental health first aid and the other sources of guidance we reviewed in the discussion. The mental health first aid guidance is oriented toward crisis management and directing students to professional help. We do not want to underestimate the importance of this advice, but in our view, it represents the minimum action instructors should take given our survey findings on student anxiety levels and the likely sources of student anxiety. The other three sources examined, namely the published literature on distance learning, comments made in the *Chronicle*'s webinar panel, and our own instructional experiences provide (1) corroboration of the student feedback on what we, as instructors, can do to help our students be successful in their courses, and (2) potential responses geared toward anxiety management through actions in the course.

While we were unable to assess directly the effectiveness of individual practices in this study, we believe that the weekly survey helped increase our general awareness of student concerns and that the student feedback we received did positively affect our subsequent instructional choices during distance learning. Based on our own personal experience, we recommend this survey practice to other instructors if they are concerned about elevated sources of stress and anxiety or as a way to express additional concern with a concrete action. In general, we received positive feedback from students on how we responded to their feedback; indeed, this demonstrated responsiveness may have reinforced the value of our efforts to improve the course structure, organization, communications, materials, and assignments. Going forward, we, as instructors, can use what we learned from this study and ongoing surveys to communicate to students that we are proactively working to address student concerns and, notably, student anxiety. Importantly, we can acknowledge that a significant basis for our efforts has been and will continue to be student feedback.

A concluding remark, even if only an anecdotal one, is that the practices that we adopted to target students experiencing heightened anxiety helped all students. This suggests to us that, whether during a pandemic or not, whether for distance learning or in-person instruction, adopting these practices is a promising way to add value to our courses.

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Research Article

Impact of COVID-19—Related Transition to Online Instruction on Student Achievement

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Abstract
Distance education and online delivery of course materials are not new in the United States. However, the sudden mass movement of entire universities online is new. The COVID-19 pandemic forced many universities to move their instruction online, over a weekend in some cases. This article explores the effects on student achievement by estimating a Poisson model of course grade outcomes to find that Spring 2020 term was not statistically significant in its effects on students completing the course, passing the course, and earning an "A" in the course. Graphically analyzed, the data show a possibility of different types of effects for different students, courses, and professors. Further research with more data is needed to understand the effect entirely.

1 Introduction

Distance education is not an entirely new phenomenon in higher education in the United States (Beaudoin 1990). As early as the National Center for Education Statistics (Lewis et al. 1997) reported the first survey on online education that represented higher education institutions, many institutions were already offering two-way online coursework, with 75 percent of the institutions planning to increase their utilization of computer-based online interaction. The paradigm shift that has occurred toward more internet-focused delivery is a more recent phase of development. The change to entirely online delivery common to Spring 2020 was unprecedented.

The online learning paradigm offers students an on-demand, asynchronous learning environment, or a synchronous experience with lectures delivered online. Online learners tend to be older than traditional students because this mode of education allows them flexibility with other aspects of life (e.g., work, family, etc.; Roddy et al., 2017). Online education is viewed as being more constructivist in its approach, requiring students to take a more active role in their education and be cognizant of technological requirements and support (Oomen-Early and Murphy 2009). The nature of online education requires that students be invested in their education, mindful of time management, and accustomed to the online format/delivery of course materials.

Faculty, likewise, have to understand the technological framework and tools necessary to facilitate online course delivery. While faculty are increasingly aware of and moving toward online capabilities, there is some reluctance to do so, potentially due to a perceived loss of community and rapport, or "disconnect," with students; issues with technology; concerns over maintaining academic integrity; and lack of engagement by students (Bower 2001; Otter et al. 2013; Roddy et al. 2017; Wingo, Ivankova, and Moss 2017). A highly significant factor is the perceived greater time commitment it takes to teach an online course versus a traditional course (Otter et al. 2013). These and many other concerns were classified by Wingo, Ivankova, and Moss (2017) in their study of more than 60 papers published

regarding online courses in higher education. Their model, an updated Technology Acceptance Model they termed TAM2, provided a framework for classifying faculty perceptions into eight constructs: perceived ease of use, subjective norms, voluntariness, experience, image, job relevance, output quality, and result demonstrability. Key barriers identified included output quality regarding student learning success and result demonstrability on the part of faculty. Student success relied on the investment of adequate time and effort to meet course learning objectives. Whether or not tangible results and benefits were gained by faculty centered on perceived workload, incentives, professional development opportunities, and institutional recognition.

Like many universities around the United States, on Monday, March 16, 2020, Louisiana Tech University (LaTech) transitioned to exclusively online instruction because of the COVID-19 pandemic ("Update for Students. Louisiana Tech University" 2020). LaTech is unique in that this nearly perfectly corresponded to the beginning of an academic term. LaTech is a quarter schedule, semester hour, school, resulting in a compressed schedule. In 2020, the spring quarter classes started on Wednesday, March 11, with great uncertainty about the term (University Registrar 2020). So much uncertainty surrounded the quarter that the dean's office required a syllabus statement, cautioning that the quarter could be very different because of COVID-19. The Respondus LockDown Browser and Respondus Monitor were made available on March 20 to allow faculty to adapt their in-person exams to an online form and maintain academic integrity (Center for Instructional Technology 2020).

This study evaluated the impacts of an abrupt transition to online education via the quasi-experiment provided by the COVID-19 pandemic. Most courses of instruction were interrupted mid-term (i.e., at universities that utilize a semester schedule). LaTech transitioned online over the weekend that followed "syllabus day." This provides an opportunity to examine the impacts of a sudden shift in the mode of instruction, without the prior weight of weeks of traditional course delivery, potentially confounding performance outcomes. The involuntary nature of the transition also means that only the most strongly opposed students opted-out of the online experience, and essentially no faculty were able to opt-out leading to very little self-selection bias in the results.

The authors met as the students were sent home and discussed strategies for adapting and expectations for the quarter. We expected that the grade distribution would be increasingly bi-modal, with students either excelling or failing under the circumstances. We presumed this outcome because many of the "A" students will be "A" students no matter the circumstances. Some students have the intellect, but lack the discipline to complete a course online. We expected those students to complete in-person coursework with "Bs" and "Cs," and we were not certain that those students would complete the online quarter. To examine the effect, we used a Poisson model to estimate the percent of students completing, passing, and earning an "A." We found no statistically significant relationship; however, we were able to demonstrate the variety of outcomes experienced by students and professors to challenge the single narrative of universal difficulty.

2 Methods

The authors requested grade information from the registrar's office. We were unable to acquire any demographic data to accompany the grades, nor were we successful in gaining permission to use our records from the Human Use Committee. While these circumstances can be considered limiting, they were the best made available.

The registrar's office grade report contains information on instructor, course, term, and grade awarded for three spring terms (Calendar Years 2018, 2019, and 2020) of courses offered through the School of Agricultural Sciences and Forestry (summary data available in Table A1 of the Appendix).

Instructor data was de-identified by randomly generating a number to replace each instructor's name. The same individual instructors typically teach most spring quarter courses. In this data set, the same instructor taught a class all three years in 20 of 40 of the courses taught, 9 of the 40 courses were not taught in all three years. Of the remaining courses, four taught the course in both 2019 and 2020. This results in a data set with 2,204 observations of grade outcomes by student and course section. Each observation included the course, section, instructor, grade outcomes, and quarter. No personally identifying information was available regarding the students, and there is no link between an individual student's performance in multiple classes.

Grades are the traditional "A–F" sequence with "W" for withdrawal. LaTech does not employ a plus/minus grading system. The university extended the "W" (Withdrawal) deadline for Spring 2020 from May 1, 2020, to May 15, 2020, and also provided an opportunity for students to choose "Pass/Fail" grading, not previously available at LaTech (a single "S" for "Pass" was present in the data for an internship in 2018, but this is exceptionally atypical). Students were able to elect Pass/Fail for grades of A, B, or C *after* the term was complete ("Interim Emergency Policy for Academics Spring Quarter 2020, COVID-19" 2020). "IC" is the notation for "Incomplete," indicating that students have until a date in the fall to complete the course. As expected, "IC" grades are only present in the Spring 2020 term. The percent of each grade awarded by term is seen in Figure 1, with Panel A showing letter grades, Panel B

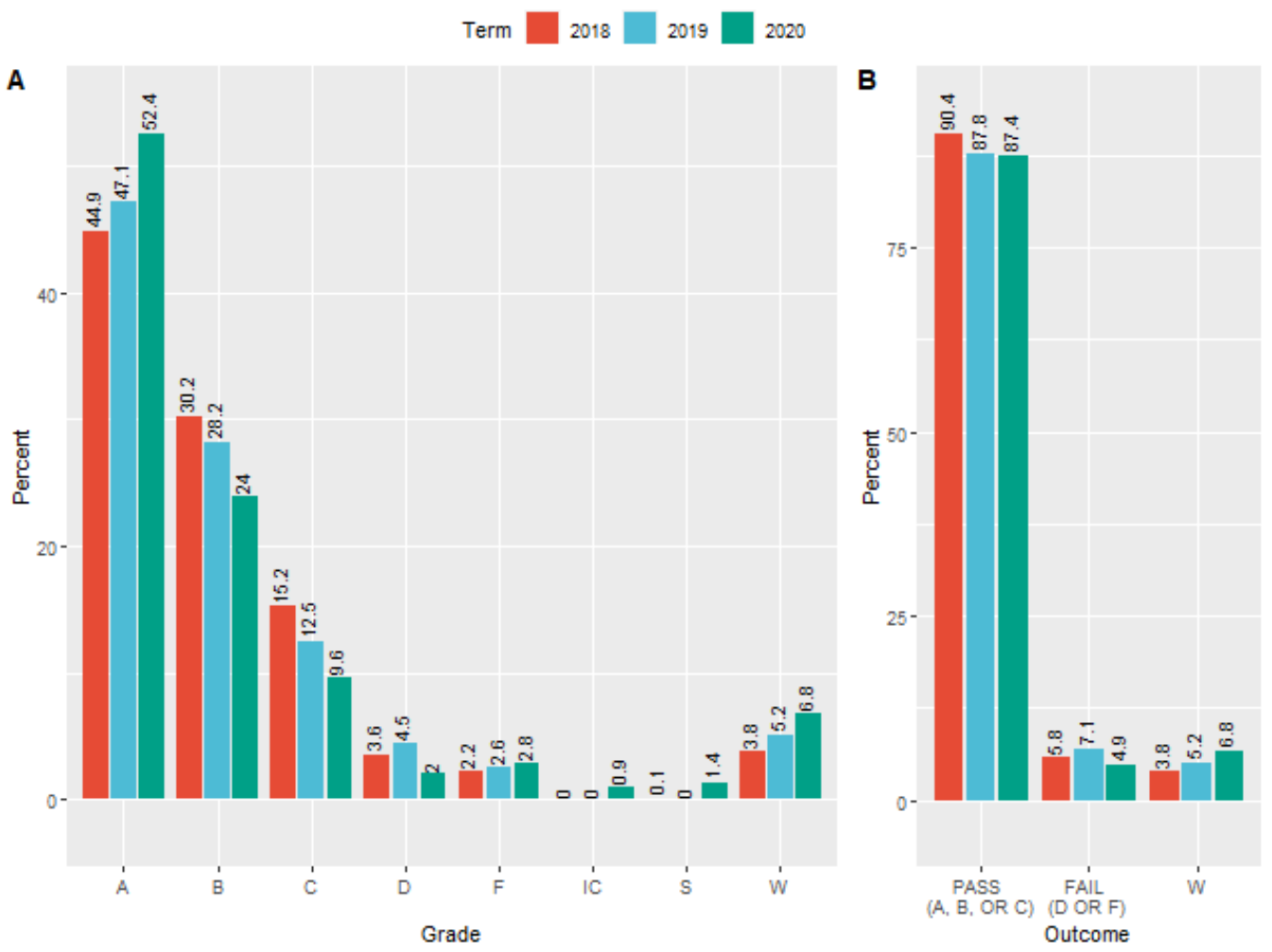

Figure 1. Grades Awarded During Spring Term from 2018 to 2020 at Louisiana Tech University School of Agricultural Sciences and Forestry

showing Pass or Fail, and both panels showing withdrawals. The panels confirm the instructors' hypothesized result, where more students excelled or withdrew during Spring 2020 term. Completing a course is considered earning any grade other than "W" or "IC." Passing a class is counted as earning an "A," "B," "C," or "S." Some curriculum in the school allow "D" grades to be counted toward graduation; however, this is not the case for all of the degree programs. Therefore, grades of "D" and "F" are regarded as failing. The percent that passed a course, and the percent that completed a course were both calculated.

Special problems and internship courses were excluded because students often earn an "A" in those classes (96 of the 2,204 observations were dropped). The registrar data was further processed such that each course, instructor, and term combination was represented as an observation with percent completing, percent passing, and percent earning an "A," as well as binary variables for instructor, course, term, and upper level. A binary variable for the "other" courses was not included in the following regressions. The resulting data set used for estimation had 87 observations.

Percent completing, percent passing, and percent earning an "A" in the course were modeled as a function of course, term, and a random disturbance (ε). Courses are identified as a series of binary variables, and the 2020 term is identified as a binary variable. Courses are further specified as upper level by a binary variable. Two instructors taught one course in the same term, so a binary explanatory variable was included to control for one of the instructors (Instructor 12) in this course. Thirty-five explanatory variables leave only 51 degrees of freedom.

$$Grade(Complete\ or\ Pass\ or\ A) = f(\boldsymbol{Course}, \boldsymbol{Term}, \varepsilon) \quad (1)$$

These three models are modeled as a Poisson process. A Poisson model is used to model count and rate data. Percent completing, percent passing, and percent earning an "A," rounded to the whole number, are appropriately modeled as a Poisson model. The model estimating percent earning an "A" failed a test of over-dispersion and was estimated using a quasi-Poisson estimator. Zou (2004) indicates that a robust standard error estimation procedure is needed when all independent variables are binary. Greene (2012) states that using a robust standard error can accommodate certain misspecifications of the Poisson model, and small sample bias was a concern, so the MacKinnon and White (1985) standard error estimator (HC1) was employed to address these concerns.

3 Results

The summary results of the three Poisson regressions are shown in Table A2. None of the Spring 2020 quarter variables were statistically significant. With 36 independent variables, all of which are binary, most values are zeros. With only 87 observations this finding is not entirely surprising. The link between larger samples and significance is well known. Marginal effects plots show interesting interactions though. This table of results uses MacKinnon and White (1985)'s standard error estimator to correct for a small sample bias, and the Spring 2020 term variable was not significant in any of the estimated regressions. If one disregards the need for a small sample correction (difficult to justify with only 87 observations) and uses White's standard errors (White 1980), the Spring 2020 variable was significant in the percent completing model; however, this should be interpreted with caution. The plots in Figures 2, 3, and 4 provide more insight than a simple test for significance.

Figure 2 contains the marginal effects, Figure 3 the historic distributions, and Figure 4 the percent completing, passing, and earning an "A" each term by class plotted to show the changes over time. The top row is percent completing, the second is percent passing, and the third row is percent earning an "A."

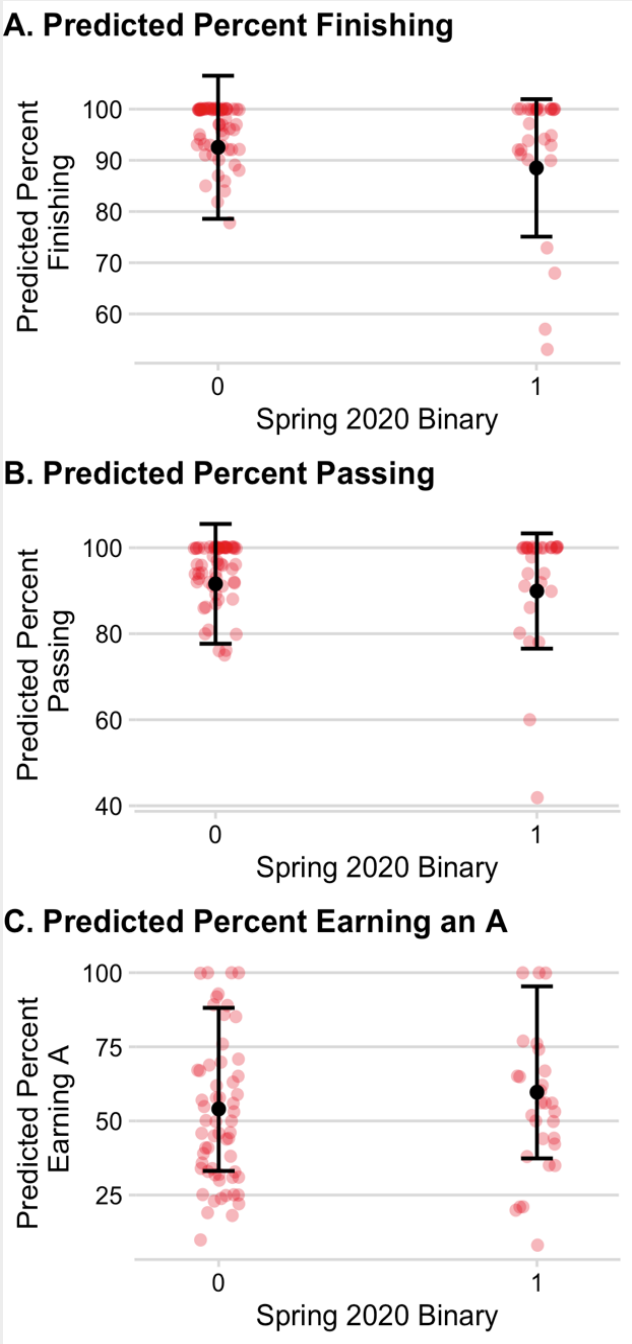

Figure 2. Marginal Effects of Predictions Impact of Spring 2020 Binary Variable on Percent Completing, Percent Passing, and Percent Earning an "A"

Taken together it becomes clearer why the models were not able to produce more significant results. There is not a single common experience across courses.

The size of the marginal effect of the spring term variable in the Poisson regressions is shown in Figure 2. Poisson marginal effects are calculated via simulation by predicting each observation and comparing the predictions (the black dot on the bar represents the median and the bar the confidence interval, while the red dots are observed values) with the documented outcomes. Figure 3 shows the historic distribution of each measure in the three periods. Figure 4 plots each of the measures over the three periods by course and plots a least squares fit over the two to three terms observed.

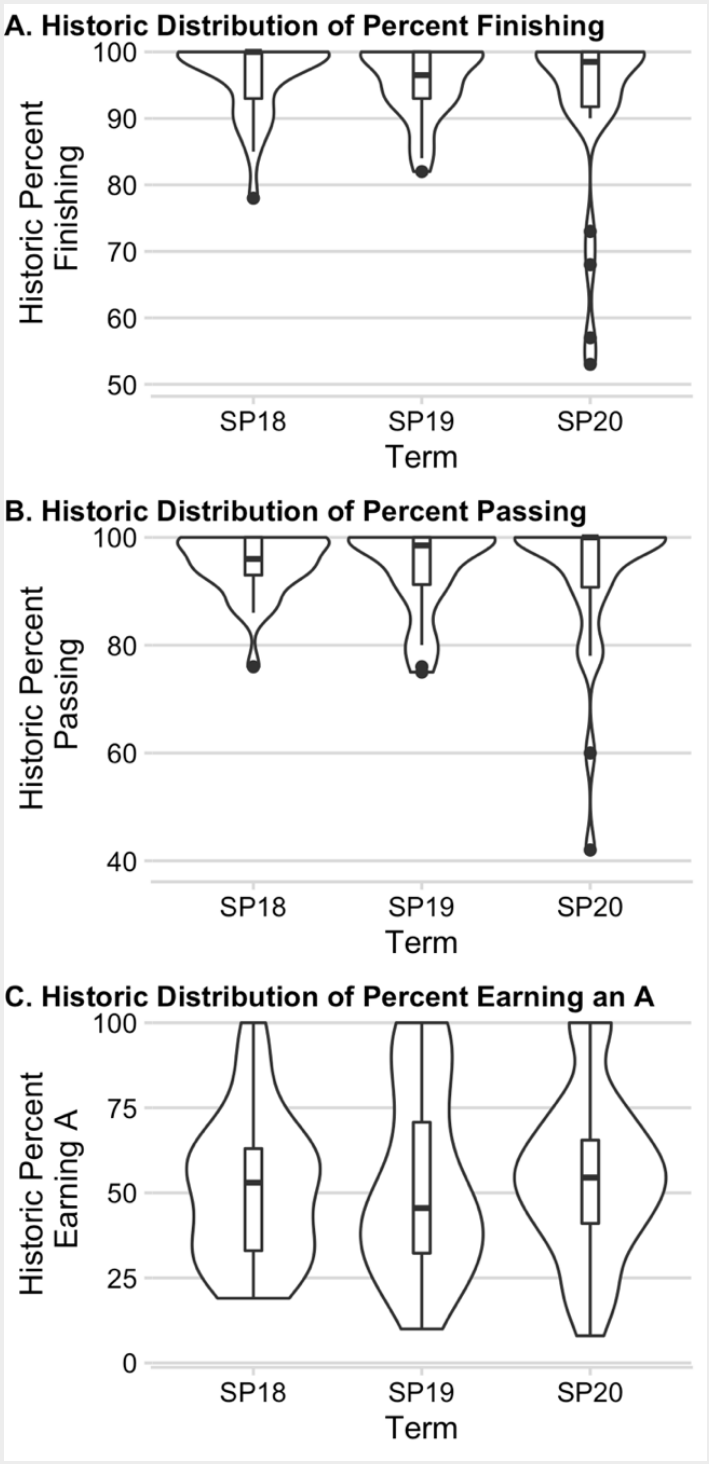

Figure 3. Historical Distribution Impact of Spring 2020 Binary Variable on Percent Completing, Percent Passing, and Percent Earning an "A"

All three marginal effects plots (Figure 2) show clusters at the 100 percent mark in Spring 2020 as well as in previous periods indicating that several courses exist where essentially all of the students complete and pass, and to a lesser degree, earn "As." The marginal effects plots show the strength of that statement by the amount of the predicted space (e.g. area indicated by the bracketed line) above the 100 percent level, which refers to a significant number of students who are completing and passing courses.

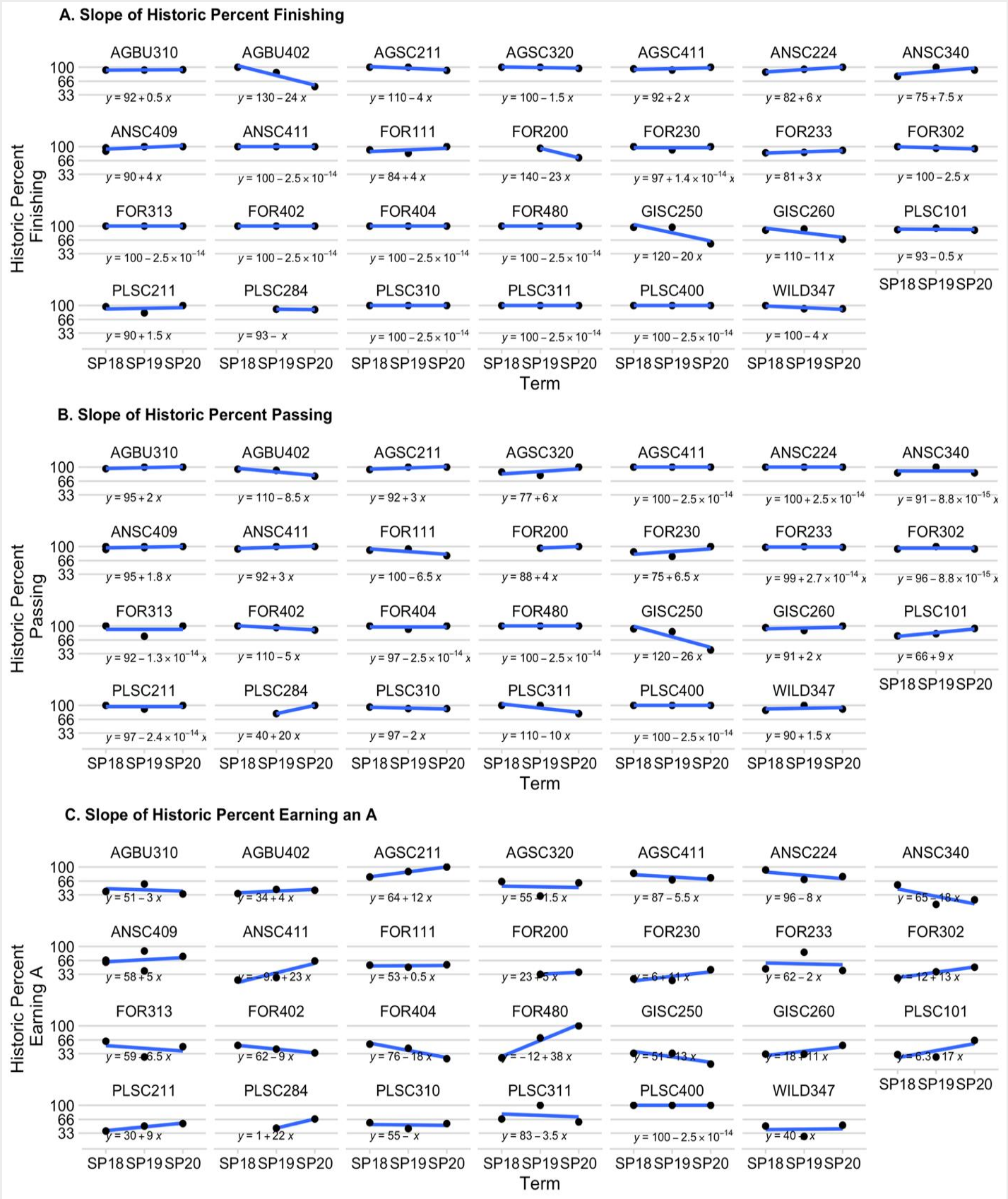

Figure 4. Distribution by Class Impact of Spring 2020 Binary Variable on Percent Completing, Percent Passing, and Percent Earning an "A"

Less of the predicted space was outside the possible space in 2020, indicating that this effect was less prevalent in that period. The predicted plots do indicate a small decrease in students completing and passing and a small increase in students earning "As" in the Spring 2020 term.

The historical distributions in Figure 3 show that the mean of students completing was very close to 100 percent for all three terms. However, the primary result of interest in Panel A is how the whisker between the minimum value and first quartile[1] is much shorter than previous terms and the increase in lower bound outliers in Spring 2020, indicating that in most classes a consistent number of students continued to complete in the Spring 2020 term, but some classes saw many more than usual students withdraw from the course. The four courses that had more trouble retaining students than usual are quantitative and computer-intensive courses (AGBU402, GISC250, GISC260, and FOR200). Many of our students struggle with both of those types of courses. Two of those courses also had fewer students pass in Spring 2020. The distribution of percent passing is very similar across terms, with the exception of the previously mentioned courses as outliers. The mean of students earning "As" was slightly higher, the inner quartile range was slightly smaller with longer whiskers, and there were no outliers in this distribution. Excluding outliers did not change the statistical significance of the Spring 2020 term for the percent passing estimation.

Figure 4 shows the same information broken down by course with a least squares fitted trendline plotted to show the direction of change over terms. A least squares trendline has the advantage of putting the Spring 2020 term in perspective, but not overreacting to a one term change. For example, PLSC211 in Panel A would look much worse if completion in Spring 2018, when completions were nearly the same as Spring 2020, were not taken into account. Along with the plot of the least squares line, the equation for the line is printed on each plot as well. A slope with an absolute value of less than one can be found in eleven courses in the percent completing plot, ten courses in the percent passing plot, and one in the percent earning an "A" plot. An absolute value of slope of less than one likely indicates little impact across terms. Seven had positive slopes indicating that more students completed, ten had positive slopes indicating more students passed, and thirteen had positive slopes indicating that more students earned "As" than usual. Nine courses had negative slopes indicating fewer students completed the course, six courses had negative slopes indicating fewer students passed, and twelve courses had negative slopes indicating fewer "As" than usual.

4 Discussion

Taken as a whole, these results show that there was not a single monolithic experience in the Spring 2020 term. Possible explanations for those differences can be divided between those relating to the student, the professor, and the content. The remaining paragraphs will parse out the experience according to those themes. The application of the explanations are anecdotal, but with the quantitative results in Figure 2, 3, and 4, they add context to the plots.

Many of our students work throughout the school year, and we (the authors) were concerned that without the structure of attending class, students would work more hours. In many cases this turned out to be true, including one of the "Ws" in AGBU230 who worked to support his family after both of his parents lost their jobs. Some students found themselves with fewer distractions as their social life was locked down. One such student in AGBU402 noted how much more he was enjoying class because he was trying (it was his second attempt).

[1] Distance between minimum value and first quartile = (Q1 - 1.5 * IQR).

The literature indicated there would be more success among better prepared students as they would be better able to adapt to the online delivery. The students remaining perhaps had more prior knowledge in the subjects and were more motivated to overcome technological issues (Roddy et al. 2017). Online education can indeed be as effective as traditional in-person education, provided thought is given to the delivery of materials and interaction with students by instructors (Tucker 2001; Frederickson, Reed, and Clifford 2005; Roddy et al. 2017). Students' ability to adapt to rapidly changing situations is an essential skill in their development and integration into the workforce.

The final student related possible explanation centers around the potential for academic dishonesty to increase in the online environment. In at least one course (to the authors' knowledge), there were three (14 percent of the initial enrollment for the course) "Fs" for academic dishonesty on homework, when there is normally about one student per term on average.

Four courses were outliers in the Spring 2020 completion distribution that had not been outliers before (Figure 3, Panel A). In addition to becoming outliers, the percent completing these courses was much lower than the outliers of previous terms. Course content was noted as a possible cause. AGBU402 is a farm enterprise analysis course that heavily employs Microsoft Excel. FOR200 is a forest measurements course that is a first introduction to statistics and regression. GISC250 is a course on GIS, and GISC260 is an introductory remote sensing course. Many students prefer to take these courses in person, and many simply decided to wait and withdrew.

The professor must thoughtfully adapt their course to online delivery to ensure success, and some were not up to the task. One such explanation is the different approaches to moving a class online. The sudden switch from in-person to online delivery caught students and professors (generally) unaware. Without time to fully prepare, faculty either maintained a synchronous online lecture or developed asynchronous delivery by using lecture capture technologies (e.g., Zoom, Google Meet, etc.). Anecdotally, some instructors were unable to imagine their courses presented remotely and simply awarded grades or compensated for their lack of confidence in their remote teaching abilities by awarding grades generously. This narrative matches the data for a course where the professor (not one of the authors) admitted to "just giving everyone an "A."

An example where course adaptation might have muted impacts of the transition to online learning was AGSC320. AGSC320 is a statistical methods course that emphasizes applications in the context of agriculture and natural resources. Students' levels range from sophomore to senior. The class was limited to 30 students in each term. In Spring 2020, AGSC320 was taught synchronously via Google Meet. The synchronous classroom was employed with the goal of keeping everyone—including the professor—disciplined and on task. Students were required to attend class at the normally scheduled times of 2:00 to 3:50 p.m. on Wednesday and Friday. Each lecture was recorded and uploaded to a shared class folder. Screens were shared, and examples were worked on a whiteboard. Multiple students commented on the sense of "normalcy" the synchronous environment provided. No student withdrew, one intended to opt for "Pass" rather than the letter grade earned (though this cannot be confirmed), and only one student failed to earn at least a "C" grade. In 2018 and 2019, approximately 10 percent of students withdrew, and another 10 percent failed to earn a "C" or better.

The results show that there is much that we do not know. However, the fact that there is not a single narrative is abundantly clear. Each student, content, and professor was impacted by the sudden shift online differently. With more observations, both leading up to the Spring 2020 term and across different colleges within the university, the outcomes could be sorted into types before implementing a regression similar to the three used in this study.

Future research needs to address student demographic variables and the student's academic history to understand how the transition online affected individual students and their academic achievement. At LaTech, this type of research will require a signed statement allowing the student to *opt-in* to the research project. For students that have stopped or dropped out, this may be impossible to acquire as those students are not likely to respond to inquiries. Other institutions may be able to use student records to examine these phenomena further to understand what causes these results.

It is vital as the pandemic continues that adequate instruction in online courses, access to training for faculty to integrate online instruction, and student access to technology that better allows them to engage in their education is available (Roddy et al. 2017). As the pandemic continues, online educational delivery will likely become more of a norm rather than an exception. It will be necessary for educators and administrators to understand what pushes students to withdraw and to attempt to continue to engage students.

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Appendix

Table A1. Number of Students in Each Course by Instructor and Term

ID	Instructor	Term	N	ID	Instructor	Term	N
AGBU310	18	20183	29	FOR313	06	20193	8
	18	20193	29		06	20203	14
	18	20203	33	FOR402	09	20183	19
AGBU402	18	20183	22		09	20193	25
	18	20193	15		09	20203	20
	18	20203	17	FOR404	07	20183	16
AGBU425	18	20183	1		07	20193	13
	18	20203	1		07	20203	14
AGSC211	03	20183	17	FOR420	02	20193	1
	03	20193	19		06	20193	4
	03	20203	13		10	20193	22
AGSC320	07	20183	17		10	20203	7
	07	20193	30	FOR478	07	20183	1
	07	20203	30	FOR480	10	20183	13
AGSC411	14	20183	27		10	20193	28
	14	20193	14		10	20203	25
	14	20203	23	GISC250	01	20183	30
AGSC478	12	20183	3		04	20193	30
	12	20193	3		04	20203	21
	11	20203	2	GISC260	04	20183	31
AGSC516	15	20193	2		04	20193	30
ANSC230	14	20193	17		04	20203	22
ANSC223	16	20193	12	PLSC101	08	20183	56
ANSC224	15	20183	17		08	20193	60
	15	20193	21		08	20203	58
	14	20203	22	PLSC211	17	20183	33
ANSC225	16	20183	6		17	20193	39
	15	20193	4		17	20203	25
	14	20183	5	PLSC284	08	20193	22
	14	20193	1		08	20203	20
	14	20203	7	PLSC310	09	20183	26

Table A1 continued.

ID	Instructor	Term	N
ANSC301	15	20183	40
ANSC315	05	20183	24
ANSC340	16	20183	9
	16	20193	10
	16	20203	15
ANSC409	12	20183	9
	12	20193	9
	11	20183	31
	11	20193	39
	11	20203	49
ANSC411	16	20183	32
	16	20193	24
	16	20203	26
ANSC425	14	20183	8
	14	20193	4
	14	20203	9
	11	20203	5
FOR111	01	20183	12
	06	20193	19
	06	20203	27
FOR200	01	20193	25
	10	20203	33
FOR230	13	20183	45
	13	20193	49
	01	20203	55
FOR233	02	20183	48
	02	20193	43
	01	20203	47
FOR302	10	20183	34
	02	20193	24
	02	20203	19
FOR313	02	20183	19
PLSC310	09	20193	25
	09	20203	25
PLSC311	09	20183	12
	09	20193	3
	09	20203	10
PLSC312	08	20183	18
PLSC400	08	20183	3
	08	20193	1
	08	20203	3
WILD314	13	20203	16
WILD347	13	20183	16
	13	20193	13
	13	20203	25

Table A2. Poisson Regression Results for Percent Passing, Percent Completing, and Percent Earning an "A"

Course	Dependent Variable:		
	Percent Passing	Percent Completing	Percent Earning an "A"
SP 2020	-1.676 (3.035)	-4.032 (2.944)	0.099 (0.095)
SP 2019	-1.503 (2.314)	0.013 (2.203)	-0.033 (0.095)
UPPER	2.492 (10.245)	3.463 (2.881)	-0.268 (0.227)
AGBU310	5.655 (4.656)	-1.285 (3.035)	0.061 (0.282)
AGBU402	-4.736 (6.705)	-15.085 (13.965)	-0.008 (0.208)
AGSC211	7.488 (9.709)	6.093*** (2.141)	0.467*** (0.137)
AGSC320	-3.677 (7.643)	4.342* (2.460)	0.212 (0.279)
AGSC411	6.974 (4.253)	1.756 (4.308)	0.585*** (0.205)
ANSC223	9.903 (9.439)	7.444*** (1.983)	0.565*** (0.130)
ANSC224	9.466 (9.361)	3.250 (5.206)	0.368** (0.157)
ANSC230	9.903 (9.439)	1.444 (1.983)	0.648*** (0.130)
ANSC301	-2.091 (4.502)	1.993 (2.894)	-0.288 (0.196)
ANSC315	1.909 (4.502)	3.993 (2.894)	0.339* (0.196)
ANSC340	-2.336 (6.729)	-4.253 (7.666)	-0.367 (0.554)
ANSC409	3.662 (5.002)	4.384 (3.273)	0.371 (0.241)
ANSC411	4.996 (4.997)	5.370* (2.833)	-0.153 (0.428)
FOR111	-2.892 (10.665)	0.955 (6.584)	-0.031 (0.126)
FOR200	7.992 (9.513)	-6.262 (8.860)	-0.456*** (0.121)
FOR230	-2.855 (12.103)	6.205 (4.160)	-0.681** (0.294)
FOR233	8.136 (9.405)	-3.771 (3.823)	0.047 (0.321)
FOR302	2.983 (4.863)	2.343 (2.745)	-0.117 (0.267)
FOR313	-1.399 (9.660)	5.370* (2.833)	0.083 (0.310)
FOR402	2.280 (4.969)	5.370* (2.833)	0.039 (0.248)
FOR404	4.296 (4.989)	5.370* (2.833)	-0.032 (0.363)
FOR480	6.974 (4.253)	5.370* (2.833)	0.424 (0.394)
GISC250	-17.021 (19.244)	-7.931 (13.221)	-0.782* (0.427)
GISC260	4.464 (9.987)	-7.750 (7.364)	-0.350* (0.195)
PLSC101	-6.813 (11.189)	0.806 (2.013)	-0.316 (0.315)
PLSC211	6.453 (9.833)	1.939 (7.240)	-0.142 (0.157)
PLSC310	0.293 (4.301)	5.370* (2.833)	0.218 (0.203)
PLSC311	0.264 (8.020)	5.370* (2.833)	0.581** (0.283)
PLSC312	5.909 (4.502)	3.993 (2.894)	-0.225 (0.196)
PLSC400	6.974 (4.253)	5.370* (2.833)	0.860*** (0.195)
WILD314	-32.415*** (4.473)	2.025 (2.903)	-0.825*** (0.193)
Instructor_12	3.004 (2.928)	-5.897 (5.589)	0.248 (0.236)
Constant	91.599*** (9.579)	92.543*** (2.629)	3.990*** (0.147)

Note: Robust standard errors are reported in parentheses and $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

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Teaching and Educational Methods

Teaching Principles of Microeconomics with the Economics Media Library

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JEL Codes: A20, A22
Keywords: Economics education, media, movies, pop culture, television

Abstract
We provide eleven short exercises that can be used in a principles of microeconomics classroom that incorporate media clips from the Economics Media Library (http://econmedialibrary.com/). The exercises have been used in both small and large classroom settings and take less than 15 minutes to complete. These teaching guides can be a helpful first step for educators interested in introducing small activities to engage students in the classroom.

1 Introduction

In his fifteen theses on teaching economics, Ken Elzinga (2001) proclaimed that "good lectures need good stories." Since his address at the Southern Economic Annual Meetings, educators have published material aimed at improving the content delivered in the economics classroom.[1] Despite growth in the number of resources available for educators to use in the classroom, there does not seem to have been an equivalent growth in research focused on how to use those resources to teach the concepts. Many of the published resources still rely on educators to determine how to integrate that material into their classrooms.

Providing engaging and relevant examples for students in the economics classroom could lead to an increased interest in the subject, as well as an increase in the number of majors. For example, Calkins and Welki (2006) found that students ranked interest in the subject as a top reason for deciding what major to select, even ahead of reasons like marketability of degree and future earnings. Becker (2003) argued that the economics profession loses majors to other business-oriented degrees because of a stubborn refusal to move from a traditional lecture to a more discussion-based classroom focused on using real-world examples and case studies. He suggested that economics could begin to attract creative students to the discipline by restructuring courses to focus on active learning and using examples that are relevant to students.

Using media in the classroom, particularly when assessments follow the same storyline, has been shown to increase quiz scores (Chu 2014) and result in increased student satisfaction at the end of the semester (Vidal, Mungenast, and Vidal 2020). A lot of the focus in education has adopted the Biggs (1996) paradigm that focuses on how students learn material rather than what topics instructors chose to teach. Teaching has transformed to more of a student-centered approach in an attempt to engage students with the learning process (Fung 2017, p. 182). The current model is to have students become more active participants in the learning process (Healey and Jenkins 2009, p. 152; Dal Bianco 2020), and educators across disciplines have developed resources to improve courses through small changes to the delivery of content (Lang 2016).

We provide a series of short teaching guides that can be used in the principles of microeconomics

[1] For a review of various pedagogical approaches to teaching economics, see Hoyt and McGoldrick (2019), Picault (2019), or Wooten et al. (2021).

classroom using media clips hosted on the Economics Media Library (Wooten 2018). These short guides have been used as part of independent practice during recitation sections and as part of group assignments in large lectures. We provide a brief background on teaching with media and then summarize the teaching guides as a collection of resources. Each guide has been included in the appendix.

2 Teaching with Media

The use of media in the classroom can largely be divided into two streams: broad and specific applications. Broad applications involved taking a media source like a single television series, a collection of movies, or musicals and finding a variety of teaching examples within the content that can be applied across a variety of economics courses. Television shows like *Seinfeld* (Ghent, Grant, and Lesica 2011) and *The Big Bang Theory* (Tierney et al. 2016) were some of the first television shows that were analyzed in depth for content. Websites like Dirk's Media Library (Mateer 2012) and the Economics Media Library (Wooten 2018) aggregate clips from a variety of television shows, movies, music videos, and commercials. The goal of these sites, however, is to highlight economics across a wide variety of media. While some sites provide teaching guides for particular clips from their site (Geerling et al. 2018), most provide only a description of the scene.

The other stream of literature focuses on specific topics that can be taught using media. The focus of this work is instead on the economic theory and then supplemented with corresponding media. Hoffer and Crowley (2013) uses a single episode of *South Park* to demonstrate the free-rider problem associated with voting. Kuester and Mateer (2018) and Rousu (2018) focus on teaching the benefits of free markets using scenes from *The Office* (Kuester, Mateer, and Youderian 2014) and Broadway musicals (Rousu 2016). Murphy, Schuler, and Wooten (2020) use a specific scene from the 1950s Western *Have Gun—Will Travel* to highlight externalities and Coasian bargaining. Finally, Wooten and White (2018) developed a simulator around a project designed to teach students the concepts and criticisms of marginal revenue product themed after the movie of *Moneyball.*

Using media in the classroom can make the material presented come across less dismal, which, anecdotally, is many students' first impression with economics. Both Harter (2003) and Hoyt (2003) have suggested that using popular media can help instructors connect with and can help explain concepts in ways that are more familiar to their students. It is important to meet students where they are because many students bring misperceptions to the classroom, which can make learning economics principles difficult (Busom, Lopez-Mayan, and Panadés 2017). The concepts taught in principles may not necessarily be intuitive to new learners, providing examples of the content in popular media provides an opportunity to build on prior knowledge. Having exercises that reinforce concepts in simple, approachable ways can be valuable to developing intuition behind certain topics in economics. Using popular media familiar to students, instructors can leverage the influence of scaffolding by building upon students' pre-developed knowledge of the media to focus teaching of new content (Van de Pol, Volman, and Beishuizen 2010).

3 Economics Media Library

The Economics Media Library[2] is an online repository of popular media segments that are available to instructors and students. There are currently over 550 scenes posted to the site with clip descriptions and tags for ease of navigation. Most of the clips on the site are not the same clips found on show-specific websites like Economics of Parks and Recreation (Wooten and Staub 2019), Economics of Modern Family (Wooten, Staub, and Reilly 2020), or Economics of Breaking Bad (Muchiri, Paraschiv, and Wooten 2021). All posts on the site are divided into categories for principles of microeconomics and macroeconomics topics, as well as field courses in behavioral, game theory, labor, health, and econometrics. Clips have

[2] The site can be accessed at http://econmedialibrary.com

been collected from media sources including television shows, comedy specials, movies, commercials, music, and other online media. The site provides a search feature to help users identify particular concepts that they may be interested in finding and provides a dedicated section to teaching with media and accessing the clips on the site.

4 Teaching Guides and Considerations

Each teaching guide included in the appendix contains seven key parts: an objective, an intended audience, a teaching strategy, a specific clip from the Economics Media Library, clip information, a set of questions or activities associated with the clip, and suggested answers to those questions. The exercises have been developed and used by the authors in their principles of microeconomics courses. The exercises have been used in large lecture classes as a means of active learning in the classroom, as well as a part of a weekly recitation section associated with a large lecture classroom. Most of the guides outlined below are modeled as think-pair-share activities, which have been shown to help students become more effective problem solvers (Kitaoka 2013).

Most of these exercises were used at the start of a lecture or recitation to review material covered from a previous class or as a starting activity to introduce concepts that would be covered in that day's lecture and recitation. The exercises are intended to be completed in the first 15 minutes of a session; however, they could be used in a wide range of classroom delivery modes with minor adaptations. For example, a large lecture may ask students to respond using a classroom response system instead of on an actual piece of paper. Classroom response systems, whether with traditional remotes (Calhoun and Mateer 2011) or with online platforms (Wooten, Acchiardo, and Mateer 2020), can be set up to engage students in a variety of classroom sizes, particularly in large lectures (Salemi 2009).

The teaching guides could also be used in an online or remote classroom with minor adjustments. For courses taught asynchronously, the clips and questions can be embedded in a content page of the course management system. Whether the material is part of a graded assessment would be at the purview of the instructor. For faculty teaching their courses synchronously, they could use breakout room functionality to have students work in small groups and then reconvene to solve the question in the main meeting room. The use of media in this way is just one method of connecting students in online courses who may feel isolated from their peers (Wooten, Geerling, and Thomas 2020).

The exercises cover most of the foundational topics in a principles of microeconomics course, which leads us to believe that they would be beneficial to a wide audience and not specific to content taught at the authors' respective universities. Using media throughout a lecture can be a form of active learning that allows students to stay engaged with the content (Hoyt 2003; Wooten 2020). Table 1 provides an overview of the topics and media included in each teaching guide.

Although the Economics Media Library has compiled numerous clips that can be utilized across various economics courses, we believe some instructors may find it difficult to know exactly how to incorporate the clips into the classroom. Goffe and Kauper (2014) find that a majority of instructors they surveyed do not believe pure lecturing is the best way for students to learn; however, half of them lecture because it is cost effective. Our intention with these teaching guides is that these exercises provide a low-cost method of incorporating media into a lecture.

Student responses are generally positive regarding the use of these teaching guides to supplement lectures and recitations. The video segments are short enough that students do not lose interest, but they take them seriously since they know an activity will follow the segment. A secondary consideration is the teaching style of the faculty member using the clip segments. Both authors use media regularly in the classroom and are comfortable showing clips from various media sources with and without the accompanying questions. Because a heavy number of media is used over the course of an entire semester, it is difficult to parse out the marginal effect of any single teaching guide.

Because all the clips are available on the Economics Media Library website, it is helpful to provide links to students who may want to review the segments to prepare for an exam. This can be done with a

Table 1. Teaching Examples in the Appendix Using Clips Posted on Economics Media Library

Appendix	Topic	Corresponding Clip Source	Clip Length (min:sec)
A	Opportunity Cost	T-Mobile commercial	0:30
B	Trade and Trade-Offs	Walmart commercial	0:30
C/D	Supply and Demand	The Hudsuckers Proxy	3:12
	(2 parts)	Always Sunny in Philadelphia	1:28
E	Elasticity	Nutella Commercial	1:20
F	Market Efficiency	Young Sheldon	1:42
G	Market Intervention	Saturday Night Live	0:30
H	Market Failures	The Good Place	2:28
I	Production & Costs	Argo	0:57
J	Perfect Competition	Horrible Bosses	1:01
K	Market Structure	The Simpsons	1:31
L	Game Theory	Golden Balls	3:53

dedicated "Exam Resources" page in a learning management system that has links for the various clips used. This has been really helpful for students who speak English as a second language. All of the segments used in the teaching guides are captioned, which can assuage any accommodation concerns.

A final challenge of teaching with media involves the "flow" of the classroom. The video files can be embedded into PowerPoint slides so that a faculty member can seamlessly integrate the media and not have to rely on an internet connection to play the video.[3] Video embedding is not available for faculty using Beamer and thus requires switching between a PDF viewer like Adobe Acrobat and a web browser like Chrome. The files can still be downloaded to a USB drive and played from a media player if instructors have unreliable internet connections.

5 Conclusion

These exercises provide benefits to both educators and students. For educators, the exercises bridge the gap between the desire to use media in the classroom and the actual process of teaching with media in the classroom. Educators can use the exercises as-is or can use the exercises to spur development of similar methods of incorporating media into a lecture. These exercises create good stories to help educators teach students not only to understand concepts in the classroom, but how to apply those concepts outside the classroom in their everyday lives. Perhaps by engaging students with a more active teaching approach and incorporating examples that they find interesting; we may also be able to increase the number of students opting to take additional economics courses.

For students, these exercises and the use of media in the classroom, provide a method to understand how economics is connected to their lives. Economics can be defined as the study of choice under conditions of scarcity, but that definition comes across irrelevant because our students face constrained choices daily, and yet they do not consider their choice set to be within the realm of economics. Students struggle to understand the relevancy of concepts covered during introductory courses but using popular media makes those topics more approachable.

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[3] Instructions are provided on Economics Media Library.

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Appendix A: Opportunity Costs

Objective: Identify opportunity costs
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "T-Mobile – Ariana or Maps?" (be sure to hide the title of the clip!)
Media Type: Commercial – T-Mobile
Clip Length: 30 seconds
Clip Link: https://econ.video/2019/06/13/t-mobile-ariana-or-maps/

Activity: Play the clip listed above and have students work independently to answer the following questions:

1. What were the driver's choices in the video? What choice did the driver make?
2. What is the opportunity cost of that choice?
3. What does T-Mobile want you to choose?
4. Describe the opportunity cost of that choice.

Have students share their work with another student and compare their answers. If the students have different answers (particularly to #2 and #4), have them work together to determine the appropriate answer.

Suggested answers:

1. Listening to music or using GPS. She chooses to use the GPS.
2. The opportunity cost of using GPS is that she gives up the ability to listen to music.
3. T-Mobile wants you to choose T-Mobile (specifically, they want you to switch from Verizon).
4. Yes! The opportunity cost of switching phone carriers could be what you would do with your time instead of going to the T-Mobile store to switch, what you could do with any money you have to spend to switch, etc.

Appendix B: Trade-Offs and Trade

Objective: Identify absolute and comparative advantage, calculate opportunity costs
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Walmart – Negotiations"
Media Type: Commercial – Walmart
Clip Length: 30 seconds
Clip Link: https://econ.video/2019/11/03/walmart-negotiations/

Activity: Assume that children going out to trick-or-treat earn different amounts of candy based on how long they stay out. Initially, the groups can produce the following payoffs for each hour they stay out.

	# Small Candy in 1 Hour	# Large Candy in 1 Hour
Spiderman Group	5	1
Princess Group	10	5

Based on the information provided in the table, answer the following questions in pairs.

1. Which group of children has the absolute advantage in collecting small candy? What about the collection of large candy? Why did you select the groups as you did?
2. Calculate the opportunity cost for each group for both small candy and large candy.
3. Which group has the comparative advantage in collecting small candy? What about large candy?

Suggested Answers:

1. The Princess group has an absolute advantage in both small and large candy collection because they can collect more of each compared to the Spiderman group. Absolute advantage is based on how much can be produced with the same number of resources.
2. The opportunity cost of each item is:

	Small Candy Opp. Cost	Large Candy Opp. Cost
Spiderman Group	⅕ of a large candy bar	5 small candy bars
Princess Group	½ of a large candy bar	2 small candy bars

3. Comparative advantage is based on which group has the lowest opportunity cost. The Spiderman group has the comparative advantage in collecting small candy, because their opportunity cost is lower (⅕ < ½). The Princess group has a comparative advantage in collecting large candy bars (2 < 5). If the two groups wanted to maximize their candy collection, the Spiderman group should focus on collecting small candy bars, and the Princess group should focus on collecting large candy bars.

Appendix C: Supply and Demand, Part 1

Objective: Distinguish between the components of the supply and demand curves
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "The Hudsucker Proxy – The Hula Hoop"
Media Type: Film – Hudsucker Proxy
Clip Length: 3 minutes, 12 seconds
Clip Link: https://econ.video/2017/10/18/1136/

Activity: Have students draw a hypothetical competitive market for hula hoops. Be sure they label the price and quantity axis, the supply and demand curves, and the initial equilibrium price and quantity. After they have their own market graph drawn out, show the video clip above and have students work in pairs to answer the following questions:

1. Why does the supply line slope up and to the right?
    a. As prices increase, the quantity sellers are willing to supply decreases.
    b. As prices decrease, the quantity sellers are willing to supply increases.
    c. As prices increase, the quantity sellers are willing to supply increases.

2. Why does the demand line slope down and to the right?
    a. As prices decrease, the quantity consumers are willing to purchase decreases.
    b. As prices increase, the quantity consumers are willing to purchase decreases.
    c. As prices increase, the quantity consumers are willing to purchase increases.

3. Based on the clip, when the price of a hula hoop was initially set at $1.79, which of the following was likely true about the market?
    a. The quantity supplied exceeded the quantity demanded at the initial price, creating a shortage.
    b. The quantity demanded exceeded the quantity supplied at the initial price, creating a shortage.
    c. The quantity supplied exceeded the quantity demanded at the initial price, creating a surplus.
    d. The quantity demanded exceeded the quantity supplied at the initial price, creating a surplus.

4. Based on the clip, what is the most likely reason for the change in demand for hula hoops?
    a. Change in income
    b. Change in preferences
    c. Change in the price of substitutes
    d. Change in the price of hula hoops

Suggested Answers:

1. B
2. B
3. C
4. B

Appendix D: Supply and Demand, Part 2

Objective: Demonstrate shifts to supply and demand curves
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Always Sunny – Supply Shifts for Fish" (be sure to hide the title of the clip!)
Media Type: TV Show – Always Sunny in Philadelphia
Clip Length: 1 minute, 28 seconds
Clip Link: https://econ.video/2018/01/15/always-sunny-supply-shifts-for-fish/

Activity: Have students work in groups to answer the following questions:

1. Based on the discussion in the clip, which curve in our supply and demand model is affected? Why do you think that?
2. Which direction does that curve shift?
3. What happens to the market equilibrium price and quantity relative to its initial equilibrium?

Suggested Answers:

1. The supply curve is affected because the waiter mentions an issue with their fish supplier.
2. The supply curve shifts left because there is an issue with the fish supplier, which suggests that there has been a decrease in the supply of fish.
3. The equilibrium price should increase, and the equilibrium quantity will decrease. While the group members may still want fish, other customers may not be willing to pay the higher price.

Note: You may want to reiterate to your students to not overcomplicate the purpose of the competitive model. While the characters in the clip still want their fish, other patrons in the restaurant may not be willing to pay the higher price. This is a good chance to remind students that models are a simplification of a more complex system and that just because a group of people do not change their behavior does not mean it is true for the entire market.

Appendix E: Elasticity

Objective: Discuss the determinants of price elasticity of demand
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "TIME – Nutella Riots After Price Drop"
Media Type: News segment – Time, Inc.
Clip Length: 1 minute, 20 seconds
Clip Link: https://econ.video/2018/01/27/time-nutella-riots-after-price-drop/

Activity: First have students work in pairs to enumerate the four determinants of price elasticity of demand. Ask students to then consider the product, Nutella, which is a chocolate hazelnut spread that is very popular across Europe. A 13 oz. jar typically costs around $4 at local supermarkets in the United States. Imitation versions of the product may be slightly cheaper.[4]

Tell students the typical price of a jar of Nutella, but then tell them that you have been told by your neighbor that your local store is planning to cut the price in half tomorrow. What response should the grocer expect? Have students work in pairs to determine if the response is likely to be elastic or inelastic based on the determinants they have listed.

Have students work in pairs to determine if they believe the demand for the product is either relatively elastic or inelastic. You may also want to press them on clearly stating whether it is a necessity or luxury. You will likely find that students can justify Nutella as having characteristics of both. Given that the price reduction is 50 percent, would they expect a more than 50 percent increase in purchases (making it an elastic response) or less than 50 percent increase (an inelastic response). Split the room in half as a way of voting for one side or the other and allow students to sort based on what they think will happen. Have students also consider what will happen to store revenue based on their choice.

Play the clip above from Time, which shows the dramatic response to the price reduction in France. Based on the response, it appears Nutella may be more elastic that some students may realize.

Suggested Answers:

The four determinants of price elasticity of demand are generally considered:

1. The availability of close substitutes.
2. Whether an item is a necessity or luxury.
3. The share of income spent on the good.
4. The time elapsed since the price change.

Price reduction for Nutella considerations:

- There are close substitutes (*more elastic*)
- It probably isn't a necessity (*more elastic)*
- It's a small share of a person's income (*more inelastic*)
- The price change is happening soon, so not a lot of time to adjust (*more inelastic*)

For price reductions on inelastic goods, revenue should fall. Revenue should increase if the product is elastic.

[4] Depending on class size, you could revisit this lesson at the end of the semester and have students taste test different jars of chocolate hazelnut spread in an attempt to rank them by quality. Students are unlikely to be able to differentiate between brands, which could be used to discuss the role of product differentiation.

Appendix F: Market Efficiency

Objective: Calculate market efficiency including consumer, producer, and total surplus
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Young Sheldon – Haggling"
Media Type: TV Show – *Young Sheldon*
Clip Length: 1 minute, 42 seconds
Clip Link: https://econ.video/2018/11/05/young-sheldon-haggling-skills/

Activity: In the scene, Georgie finds a lamp that he thinks is overpriced at $10. He thinks it's probably worth closer to $3. Meemaw was given the lamp as a gift, so she'd be willing to give it away just to clear out space. Suppose a customer stops by and is able to negotiate the lamp down to $5, but actually would have been willing to pay the original $10 price tag.

After showing the clip, have students work in pairs to calculate the following:

1. Customer's consumer surplus.
2. Meemaw's producer surplus.
3. Total surplus generated from the exchange.

Suggested Answers:

1. Consumer Surplus = Willingness to Pay – Price
   Consumer Surplus = $10 – $5 = $5
2. Producer Surplus = Price – Marginal Cost
   Producer Surplus = $5 – $0 = $5
3. Total Surplus = Consumer Surplus + Producer Surplus
   Total Surplus = $5 + $5 = $10

Appendix G: Market Intervention

Objective: Discuss costs and benefits of price floors
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Saturday Night Live – Chris Rock on Minimum Wage"
Media Type: TV Show – *Saturday Night Live*
Clip Length: 30 seconds
Clip Link: https://econ.video/2017/01/31/saturday-night-live-chris-rock-on-minimum-wage/

Activity: Have students work together to answer the following questions.

1. Minimum wage, as Chris Rock has described it, is an example of which government intervention?
    a. Price ceiling
    b. Price floor
    c. Quota
    d. Taxes

2. Which of the following will likely be true about the effects of a minimum wage in a competitive labor market?
    a. Income will increase for all workers
    b. Income will decrease for all workers
    c. Income will increase for some workers, but decrease for others
    d. Income will remain unchanged for all workers

3. Some people argue that a minimum wage is good because it would lead to better service at places hiring minimum wage workers. This would most likely represent an example of:
    a. Inefficiently high quality
    b. Wasted resources
    c. Inefficient allocation of sales among sellers
    d. Illegal activity

4. Some potential employees spend hours applying for jobs and changing the fonts on their resumes to help them stand out. This would most likely represent an example of:
    a. Inefficiently high quality
    b. Wasted resources
    c. Inefficient allocation of sales among sellers
    d. Illegal activity

Suggested Answers:

1. B
2. C
3. A
4. B

Appendix H: Market Failures

Objective: Distinguish between marginal private costs, marginal private benefits, marginal social costs, and marginal social benefits
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "The Good Place – Externalities and Unintended Consequences"
Media Type: TV Show – *The Good Place*
Clip Length: 2 minutes, 28 seconds
Clip Link: https://econ.video/2019/02/19/the-good-place-externalities-unintended-consequences/

Activity: Show the clip above and then have students work individually to complete the following questions. Afterward, have students work in pairs to compare answers and revise as necessary.

1. Graph the market for roses based on 1534 Doug's experience. Be sure your graph contains both private and social curves. Identify the market equilibrium and the socially optimal equilibrium.
2. Graph the market for roses based on 2009 Doug's experience with the new information provided. Be sure your graph contains both private and social curves. Identify the market equilibrium and the socially optimal equilibrium.

Suggested Answers:

1. Based on the description in the clip, there doesn't appear to be any externalities in 1534, which means that 1534 Doug's marginal private cost (MPC) is equal to the marginal social cost (MSC) and the marginal private benefit (MPB) curve is equal to the marginal social benefit (MSB). The social equilibrium is where MSC and MSB are equal, which the market outcome is where MPB equals MSB. Since there are no externalities, the socially efficient outcome and the market outcome are the same.
2. For 2009 Doug, it appears that externalities have formed in the market for roses. Based on the provided list, the MSC is now greater than (above) the MPC. The market outcome is to the right of the socially optimal outcome, which means that too many roses are being produced and consumed. This is shown in the clip with negative happiness obtained in the 2009 version of Doug.

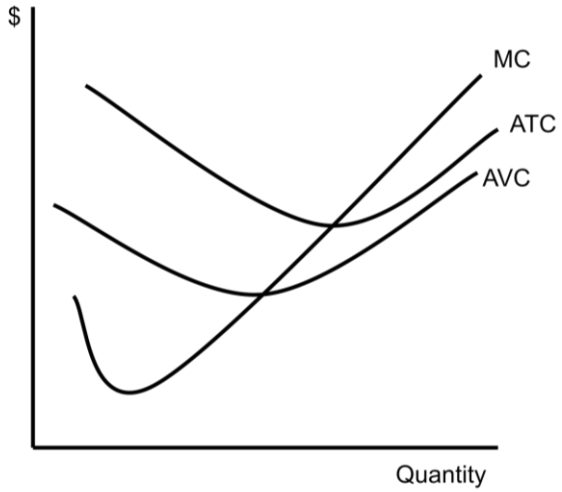
Note: This is a good opportunity to remind students not to overcomplicate models presented in class. The purpose of models is to simplify a relative complex environment by assuming some conditions. You can consider adding a question about what things could be included in the marginal external costs to see if they recall unintended consequences!

Appendix I: Production and Costs

Objective: Identify the relationship between marginal costs, average variable costs, and average total costs
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Argo – The Best Bad Idea"
Media Type: Movie – *Argo*
Clip Length: 57 seconds
Clip Link: https://econ.video/2019/02/15/argo-the-best-bad-idea/?

Activity: The concept of "the best bad idea" helps explain why some firms may operate in the short run despite suffering a loss. This concept is typically one of the more difficult concepts to teach because students tend to associate all losses as something to be avoided. The goal with this lesson is to have students realize that there are "levels" of bad outcomes and that firms should make the best option, even if it seems like a "bad idea."

Have students first graph the costs curves on their own sheet of paper. Their answers will likely look something like:



Where MC represents marginal cost, ATC represents average total cost, and AVC represents the average variable cost for the firm. While firms would prefer to earn a positive profit, there are a few loss scenarios to consider as well. Divide the class into thirds, and assign one third to depict each of the following outcomes:

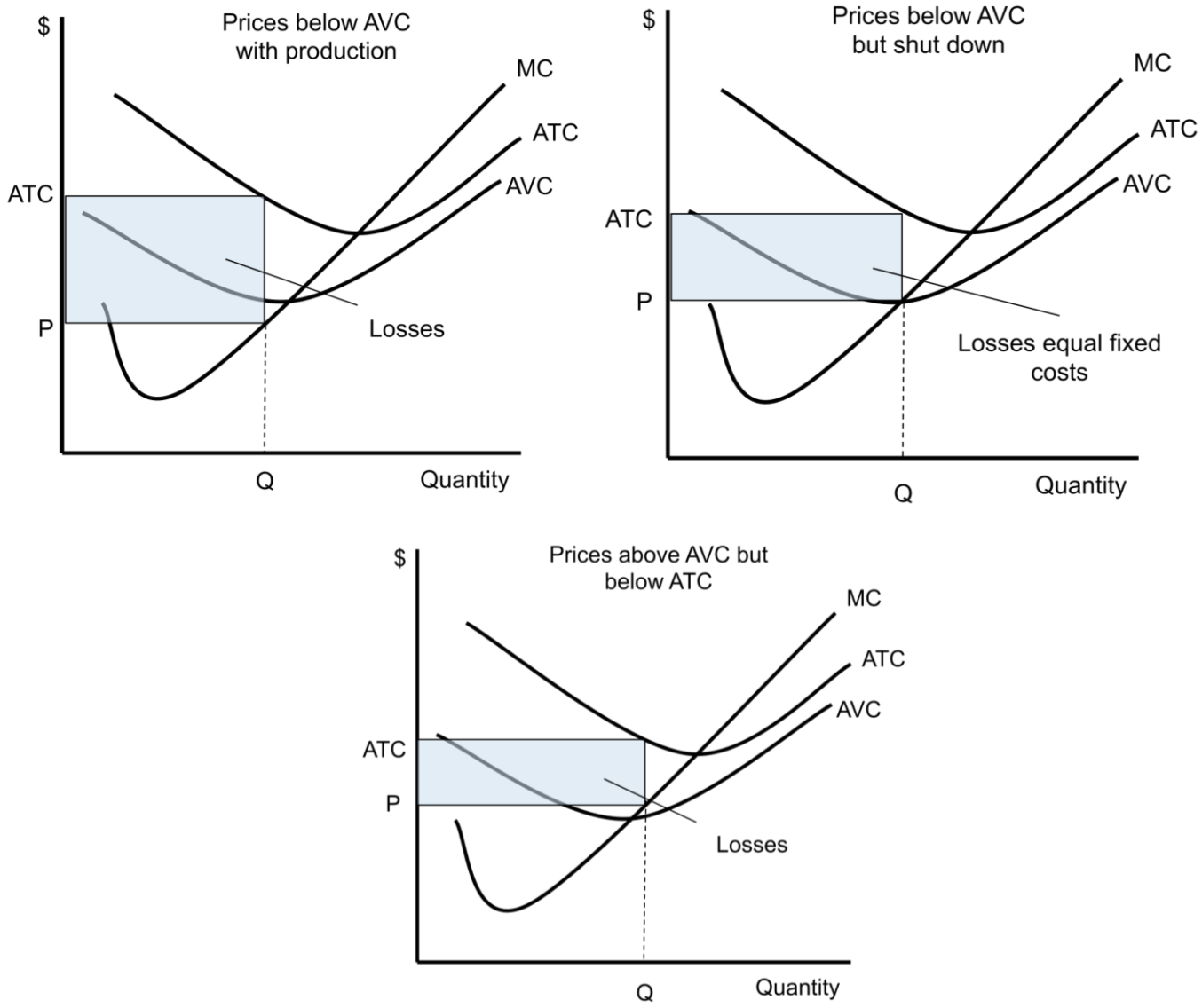
1. Prices are below AVC, and they decide to produce
2. Prices are below AVC, but they shut down
3. Prices are above AVC, but below ATC

Have students select a price that meets the condition they have been assigned and shade their graph to identify total revenue, total costs, and total losses.

Have students form triplets with one student from each of the above three conditions. Given what they have found, ask students to rank the options based on what's the "best of the bad" options they have been presented.

Suggested Answers:

The graph for shut down when below AVC is shown at the shutdown point.



Ranking

1. (WORST) Firms producing below AVC will have losses that include both their fixed costs and some of their variable costs that they could not recoup.
2. (BAD) Firms can shut down when prices are below AVC and have losses equivalent to only their fixed costs.
3. (BEST OF THE BAD) Firms can continue producing as long as prices are above AVC. They will cover their fixed costs, and only lose a fraction of their variable costs.

Appendix J: Perfect Competition

Objective: Calculate marginal revenue and marginal cost, discuss the relationship between marginal revenue and marginal cost
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Horrible Bosses – Child Labor"
Media Type: Film – *Horrible Bosses*
Clip Length: 1 minutes, 01 seconds
Clip Link: https://econ.video/2018/07/30/horrible-bosses-2-child-labor/

Activity: Present the following information on a slide or passed out on a sheet of paper for review. Have students work in teams to determine their answers. You can split the class initially by Yes/No distinction then drill down further for the "why" portion.

Suppose you are one of the three owners of the production facility and are currently producing 100 cases of Shower Buddies. Your average costs per case is given in the table below:

Cases	Average Cost
100	$100
101	$101
102	$102
103	$103

A new customer would like to place an order for an additional case of Shower Buddies. This would increase your production to 101 cases.

The customer offers $150 for the case. Should you produce it? Why?

Suggested Answers:
You should not produce this unit because MC > MR.

Marginal revenue is equal to $150, and MC can be calculated using the table above:

Total Cost @ 100 units = 100 × 100 = $10,000

Total Cost @ 101 units = 101 × 101 = $10,201

Marginal cost of the 101st unit is $201.

Common wrong responses include believing that production should occur since price is above average cost, while other students will believe you should not produce only because average cost is increasing.

Appendix K: Market Structure Review

Objective: Compare and contrast market structures
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Simpsons – Mr. Plow"
Media Type: TV Show – *The Simpsons*
Clip Length: 1 minutes, 31 seconds
Clip Link: https://econ.video/2017/10/03/simpsons-mr-plow/

Activity: Homer starts as a monopolist in the snow clearing business for Springfield, but his profits are short lived. Barney learns that Homer has been successful and decides to enter the market. Have students start by answering the following question:

Why are Homer's profits so short lived?

A. It is relatively easy to start a snowplowing business
B. He has very low fixed costs of production
C. There is not a large demand for snowplow companies

By this point in the semester, each of the market structures has been covered, and students should be familiar with the characteristics of each market structure. Have students complete the following matrix that outlines the key characteristics of all four market structures:

Market Structure	# of Firms	Price Control	Differentiation	Barriers to Entry
Perfect Competition				
Monopolistic Competition				
Oligopoly				
Monopoly				

Consider again the market for snow clearance in Springfield. With Mr. Plow, Homer has a monopoly over the market. Once Barney enters the market, the two of them operate in an oligopoly providing identical services. Have students create market scenarios that would describe perfect competition and monopolistic competition in the snow removal market.

Suggested Answers:
Homer's profits are likely short lived because it's relatively easy to start a snowplow business. In the clip, Barney seems to have joined the market fairly quickly.

Market Structure	# of Firms	Price Control	Product Type	Barriers to Entry
Perfect Competition	Lots	None	Identical (homogenous)	None
Monopolistic Competition	Lots	Very little	Differentiated	None (or very low)
Oligopoly	A few	Some	Differentiated or Identical	High
Monopoly	One	Complete	Unique products	Entry is blocked

Market Scenarios

Perfect competition:
There are lots of firms providing snow removal services all for the same price based on the size of the driveway or sidewalks. This could be achieved if people attached snowplows to their cars, or if they did all the work using snow shovels. All firms would provide identical service, and customers would not be able to tell the difference in a company's performance.

Monopolistic competition:
Smaller lawn maintenance companies begin providing snow clearance in the winter, but they may offer differentiated services. Some may only clear snow at night, while others during the day. Some may offer to salt driveways or provide a discount if you sign up for grass mowing in the spring. Companies would brand themselves and spend a portion of their earnings trying to convince homeowners to switch services.

Appendix L: Game Theory

Objective: Identify payoffs
Intended Audience: Principles of Microeconomics
Teaching Strategy: Utilizing Technology in the Classroom, Cooperative Learning
Clip Title: "Golden Balls – Split or Steal"
Media Type: Game Show – *Golden Balls*
Clip Length: 3 minutes, 53 seconds
Clip Link: https://econ.video/2017/08/24/golden-balls-split-or-steal/

Activity: For this particular scene, break the video into parts by pausing at strategic moments to ask students to predict the outcome. Play the first 1 minute and 45 seconds, which involves the game show host describing the game setting. In general, Sarah and Steve are asked to select either a ball that indicates whether they want to split the jackpot or steal the jackpot. The potential outcomes are:

- Both split the jackpot of £100,150. Each would receive £50,075
- One steals the entire £100,150 jackpot, and the other receives nothing
- Both select steal and both earn nothing

At the break, ask students what they would do in this situation. You may have them write it on a note card or sticky note so that you can consider the percentage of the class that says they would split it to the percentage who believe the contestants will split it.

Play the clip from the stopping point, but stop just before the host reveals the outcome, around 2 minutes and 45 seconds into the clip. Ask students to predict the outcome. You can have students work together to complete a simultaneous game box:

		Sarah	
		Split	Steal
Steven	Split		
	Steal		

Have students start by considering only the payoffs associated with the jackpot from the show. Then have students consider nonmonetary costs of public embarrassment associated with leaving with nothing. This will allow for an interesting conversation about what is included in payoff tables and what assumptions economists make about payoffs.

Suggested Answers:

		Sarah	
		Split	Steal
Steven	Split	£50,075, £50,075	£0, £100,150
	Steal	£100,150, £0	£0, £0

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Extension Education

Obtaining Extension Stakeholder Input to Influence Extension Education Programming and Staffing Needs

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Abstract
Cooperative extension has had to adapt communication and outreach efforts for the past several years because of changes in funding, technology, farmer demographics, and overall industry demands and needs. Given decreasing resources, effective program planning is necessary to optimize output and impact. The Michigan State University Extension Beef Team conducted a needs assessment using an online producer survey. As an interdisciplinary team, the Beef Team was able to address all facets of the Michigan beef industry. Specifically, agricultural economists contributed to the needs assessment with core economic concepts, as well as survey design and analysis. Upon data collection, producers identified marketing, profitability, and animal health as the biggest challenges facing their operations in the next 5 to 10 years. The Beef Team utilized these results for program planning and to make staffing recommendations to administration.

1 Introduction

Throughout the past 100 years, cooperative extension has had to continually adapt communication and outreach efforts because of changes in funding, technology, farmer demographics, and overall industry demands and needs. Now more than ever, we see an important economic concept come into play, to optimize extension professionals' output (e.g., presentations, content delivery, and workshops) and impact on their communities, given scarce financial and staffing resources. Donaldson and Franck said it best in their *Needs Assessment Guidebook for Extension Professionals,* "Our world faces unlimited needs, but limited resources (Donaldson and Franck 2016, p. 6)." The purpose of this paper is to identify the needs of the Michigan beef industry and pinpoint how Michigan State University (MSU) Extension can better address such needs through future programing and staffing. Additionally, we highlight the role agricultural economists can play in interdisciplinary teams conducting needs assessments.

Utilizing intentional planning methods is more effective than inflicting change because of an unexpected shock or immediate need (Lyford et al. 2002). According to Seevers and Graham (2012), program plan development is defined as, "a continuous series of complex, interrelated processes which result in the accomplishment of the educational mission and objectives of the organization." There are many different program planning models, including a results-driven model mainly used in education (Tyler 1949), a less structured plan driven by a designed change theory (Lippitt, Watson, and Westley 1958), a model to link the planning organization to the impacted community (Boone, Safrit, and Jones 2002), and many more. By implementing one of the various program planning models, cooperative extension teams can evaluate their programs in a way that allows them to better reach the needs and desires of their constituents using their scarce resources (Diaz, Gusto, and Diehl 2018). By in large, all program planning models are composed of four components—planning, design and implementation, participant-driven needs assessment, and evaluation (Diaz, Gusto, and Diehl 2018).

A key component of program planning models—needs assessments—is the focus of this paper. A need arises when a gap exists between what ought to be, the desirable outcome, and what is, the actual situation (Leagans 1981). The goals of needs assessments are twofold: (1) to learn about stakeholders' problems, issues, and/or concerns, and (2) to understand how to respond with programs, products, and services (Garst and McCawley 2015). Needs assessments of the beef industry have been conducted for Arkansas (Troxel et al. 2007), Arizona (Wright, Greene, and Faulkner 2017), Colorado (Dideriksen 2018), Idaho (Roubal 2017), Iowa (Gunn and Loy 2015) and Michigan (Cowley et al. 2000), as well as for the U.S. cow-calf industry (Martin et al. 2019).

Receiving input from community stakeholders proves highly beneficial in program development and stakeholder buy-in over time (Franz 2011). However, previous needs assessment methods used to gather stakeholder input—including focus groups, in-person or mail surveys, and open listening sessions (Donaldson and Franck 2016) are costly and time consuming. Limited budgets, decreased staffing, and changing technology motivate requisite changes in needs assessment methodology. Given that there has been no increase in funding for extension, as well as a steady decline in extension employee full-time equivalents (FTEs) across the country (Wang 2014), more cost effective and less labor-intensive methods are needed.

The first contribution of this analysis is the development and use of an online survey needs assessment tool. Unlike the needs assessment conducted by MSU Extension in 1999 surveying the beef industry via mail (Cowley et al. 2000), the survey used in this study was administered online via Qualtrics and disseminated via email and on the MSU Extension website to beef producers across the state. All responses were collected online making for more streamlined data collection and analysis, saving money and time (Wright 2005). Furthermore, the online format allowed for broader dissemination, reaching beef producers who had not utilized MSU Extension services before. Given agriculture economists familiarity with survey development and data analysis, they can play a key role in leading needs assessments on extension teams.

The second contribution is our interdisciplinary approach to the needs assessment. According to Stock and Burton (2011), "Interdisciplinary studies focus on addressing specific 'real world' system problems and, as a result, the research process forces participants (from a variety of unrelated disciplines) to cross boundaries to create new knowledge" (p. 1096). For a long time, MSU Extension has relied on an interdisciplinary approach to reach farmers and producers across the state (Michigan State University n.d.; Leholm et al. 1999). Not only are interdisciplinary teams important to maximize outputs with decreasing budgets, but because the needs across the industry are diverse, it is important that extension teams are equipped to address a variety of issues (Redfearn, Parsons, and Drew 2016). Specifically, in this article we highlight how agricultural economists can use their skill sets to help fellow cooperative extension professionals develop needs assessments that effectively determine the needs of stakeholders.

As land-grant institutions across the country operate their extension programs differently, this article begins with an explanation of the MSU Extension structure. We then explain the methods and data collection, including the online survey instrument, followed by our results, and discussion, including a discussion on how agricultural economists can serve their extension teams through needs assessments. We will end with the implications of this process.

1.1 Michigan State University Extension

Michigan State University Extension has played a crucial role in bringing institutional knowledge to counties throughout the state of Michigan since adoption of the Smith-Lever Act in 1914. During the mid-1990s, Michigan's Extension program and research experiment stations underwent significant structural and operational changes when the educational planning and delivery model shifted to self-directed work teams of extension educators and specialists, and experiment station researchers, called area of expertise (AoE) teams. The field crops, dairy, and livestock AoE teams launched in 1994, with

many other teams to follow (Leholm et al. 1999). Over time, the livestock AoE team further subdivided into species work groups.

The interdisciplinary work group that facilitated the current study and serves the Michigan beef industry is referred to herein as the "Beef Team." The Beef Team is composed of both field educators and campus faculty from multiple disciplines, including, agricultural economics, animal welfare, beef production systems, environmental management, farm business management, forages, genetics, meat science, nutrition, program evaluation, and veterinary medicine. The Beef Team meets monthly to discuss industry trends, identify challenges and areas of needed research or educational programming, and coordinate projects among team members. Work group operational logistics have evolved, with additional emphasis on planning and reporting of team activities, including outcomes, impacts, and documentation of clientele's behavioral changes (Bitsch and Thornsbury 2010). Additional expertise is recruited to support team activities on an as-needed basis and the team works closely with industry stakeholders. The interdisciplinary approach of the beef team was core to the development of this needs assessment and study design.

Despite the impressive real social rate of return to public investments in agricultural extension (Jin and Huffman 2016), federal and state investment in extensions has steadily declined over the last three decades in many states. Between 1980 and 2010, field-based educator positions in the United States fell at a faster rate than their campus-based specialist counterparts (Wang 2014). However, starting in 2010, the Michigan system, under even greater financial pressure, had a more dramatic decline in both campus- and field-based personnel. In 2001, following the conversion to an AoE structure, the Beef Team had 3.65 campus-based beef specialist FTEs and 8.0 field-based beef educator FTEs. In 2019, despite serving a larger beef industry, the Beef Team had just 37 percent of both campus faculty and field educator FTEs that it had in 2001 (Buskirk et al. 2020). Because of loss of team members and expertise, the Beef Team has been forced to become more efficient and focused with program design, implementation, delivery, and evaluation.

In 1999, the Beef Team received internal funding to send a 5-page, printed survey via U.S. mail to 2,327 Michigan beef producers to solicit extension education priorities (Cowley et al. 2000). The survey was an effective instrument to obtain representative industry feedback, but was expensive to print, mail, and provide return postage, and was labor intensive to complete data entry and analysis. Since then, periodic needs assessments of the Michigan beef industry priorities have been obtained through written evaluations or electronic polling at extension events, selected focus groups (organized by MSU Extension and/or Michigan Cattlemen's Association) or using information from secondary data sources, such as surveys by the USDA NASS Census of Agriculture (2017) and USDA APHIS National Animal Health Monitoring System. Internal Beef Team communications have also been used to discuss and monitor industry trends. A more robust and representative method to assess industry needs was desired. The instrument needed to be inexpensive, capture broad and representative input, and require minimal staff time to distribute, acquire the data, and analyze.

2 Data Collection and Methods

A survey was designed by the Beef Team, composed of campus- and field-based personnel from multiple disciplines, with input from the Michigan Cattleman's Association, to solicit responses from affiliates of the Michigan beef cattle industry. An interdisciplinary approach was followed as this project brought together collaborators and ideas from multiple disciplines to frame the problem, decide on an approach, and analyze the data (Stock and Burton 2011). The Beef Team used an iterative research process including multiple virtual meetings to discuss the research questions and design the survey instrument.

The study received Institutional Review Board (IRB) approval (MSU Study ID: STUDY00001942). The survey instrument can be found at https://www.canr.msu.edu/resources/needs-assessment-of-michigan-beef-industries. The survey was administered online via Qualtrics and sent out by the Beef

Team to numerous listservs and posted on the MSU Extension website. Some of these listservs include the MSU Beef Production News Digest, the Beef Team members' email contact lists, as well as Michigan Cattleman's Association membership. In addition, the survey was posted to the MSU Extension website. Paper copies of the survey were available at beef extension meetings, as well as a QR-code handout with the survey link. Paper copies were not used by meeting attendees, and therefore all responses were collected online.[1] This strategy is consistent with other recent producer studies (McKendree, Tonsor and Wolf 2018; Schulz and Tonsor 2010; Martin et al. 2019; Lee, Schulz, and Tonsor 2019) and increase use of technology adoption by producers.

At the outset of the survey, we asked the respondents to identify their affiliation with the beef industry—beef producer, allied industry member, both, or neither. Skip logic was used to direct respondents to three different survey paths (beef producer, allied industry, or neither) based on the category they selected. We received 342 responses—253 beef producers, 25 allied industry members, 38 beef producers and allied industry members (both), and 26 that indicated neither of these affiliations. Those who self-identified as both producer and allied industry member were prompted with the beef producer question path. Given the sampling strategy, the response rate is unknown. For brevity, we present results from those that identified as producers, as well as those who identified as both beef producers and allied industry members to understand the needs and demands of the Michigan beef producers (291 responses).

We designed the survey to gather information on respondent demographics, operation type, perceived industry challenges, and views related to MSU Extension's role in addressing the identified challenges. One of the major goals was to understand Michigan beef producers' past and foreseeable challenges and how MSU could help address these issues. As such, we asked producers both open-ended and Likert-scale questions related to issues and challenges facing their operations. The first two open-ended questions were, "*Considering where you want your beef operation to be in the next 5–10 years, what are the largest issues or challenges that need to be addressed to get you there?*" and "*How could MSU Extension help to address the above issues or challenges?*" Next, we asked producers how concerning 19 different issues, identified by the Beef Team, had been to their operation in the past 5 years, using Likert-scale questions. The scale was, not concerning (1), somewhat concerning (2), and very concerning (3), as well as a "does not apply to my operation" option. We intentionally placed this series of Likert-scale questions after the aforementioned open-ended questions to not introduce bias into producer responses. The final open-ended question in this analysis was "*What type of expertise or specializations are needed within MSU Extension staffing to strengthen the Michigan beef industry? Please list specific suggestions.*"

To analyze the open-ended responses, we categorized the responses into themes using an iterative process (Taylor-Powell and Renner 2003). First, we decided on a list of potential themes for the first round of coding. The 19 issues from the Likert-scale questions were used as the first set of potential themes for the open-ended question about challenges facing producers in the next 5 to 10 years. We then categorized comments into one or more themes, depending on the length and content of the comment, by each of the authors individually. Next, thematic coding from all the authors were compared. We discussed responses with discrepancies and assigned them to their corresponding theme(s) based on group consensus. During the discussion, new themes arose that better summarized the producer's comments, such as facility management. Finally, we checked the open-ended responses again for these new themes. After these steps, we created a master data set that classified all the open-ended responses into a final set of themes.

The quantitative outputs for this paper were generated using SAS software, Version 9.2 of the SAS

[1] In addition, while it may have been possible for an individual to receive the survey more than once, the "prevent ballot box stuffing" feature in Qualtrics, made it possible for only one survey response to be submitted from each computer browser by placing a cookie on their browser when a response is submitted (Qualtrics n.d.).

System for Microsoft Windows 10. Copyright 2014 SAS Institute Inc.[2] The numerical data from the themes were analyzed using frequency tables, similar to Suvedi, Jeong, and Coombs (2010). The Likert-scale and demographic multiple-choice questions were analyzed using simple means.[3] When questions were not answered, or left blank, they were treated as "no response" and did not count toward sample statistics. See McKendree et. al. (2020) for the full survey results.

3 Results

Understanding the demographic makeup of Michigan beef producers and how this makeup has changed over time will help to better target and shape extension efforts. Based on the demographic data collected, our sample was representative of the Michigan beef industry. Nearly half of the respondents were 55 years or older, and 84 percent were male (Table 1). These statistics are consistent with the 2017 USDA Census of Agriculture, identifying that the largest percentage of producers in Michigan were male and over the age of 55 (U.S. Department of Agriculture 2017). Over half of producer respondents had commercial cow calf operations, followed by feedlots at 32 percent, and grass finisher and seedstock, both representing 25 percent of the sample, respectively. Respondents were able to select all of the operation types on their farm yielding a total percentage greater than 100 percent. The most commonly represented operation size was less than 50 head of cattle (48 percent), followed by 25 percent of producers having 51–100 head of cattle, a combined 25 percent of respondents have operations with between 100 and 1,000 head of cattle, and only 3 percent of respondents having more than 1,000 head of cattle.

3.1 Michigan Beef Industry Issues or Challenges

Of the 282 producer responses to the open-ended question, marketing/market access, prices/profitability, and animal health were the top three issues facing beef producers in the next 5–10 years (Table 2). Furthermore, land/pasture availability, input costs, capital availability, and genetics/reproduction were each mentioned by more than 20 percent of respondents. As a follow-up question, we asked producers how MSU Extension could help address these challenges. Education to producers (52 percent), education to consumers (13 percent), and education to policy makers and working with agencies (13 percent) were the most common themes mentioned.

After the open-ended question, the respondents were prompted with a series of Likert-scale questions to deduce issues they have faced in the past 5 years (Table 3). Input costs and government regulations had been the most concerning to producers. Producers were also concerned about pasture availability, environmental issues, animal health, land availability, succession of operation, and capital availability. Producers were the least concerned about lack of custom feeders and livestock transportation.

3.2 Michigan State University Extension Engagement

To better help the MSU Extension Beef Team with potential for filling future position(s), we asked producers an open-ended question on needed expertise or specializations within MSU Extension to help strengthen the Michigan beef industry (Table 4). Expertise in general beef knowledge, economic/finance/marketing, and nutrition were the top three themes producers listed as areas MSU Extension could use to improve the beef industry, followed closely by feedlot management, grazing/forage, and ag literacy/communications.

[2] SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

[3] "Proc freq" and "proc mean" procedures were used in SAS software version 9.2 to calculate the summary statistics and frequency tables

Table 1. Demographic summary statistics of producer respondents

Demographic Variable	Number Reporting	Percentage
Gender		
Male	174	84%
Female	26	13%
Choose not to provide	7	3%
Total	207	100%
No Response	84	
Age		
18 to 24	5	2%
25 to 34	27	13%
35 to 44	35	17%
45 to 54	42	20%
55 to 64	54	26%
65 and older	42	20%
Choose not to provide	3	1%
Total	208	100%
No response	83	
Enterprises **(*n* = 291)**[a]		
Seedstock	54	25%
Commercial cow calf	120	55%
Stocker/background	22	10%
Feedlot	70	32%
Grass Finisher	54	25%
Total Producers	219	
No responses	72	
Operation Size		
Less than 50	103	48%
51-100	54	25%
101-250	28	13%
251-1000	26	12%
1001-2000	2	1%
>2000	5	2%
No responses	73	

[a]Enterprises were only asked of those that selected beef producer (***n*** = 253) or both (***n*** = 38).

To be effective at reaching producers, it is imperative that producers can identify and reach extension personnel. From 251 responses, 63 percent indicated they have had contact with MSU Extension in the past 5 years, while 28 percent indicated they had not had contact or were not sure if they have had contact (Table 5). Sixty-eight percent of respondents stated the most preferred way to connect with MSU Extension was through organizational events, such as meetings, field days, and field schools. However, just short of that, 63 percent of respondents indicated they preferred to hear from MSU Extension via electronic sources, such as electronic newsletters and social media.

Table 2. Responses to: "Considering where you want your beef operation to be in the next 5–10 years, what are the largest issues or challenges that need to be addressed to get you there?"[a, b]

Theme	Frequency	Percent	Response Examples
Marketing/market access	52	18%	– "Need to be able to do more direct marketing of beef without more regulations." – "Advertising—I use mostly FB right now, and people I work with buy from me."
Prices/profitability	52	18%	– "Economics, finance, business planning." – "Slow return on investment buying or raising heifers."
Animal health	29	10%	– "Producing a healthy herd with quality animals." – "Keeping my herd free of disease, i.e. Johne's, BVD, TB, Tric, FMD, etc. by more positive means than "bio security." These diseases need to be eradicated in the United States, not managed."
Land/pasture availability	28	10%	– "Grazable acreage in close proximity to infrastructure." – "Grow to 40 head of cows. Land will be the greatest challenge."
Input costs	24	9%	– "Managing input costs, namely feed and fertilizer." – "Input costs compared to sale prices up here in MI."
Capital availability	22	8%	– "Capital and land." – "Capital to take the next steps."
Genetics/reproduction	22	8%	– "Genomic education for our clients." – "I am interested in switching to grass-fed beef. Timely rebreeding is a problem nobody even a vet seems to have a solution. We use BSE, vaccinate and use feed supplements, bull breed and AI with unacceptable pregnancy rates."
Government regulations	16	6%	– "Government policy that provides similar support to the sustainable agriculture market segment as it provides to conventional agriculture. Current programs are not equitable." – "Too many regulations that don't always apply to the small producer and don't always have a scientific need for them. Big Corporations shouldn't be putting them on."

Table 2 continued.

Theme	Frequency	Percent	Response Examples
Other	16	6%	– "Profitable herd dispersal and sale of capital investments." – "We primarily sell freezer beef, so we're always looking to improve our beef, marbling, tenderness, etc."
Facilities/fencing	14	5%	– "Getting pens, gates, alley way set up. Would like to get a squeeze chute. Started from scratch. – "Facilities to house livestock."
Ag Literacy/ Communication	14	5%	– "There has also been [too] much negativity in the media in regard to beef production." – "Improve both my own genetics as well as the image of Michigan producers."
Succession of operation	11	4%	– "Successful retirement from farming." – "Succession planning."
Consumer demand	11	4%	– "More demand for beef." – "I am not sure how to convince consumers that natural meat products are better than lab-grown "fake" meat. Nor how to convince them that vegan and vegetarian is not necessarily more healthy."
Environmental issues	11	4%	– "Continuing to improve our beef cow profitability and addressing environmental concerns." – "Environmental sustainability."

[a] Of the 291 producer respondents, 284 responded to this question, and 282 had recordable responses.
[b] Business planning, forage management, feed availability, labor, nutrition, export markets, watering systems, weather/climate changes, manure application/storage, and livestock transportation, in that order, were also common themes, but mentioned 8 times or fewer.

Table 3. Producers' response to "How concerning have the following issues been on your beef operation in the past 5 years?"[a, b, c]

Concern	*N*	Not concerned (1)	Somewhat concerned (2)	Very concerned (3)	Mean	*SD*
Input Costs	217	9%	36%	55%	2.46	0.66
Government Regulations	213	15%	33%	53%	2.38	0.73
Pasture Availability	198	24%	35%	41%	2.18	0.79
Environmental Issues	217	18%	48%	34%	2.16	0.70
Animal health	216	23%	40%	37%	2.14	0.77
Land Availability	209	23%	40%	37%	2.13	0.81
Succession of Operation	213	27%	33%	39%	2.12	0.81
Capital Availability	215	23%	44%	33%	2.11	0.74
Consumer Demand	216	24%	46%	30%	2.06	0.74
Food Safety	211	32%	38%	30%	1.98	0.79
Feed Availability	217	30%	42%	28%	1.97	0.76
Exports Markets	192	36%	32%	32%	1.95	0.83
Labor Availability	202	40%	31%	29%	1.89	0.82
Weather/Climate Changes	212	38%	42%	20%	1.83	0.74
Manure Application/Storage	210	37%	44%	19%	1.81	0.72
Labor Cost	197	40%	31%	29%	1.79	0.81
Watering System	216	45%	36%	18%	1.73	0.75
Lack of Custom Feeders	177	60%	27%	13%	1.53	0.72
Livestock Transportation	206	58%	34%	8%	1.50	0.64

[a] The list of concerns were provided by the researchers on the survey.
[b] Sample size indicated is for individual issue listed.
[c] 1 indicates not concerned, 2 indicates somewhat concerned, and 3 indicates very concerned. Those that selected "does not apply to my operation" were not included in these calculations.

Table 4. Responses to: "What type of expertise or specializations are needed within MSU Extension staffing to strengthen the Michigan beef industry? Please list specific suggestions."[a, b]

Theme	Frequency	Percent	Response Examples
General Beef Knowledge	27	13%	– "Information from individuals with hands-on training, raise cattle, feed cattle, individuals that have fought the elements that come with living in Michigan and managed a feedlot. Individuals that have calved out cows in January Mud and April Freezes." – "Experts to visit my operation to provide suggestions and training."
Economics/finance/marketing	25	12%	– "More on the economics of growing cattle, more on markets and sale opportunities." – "How to market, a lower cost examples of marketing flyers, etc."
Nutrition	20	10%	– "Feeding and nutrition assistance, general animal husbandry recommendations." – "Nutrition Specialist."
Feedlot Management	18	9%	– "Cow Calf, and feedlot management." – "There is a need for increased coverage of the feeding sector. Need an agent with expertise in the feedlot portion of the industry."
Grazing/forge	17	8%	– "Education on soil improvements for hay and pastures with emphasis on organic-type practices." – "More info on nutrition and forage."
Ag literacy/ communications	16	8%	– "Help with teaching the average 'cattle person' how to talk to the public on beef production best practices along with presenting verifiable, scientific information to the nonagricultural public." – "Feeding, marketing, vet, animal husbandry, animal welfare, public education on agriculture, educating in schools."
Genomics/ reproduction	15	7%	– "Understanding of ends and genomic testing." – "EPD knowledge and someone to speak up for cow calf producers not for MI Cattleman's Association."
Animal health	14	7%	– "As the beef industry is losing more veterinarians in our area, some assistance is locating help for the small breeders, and general guidelines on some medical emergencies will be important." – "Getting small producers onboard with vaccines, [pregnancy] checks, etc."

[a]Of the 291 producer respondents, 246 responded to the question, and 209 had useable responses.
[b]Animal welfare/handling, other, meats, and environmental, in that order, had 7 or fewer mentions.

Table 5. MSU Extension communication and preferred methods of contact[a]

	Number of Times Selected	Percent of Total Respondents
Communication with MSU Extension		
Yes, within last 5 years	157	63
Yes, more than 5 years ago	23	9
No	61	24
Not sure	10	4
Total	251	100
No response	91	
Preferred method of obtaining information[a]		
Personal farm call	68	28
Electronic source (e.g., electronic newsletter, social media)	150	63
Meeting at different locations throughout MI	129	54
Meetings—MSU campus	33	14
Publication mailings (e.g., paid subscription to hard copy newsletter)	70	29
Organizational events (e.g., meetings, field days, field schools, etc.)	164	68
Other	9	4
Total respondents	247	
No response	95	

[a]The number reporting does not sum to total respondents because respondents were able to select all that apply.

4 Discussion

The needs of beef producers across the country are ever changing and evolving. In 2010, the educational needs of Michigan farmers focused on business practices and sustainable farming practices (Suvedi, Lapinski, and Campo 2010). Presently, producers are concerned with market/market access, prices, input costs, pasture availability, environmental issues, and animal health. These concerns are consistent with a 2019 survey of U.S. cow-calf producers that found that the top five issues facing producers are animal and reproductive health, export markets, pasture availability, and biosecurity and disease (Martin et al. 2019). In addition, rising input costs and animal health issues were identified as a potential threat to the beef industry for Arkansas producers (Troxel et al. 2007). In a 1999 survey conducted to elicit the needs of the Michigan beef industry, animal health, beef quality, and food safety were the most identified issues facing producers (Cowley et al. 2000). While animal health appears in today's assessment, food safety and beef quality were not listed as being major concerns for producers in this assessment. Since 1994, Michigan has had a prevalence of bovine tuberculosis in wildlife and cattle within the state (Schmitt et al. 1997; Verteramo Chiu et al. 2019). Because of this, it is of no surprise that animal health is of high priority to today's producers. An issue that arose in this assessment that was not prominent in past studies was government regulations. Producers indicated that government regulations were an issue that had faced the industry over the past 5 years in a Likert-scale question; however, it was only listed 16 times in the open-ended responses for the next 5 to 10 years. Potentially, government regulations are of more concern to larger operations in Michigan and thus a smaller percentage of the respondents.

Looking further into the results, we see that there are some issues that do not appear often in the open-ended format but were listed as having some level of concern when prompted in the Likert-scale questions—often long run strategic issues. For example, succession planning appeared 11 times when

producers were asked to list issues facing their operation in the next 5 to 10 years. However, succession planning had an average of 2.12 in the Likert-scale question, indicating on average producers were somewhat concerned about operation succession in the past five to ten years. Longer term or strategic issues like succession planning may be more important to producers, especially as the average age of producers increases. We asked the open-ended questions prior to Likert-scale questions, to not bias responses to the open-ended questions. By allowing producers to type what their concerns were for the next 5 years, we likely gathered the issues that were at the forefront of their minds, issues they were currently facing. However, when we asked similar questions, in Likert-scale form, we were able to present possible issues that could arise on operations in the next 5 years that albeit important, might not be at the forefront of producers' minds given the day-to-day problems they may be dealing with. Thus, extension programing should continue to focus on helping producers meet current challenges, but also longer-term strategic decisions that can easily get overlooked given the many hats producers wear. We suggest that future needs assessments include a mix of questions types to gain a more complete view of issues facing agricultural producers.

In a study conducted in 1999 to evaluate MSU Extension, 10 percent of respondents from the overall Michigan livestock community indicated they had received information from the internet (Suvedi, Lapinski, and Campo 2000). However, in a similarly timed study surveying the Michigan beef industry, it was found that 41 percent of producers received information from the internet (Cowley et al. 2000). Nearly 20 years later, we see the trend for communication shifting significantly, with most farmers using the internet and the adoption of communication methods like conversational user interfaces (Burke and Sewake 2008; Kobielus 2018). Our study shows that while 63 percent of producers wish to receive information via electronic sources, 68 percent of producers responded that they like receiving information via organizational meetings. This data indicates that while there is a trend shifting to electronic communication, there is still a need for in-person, field-based programming, and interaction with producers. This finding is consistent with an Iowa Extension summary report from 2016, indicating that producers still prefer in-person meetings and events with extension personnel (Arbunkle 2017).

Understanding what producers' needs are and the best way to reach them is only the beginning of extension program development. Extension program development should be a carefully planned process through which extension professionals design, implement, and evaluate educational programs that address identified needs. The initial and key step in the process is assessing clientele needs. As such, needs assessments serve as the foundation for overall program personnel management, as well as the educational program development cycle. A needs assessment may be completed to determine extension personnel expertise needs, educational program needs, or both. In times of organizational growth, the needs assessment may inform position expertise requirements in hiring decisions, whereas during organizational contraction with dwindling resources, it may elucidate strategic areas of focus.

The needs assessment results were used for both informing hiring decisions and to focus educational programming efforts. Based on producer responses to the survey, and the judgments and knowledge of Beef Team members, the team developed a prioritized list of needed expertise. Team judgements were based on knowledge of existing expertise and consideration of recent and upcoming retirements. This list of needed positions included specialization in feedlot systems, grazing systems, cow-calf production, animal health, livestock marketing, and meat science. The needs assessment accompanied a Beef Team staffing plan which was presented to MSU Extension administration. Ultimately, a feedlot educator position was approved given the size of the Michigan Feedlot industry (32 percent of our sample) and lack of expertise on the Beef Team. Although this position is mainly focused on the feedlot industry, the educator will also be well versed in general beef knowledge. A successful national search was conducted with the new educator starting in Fall 2020.

The Beef Team also used the highest priorities revealed in the assessment to develop educational programs in the identified areas during their annual and future planning cycles. Furthermore, the results of the needs assessment were published on the MSU Extension website (2020) and published in *The*

Michigan Cattleman (Schweihofer, McKendree, and Lineback 2020). The results were also presented at the Michigan Cattlemen's Association summer meeting to kickstart a strategic planning session held with membership.

The interdisciplinary approach, including agricultural economists, to this needs assessment was unique. Agricultural economists can bring multiple skills sets to interdisciplinary needs assessments including survey design, statistical analysis, core economic concepts, and economic impact evaluations. Agricultural economists commonly use online surveys for consumer and producer research that could be applied in these contexts. Foreseeably, future needs assessment surveys could include best-worst or maximum difference scaling (McKendree, Tonsor, and Wolf 2018; Lusk and Briggeman 2009) to understand the most and least important challenges facing producers, for example. Discrete choice experiments could also be used to understand willingness to pay for fee-based extension services moving forward given budget constraints, such as those used by Ellison et al. (2017). Agricultural economists can also contribute to the conversation about needs assessments and programming using their basic economic concepts, such as opportunity costs. Additionally, many of the programming needs identified included agricultural economic and farm management topics including marketing, profitability, and business planning. For example, many respondents indicated that they were concerned with, "how to market," their products to local consumers or how to find sales opportunities. Another area of concern was understanding the true cost of production. Topics like these are great opportunities for agricultural economists with extension or research appointments to assist producers in their day-to-day operations.

5 Implications

Online needs assessments are useful for determining stakeholder needs and are just one tool in an extension educator's toolbox to determine the best way to serve their constituents. The results can be used to develop relevant extension programming and to prioritize additional specializations in needed team expertise. Extension teams can utilize producer and industry desires with team needs to advocate for critical positions needed with extension administration. It is important for extension personnel to conduct needs assessments and maintain an understanding of producers' needs, as well as those in the industry. More periodic needs surveys may reveal industry trends, educational advancements or deficits, and highlight potential areas for strategic focus. Agricultural economists can use their skills in survey development and statistical analysis, as well as their economic foundations to assist in such needs assessments.

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Case Study

The Feasibility of Investing in a High-Speed Grain-Handling Facility in Kansas

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JEL Codes: Q13, Q14
Keywords: Shuttle loader, grain-handling facility, investment, rural development, agricultural finance

Abstract
Rural communities often combine quantitative and qualitative approaches to determine which investments can be supported by the local economy. In this case study, the goal of an economic development council (EDC) in rural Kansas was to promote economic and population growth by making the best use of the local resources. From a list of potential investment projects, the EDC identified a high-speed grain-handling installation as an opportunity to facilitate local economic growth. A community leader then had to determine whether an investment in such a facility was financially feasible for the community. This case study emphasizes the applied financial analysis methods used to make investment decisions about rural projects. It presumes a variable mix of historical grain prices and local grain production to project the most likely profit outcome. Thus, it helps inform investment decision of the EDC and county commissioners.

1 Introduction

The Economic Development Council (EDC) of Stafford County, Kansas, was founded in 2011. The council was eager to promote economic growth opportunities in south-central Kansas. Director Carolyn Dunn's focus was on job creation and entrepreneurship to improve the county's economic performance.

The economic performance of many rural communities' lags behind that of most metropolitan and micropolitan areas, and Stafford County, which faces challenges similar to those of other rural communities across the state, was no exception in this regard. In the county of 4,200 residents, the agriculture and food processing industries employ approximately 36 percent of the total workforce and represent 35 percent of the gross regional product (KDA 2017). Agricultural production is not unique in south-central Kansas, and Dunn's focus was on the county's unique strengths rather than its weaknesses.

In 2018, the EDC, County Board of Commissioners, and White's FoodLiner united to invest in and operate a grocery store in the county seat—St John, Kansas. After the successful launch of the grocery store, Dunn envisioned a designated area in the county that could perform the value-added services of shipping, storing, transloading, and merchandising corn, wheat, soybeans, and milo. Stafford County's proximity to a U.S. interstate, easy access to two Class I railroads, land zoned for the development of an airport, secondary railway line, and industrial storage complemented the county's infrastructure. A high-speed grain-handling facility would anchor the development project and likely attract collaboration interests from a Class I railroad as well as from grain merchandising and grain exporting companies.

Dunn and the Board of County Commissioners envisioned a high-speed grain-handling facility that would support local grain companies, shippers, and carriers of corn to ports in California, the Gulf of Mexico, and the Pacific Northwest. Additionally, the facility would serve as a storage location for animal feed purchased by local feedlots. Dunn was ambitious, but cautious. She trusted her intuition but wanted to validate the premise of a high-speed grain-handling facility with supporting data and financial analysis. She encouraged a consultant to study the financial costs and benefits and agreed with the consultant that

input from key supply chain network and logistics suppliers would enhance the study's results. She believed that input from the BNSF Railroad, local cooperatives, and grain companies would provide additional insight into the financial viability and feasibility of the high-speed grain-handling facility for the county.

The decision to invest is based on an analysis that stems from the application of strategic and financial management concepts. The strategic management focus discerns the practicability of the county's resources and the potential of a high-speed grain-handling facility to create a competitive advantage for the county. Moreover, the financial analysis concentrates on the commercial viability of the long-term investment.

2 History of Grain-Handling Facilities

High-speed grain-handling facilities are considered to be "sub-terminal elevators" and are commonly referred to as shuttle loaders, which are devoted to the storage, loading, and distribution of grain commodities. They are specifically designed for long-distance transportation, moving grain from origin to destination as a shuttle train (75–120 dedicated railcars). High-speed grain-handling facilities experienced peak growth in the early 2000s, following a rapid expansion of U.S. grain production (USDA 2013). However, the number of grain shuttle loaders has dwindled; only 1 percent to 2 percent of Midwestern rural communities remain viable investment locations for these loaders, mainly because grain storage capacity has become oversaturated (Kowalski 2014). Within a 60-mile radius of Stafford County, there are six shuttle loader facilities, three of which comprise more than 90 percent of the area's storage capacity.

Grain handling involves four main steps: inbound shipments, processing, storage, and outbound shipments. Country elevators routinely receive grain directly from farmers, who store the grain, sell it to processors and exporters, or both. Shuttle loader facilities can load and unload inbound and outbound shipments by truck, railcar, river barge, and ocean-going vessel. These facilities feature handling equipment that operates at higher speeds than that of country elevators. This equipment significantly reduces grain unloading and loading time and improves worker safety and product quality.

Among more recent grain elevator innovations are fully automated elevator legs, conveyors, and gate systems that allow grain to be routed automatically from the initial receiving pit through the facility's warehouse and storage bins to the railcar for outbound shipments. Additionally, some facilities have state-of-the-art blending software to reduce the intermingling of commodities and improve inventory management.

A high-performing shuttle loader facility requires a larger capital investment than many country elevators. A shuttle loader is specifically designed to capture the benefits of economies of scale by handling large quantities of grain in short periods of time (Bekkerman and Taylor 2017). Thus, a shuttle loader reduces the average cost of grain, increases the opportunity to market grain for export, and vastly contributes to investors' return on investment (ROI) when compared with investments in small country elevators. Figure 1 illustrates the role that shuttle loaders play when grain is exported or used domestically. Farmers and country elevators supply grain to the shuttle loader, which supplies grain to both livestock feed yards and export elevators. An average-sized shuttle loader in Kansas has the capacity to manage approximately two million bushels of grain storage.

Dunn pondered whether an investment in a shuttle loader was a wise choice. She still had many questions. What shuttle loader size and trading capacity was best suited for Stafford County? At what point would the investment in a shuttle loader become profitable? What were stakeholders' criteria for capital investments in the county? What incentives would attract potential investors? Were the county's resources and capabilities—locally harvested grain quantities, country elevators, rail transportation, community financial support, and skilled personnel—sufficient?

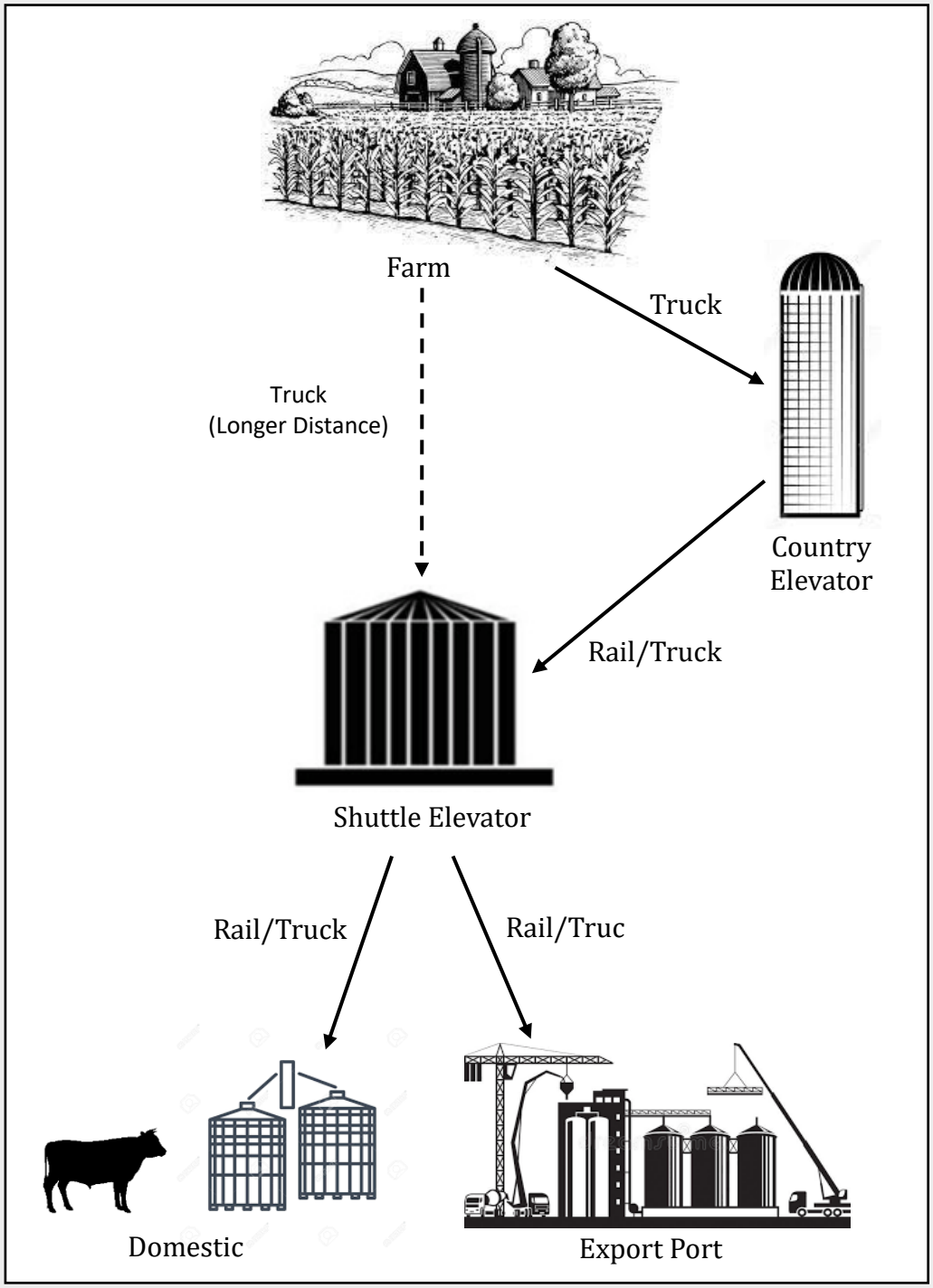


Figure 1. Traditional Supply Chain Flow of Grain

Source: Adapted Ndembe and Bitzen (2018).

Dunn was certain that the county commissioners would support her search for answers to these critical questions. She had some experience in public fundraising, already having attracted private investments to the county and having negotiated contracts to create successful public-private partnerships. However, to make an informed investment decision, she needed a better understanding of the operational and financial aspects of a high-speed grain-handling facility.

3 Risk Factors Impacting a Decision to Invest

Dunn sought the answers to her questions. She called on her network of grain companies, food processors, state port authorities, railroad companies, and Kansas State University consultants to identify which factors might determine whether an investment was feasible.

Like other agricultural enterprises, grain merchandising is often characterized by large quantities and low profit margins. Consequently, a great amount of throughput is needed to cover fixed and variable costs. Additionally, well-established relationships with local country elevators and grain producers are fundamental for ensuring that a minimum amount of grain is available for trade. Many industry experts argue that a profitable shuttle-loading facility must make 3 to 4 grain shipments per month or turn its inventory over 9 to 10 times per year. Furthermore, grain merchandising activities should contribute an estimated $0.13 to $0.15 per bushel to the company's net grain margin. The gross margin calculation, or the conversion cost used in grain, includes the selling price, the origination or purchase price, and transportation and handling costs (USDA 2015).

The degree of competition from other grain-handling and storage agribusinesses in the area will affect the time it will take to reach an acceptable return on investment. The higher the concentration of shuttle loaders in the area, the lower the probability that a proposed facility would outbid the competitors, thus lowering grain profit margins. Additionally, margins are significantly shaped by agreements and relationships with railroads; the number of inbound and outbound railcars used for the shuttle loader could impact the county's ability to negotiate favorable transportation rates.

Management and labor are other costs to consider. The proposed shuttle loader requires 11 salaried and wage-earning employees, including a merchandising manager, an operations manager, a logistics supervisor, elevator operators, and administrative staff. The county must recruit industry professionals that have the knowledge to execute the business strategy related to generating revenue from merchandising activities, creating cost-saving opportunities, and responding to competitors. Dunn understood the EDC's role in minimizing the cost of business in the county by providing incentives such as tax incentives, including abatements, subsidies, and equity partnerships in investments.

Finally, Dunn considered how an investment would be capitalized, either through debt or equity financing. If through debt financing, the interest rate would affect the cash flow of the business. If through equity financing, the investors would need to have similar long-term expectations.

After receiving a list of key risk factors and the type of risk they presented, Dunn considered the extent to which each factor was significant and its relative weight on the final decision. For example, did the amount of tradeable grain present a significant investment risk? Could the county ensure that the necessary quantity of grain was available? Were relationships with the supply chain network (local farmers and cooperatives) significant to the investment decision—that is, could the county justify the investment without a strong network of suppliers?

Dunn ranked each risk factor's significance—low, medium, or high—on the basis of her perception of each factor's importance to the decision maker. Then, she assessed each factor by attributing a percentage weight corresponding to its relative impact on the decision. The weight and the significance ranking prioritized each risk factor's relative importance to the investment decision. For instance, the risk factor "quantity of grain traded" was considered to have "high" significance and was attributed a weight of 20 percent, suggesting that the decision maker valued ability to trade volume more than lower-weighted risk factors when considering the decision to invest in a grain-handling facility. Finally, a collective evaluation of each risk factor helped inform the decision to invest. Table 1 summarizes the risk factors, their significance, and their relative weights.

Table 1. Risk Factors[a]

Risk Factor	Risk Type	Significance	Weight
Volume traded	Value Chain		
Supplier relationship	Value Chain		
Carrier (railroad) relationship	Value Chain		
Commodity prices spread	Market		
Transportation cost	Market		
Competition	Market		
Interest rates	Market		
Capital structure (debt versus equity financing)	Credit		
Management and labor	Operational		
Public-private partnership	Operational		

[a]See Teaching Notes. Students are to insert values into the last two columns.

4. A Resource-Based View of the County

Corn and wheat are the main crops of the six counties comprising south-central Kansas. Among these counties, Stafford County ranks third in total production volume of corn and fifth in that of wheat. From 2011 to 2017, the county had approximately 536 farms that produced 145 and 107 million bushels of corn and wheat, respectively (KDA 2017). The vast majority of these farms rely on three main country elevators to store and market commodities, and these elevators account for approximately 70 percent of the storage capacity in the region (Briggeman et al. 2016).

Table 2 shows the number of country elevators and their respective grain market share in the area of study. A total of 11 shuttle train elevators with multi-commodity storing and handling capabilities exists within a 70-mile radius of St John, Kansas. The top three grain companies (in terms of grain storage capacity) own a total of five elevators (located east and west of St John) that represent approximately 90 percent of the total regional grain market share (Table 3).

The potential buyers of wheat and corn from a shuttle loader are livestock feeders, export terminal elevators, and out-of-state flour mills. Numerous flour mills are located in the state of Oklahoma; livestock feed yards are found in the Texas Panhandle, the largest cattle-feeding area in the United States. The potential customers for a shuttle loader are feedlots and ethanol plants located near St John and in the surrounding counties. Maps 1 and 2 show the proposed grain shuttle loader's competitors and suppliers within a 60-mile radius.

Table 2. Market Share of Country Elevators in the Area of Study

Country Elevator	Capacity (mil bu)	Market Share (%)
Company G	12,927,000	35.84
Company H	6,995,000	19.40
Company I	6,613,000	18.34
Company B	2,230,000	6.18
Company J	2,217,000	6.15
Company K	1,550,000	4.30
Company L	1,284,000	3.56
Company M	1,375,000	3.81
Company N	418,000	1.16
Company O	456,000	1.26
Total	36,065,000	100.00

Note: Constructed on the basis of data compiled from Arthur Capper Cooperative Center Interactive Maps.

Table 3. Market Share of Shuttle Loaders in the Area of Study

Shuttle Loader	Capacity (mil bu)	Market Share (%)
Company A	23,530,000	33.57
Company B	25,980,000	37.07
Company C	14,540,000	20.74
Company D	2,943,000	4.20
Company E	1,800,000	2.57
Company F	1,300,000	1.85
Total	70,093,000	100.0

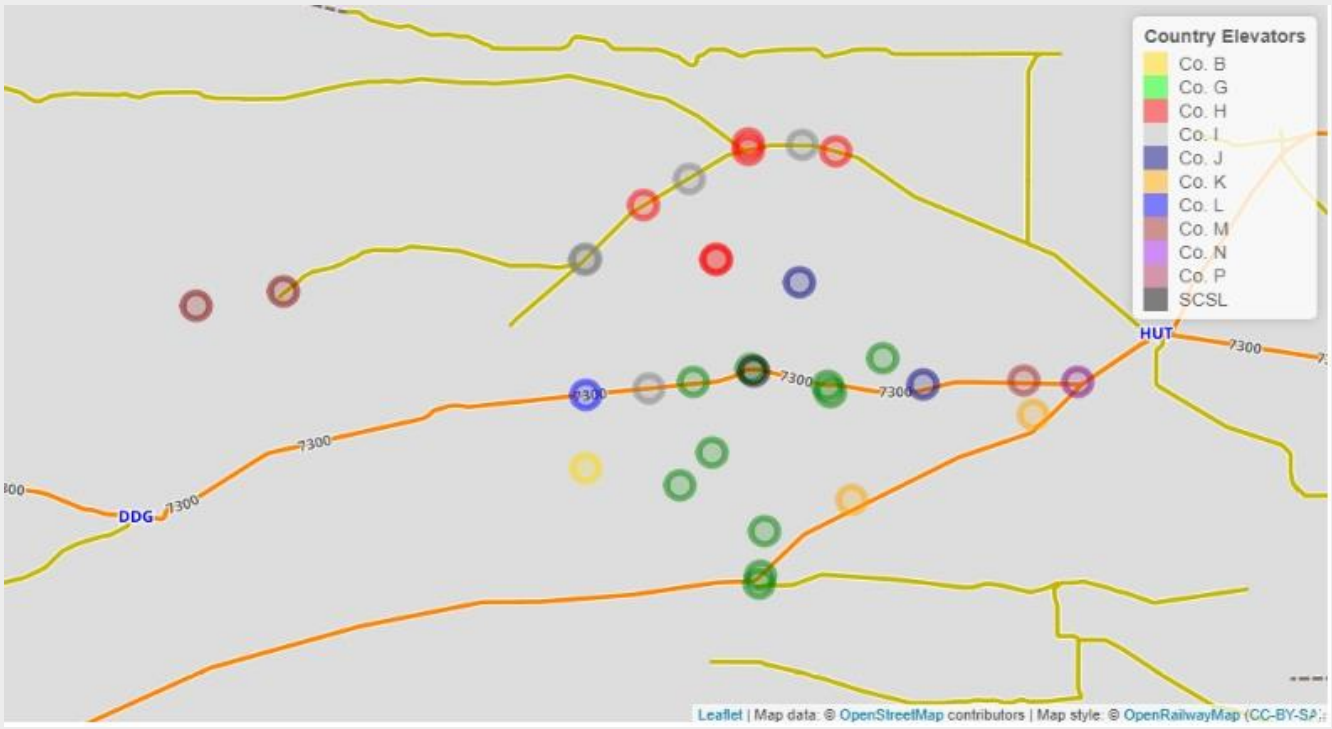
Note: Constructed on the basis of data compiled from Arthur Capper Cooperative Center Interactive Maps.

Map 1. Grain Shuttle Loaders in South-Central Kansas

Note: The facility (SCSL) is located in the heart of St John, Kansas. The Class I BNSF railway runs east and west, passing from Hutchison in the east through Stafford County and continuing west to Dodge City.

Recently, several investors, including local, regional, and international grain companies, have become motivated to invest in a grain shuttle loader in Stafford County, thereby accessing additional opportunities to merchandise grain to terminal markets. International grain-trading corporations typically expect to pay back a capital investment in a maximum of five years; regional grain companies and local cooperatives generally invest in shuttle loaders to gain access to non-local markets and export markets. Thus, small to medium-sized companies have an opportunity to market grain in regions that are otherwise beyond their geographic scope. Often, small or undercapitalized organizations accept a payback period of 5 to 15 years on capital investments, or they raise money through debt financing.

ROI criteria vary in accordance with each investor's risk-reward profile. For some investors, an ROI between 4 percent and 8 percent is reasonable, whereas for others, an ROI between 6 percent and 13 percent is ideal. Almost all investors compare the ROI to the cost of acquiring capital (i.e., the discount or interest rate). If the ROI is greater than that cost, the companies are more likely to invest. To further



Map 2. Grain Country Elevators in South Central Kansas

Note: The facility (SCSL) is located in the heart of St John, Kansas. The Class I BNSF railway runs east and west, passing from Hutchison in the east through Stafford County and continuing west to Dodge City.

incentivize investors, the EDC was prepared to cover approximately 30 percent of the investment expenditure, which included the cost of land, trackage, and switches.

5 Investment Specifications

Two grain elevator designs are best suited for a shuttle loader: standard commercial steel bins and concrete annex bins. Commercial cylindrical steel bins have thick walls and additional reinforcements to withstand repeated filling, emptying, stirring, and blending. These bins have an average life of approximately 20 years and a loading and unloading efficiency rate of 60,000 bushels per hour. Concrete annex bins are composed of a concrete foundation and concrete pads with piles as well as a concrete floor, walls, roof, and tunnels. They have an average life of 40 years and a maximum loading and unloading efficiency rate of 90,000 bushels per hour (SAMA 2015).

The proposed facility would have a bin storage capacity of two million bushels and would be constructed on 100 acres of land and along 11,000 linear feet of railroad track. The track would connect to the mainline Class I railroad for transloading cargo. The total estimated capital expenditure costs for the steel and concrete construction are approximately $16.8 million and $20.8 million, respectively.

6 Applied Financial Analysis

The input from Dunn's network answered many questions. Dunn understood the risk factors that could have adverse or favorable effects, the estimated capital expenditure costs, the expected ROI for potential investors, and the extent of the county's resources and capabilities. She then had to determine the financial feasibility of the high-speed grain-handling facility.

A net present value (NPV) model was used to determine the project's financial feasibility. Three crop market share scenarios were developed to account for the supply variability of corn and wheat: base, optimistic, and pessimistic. Each scenario considered payback periods of 5, 10, and 15 years for each of the two building designs (concrete and steel). The base scenario was established on 10-year

Table 4. Volume of Trade in the Area of Study			
Variables	**Base**	**Pessimistic (10% Decrease in Market Share)**	**Optimistic (10% Increase in Market Share)**
Corn (bu)	2,682,458	2,399,079	2,965,837
Wheat (bu)	4,579,219	4,170,039	4,988,400
Total bushels	7,261,678	6,559,118	7,954,237
Turns per year	3.63	3.28	3.98
Shipments/month	1.51	1.37	1.66

average crop production and grain rail shipments, assuming that the shuttle loader would be involved in handling 50 percent of the available grain. The pessimistic scenario assumed a 10 percent market share reduction from the base scenario. The optimistic scenario assumed a 10 percent market share increase from the base scenario. Table 4 summarizes the annual number of traded corn and wheat bushels, provides the monthly estimate of shipments for each grain, and approximates the inventory turnover for a facility with a capacity of two million bushels.

According to the base model, the new shuttle loader would control 50 percent of the shipment volume in Stafford County. That estimate accounted for a reasonable amount of grain from surrounding counties, varying between 5 percent and 15 percent of market share (shipment volume) of the surrounding area's total production. Grain margin estimates were trickier to establish. The ability to profit from merchandising activities is dependent on the decision to store or trade grain and on the market conditions that influence grain prices. Typically, grain storage is less profitable than grain trading. Shuttle loader owners have more incentive to trade than to store grain, given that they have invested in the infrastructure to transport grain by rail. A review of grain price history revealed that Stafford County's storage margins oscillated between \$0.03 and \$0.05 per bushel and that grain trading margins oscillated between \$0.15 and \$0.23 per bushel for wheat and corn, respectively.

The three market share scenarios included the quantity of grain traded, the grain storage cost, and the grain marketing margins. Each scenario was used to project income statements (pro-forma) and perform an NPV analysis to determine the financial feasibility of the project. Grain handling costs, fixed costs, depreciation of grain bins, interest, and tax expenses were included in the pro-forma. These variables were gathered and constructed from local and regional economic sources. Next, the operating cash flow (OCF) was calculated as follows:

$$\text{OCF} = \text{EBIT} + \text{D\&A} - \text{TAX} - \text{INTEREST} \quad (1)$$

As seen above, the OCF reflects the cash a company generates from its operations less the operating expenses and changes in working capital. In the case of Stafford County, the OCF was the projected net cash flow over a period of 5–15 years. EBIT represents the company's earnings before interest and tax, and D&A stands for depreciation and amortization. The last two components represent the tax on earnings and debt interest accrued.

The following equation was used to calculate the NPV:

$$NPV = C_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} \quad (2)$$

The first term, C_0 ,refers to the project's capital expenditure cost (CAPEX). The second term, $\sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$, refers to the discounted cash flow (DCF) formulation. C_t is the annual OCF, and r is the discount rate or the rate of return that could be earned through alternative investments.[1] NPV is best described as the

[1] The discount rate of 6.75 percent was estimated on the basis of the Omaha Federal Reserve's quarterly lending interest rates for farm machinery and equipment (15-year maturity). A positive NPV signifies that the projected earnings (in present

value of all future cash flows over the entire life of an investment discounted to the present DCF minus the initial CAPEX.

7 Financial Assessment

In Stafford County, grain production is the primary industry and as much a part of the culture as any other business area. Economically, grain is abundant, but marketing options are lacking. Dunn and the county commissioners were unsure if an investment was financially feasible without equity or debt financing from private investor(s) who might consider a partnership, joint venture, or strategic alliance.

On the basis of the pro-forma income projections, three scenarios were used to identify a feasible option. The base scenario takes into consideration a 50 percent market share of grain handled in the target area. The optimistic (pessimistic) scenario is represented by a 10 percent increase(decrease) of the base scenario's market share. The capital expenditure estimation of a two-million-bushel shuttle loading capacity and constructed with either steel or concrete building material was based on an average cost per bushel of $5.5 and $7.5, respectively.

Table 5 summarizes an option for private investment. It includes two building material types, three scenarios, and three payback periods. The financial loss was projected to be $3,794,000 for the most favorable price and cost conditions of a steel building, optimistic grain marketing opportunities, and 15-year timeline.

The initial reaction of the EDC's staff was as follows: "Wow, all results are negative; that can't be good." Considering the key drivers that most influenced these results, Dunn said, "Well, we knew this could be a possibility, so we had a contingency plan in place. Given the funds I believe I can raise, the county can contribute $5.8 million to the project." Another EDC staff member concurred: "That ought to make the difference in the financial results." The funds could be raised through public debt or from private investors who would benefit from reducing their grain-to-market cost.

Table 6 summarizes this information, the NPV analysis, and a reduction of $5.8 million in CAPEX based on the expected contributions the EDC could raise through grant funding and fundraising events.

The EDC was disappointed by the study's results but understood that the investment was not feasible, not because of the contribution from the county but due to other factors. "So, then, at what point does this investment become feasible?" Dunn asked. Various scenarios were stress tested by adjusting the assumptions for volume, conversion margins, and other key risk factors until a plausible scenario was found.

Table 5. NPV Financial Results for Private Equity Investment[a]

Building Material	CAPEX ($Mil)	Scenario	Payback Period		
			5 Years	10 Years	15 Years
Steel	$16.8	Base	($13,933,000)	($11,182,000)	($8,644,000)
		Optimistic	($11,977,000)	($7,632,000)	($3,794,000)
		Pessimistic	($15,667,000)	($14,330,000)	($12,950,000)
Concrete	$20.8	Base	($17,933,000)	($15,182,000)	($12,644,000)
		Optimistic	($15,977,000)	($11,632,000)	($7,794,000)
		Pessimistic	($19,667,000)	($18,331,000)	($16,950,000)

[a]See the assumptions made for the three scenarios and CAPEX estimations in the Financial Assessment section. The assumptions for building materials are found in the Investment Specifications section.

dollars) exceed the capital cost of the project's funding. A negative NPV signifies insufficient generation of present cash flow earnings to cover for the CAPEX.

Table 6. NPV Financial Results with Contribution[a]

Building Material	CAPEX ($Mil)	Scenario	Payback Period		
			5 Years	10 Years	15 Years
Steel	$11	Base	($8,049,000)	($5,297,000)	($2,759,000)
		Optimistic	($6,092,000)	($1,747,000)	$2,090,000
		Pessimistic	($9,782,000)	($8,446,000)	($7,066,000)
Concrete	$15	Base	($12,049,000)	($9,297,000)	($6,759,000)
		Optimistic	($10,092,000)	($5,747,000)	($1,910,000)
		Pessimistic	($13,782,000)	($12,446,000)	($11,066,000)

[a]See the assumptions made for the three scenarios and CAPEX estimations in the Financial Assessment section. The assumptions for building materials are found in the Investment Specifications sections. An additional $5.8 million in capital expenditure (attributed to the cost of trackage and railroad switches was discounted on the basis of public financial contributions from EDC's grand funding and other fundraising events.

Table 7 summarizes the results for the adjusted scenarios based on an increase in the base scenario of volume traded from 50 percent to 63 percent. Similarly, Table 8 summarizes the ROI results for the adjusted scenarios.

Table 7. NPV Financial Results for Profitable Scenarios[a]

Building Material	CAPEX ($Mil)	Scenario	Payback Period		
			5 Years	10 Years	15 Years
Steel	$16.8	Base	($7,773,000)	$516,000	$8,018,000
		Optimistic	$3,709,000	$7,817,000	$17,897,000
		Pessimistic	($12,014,000)	($7,103,000)	($2,291,000)
Concrete	$15	Base	($11,773,000)	($3,484,000)	$4,018,000
		Optimistic	($7,709,000)	$3,817,000	$13,897,000
		Pessimistic	($16,014,000)	($11,103,000)	($6,291,000)

[a]See the assumptions made for the three scenarios and CAPEX estimations in the Financial Assessment section.

Table 8. ROI for Profitable Scenarios[a]

Building Material	CAPEX ($Mil)	Scenario	Payback Period		
			5 Years	10 Years	15 Years
Steel	$16.8	Base	-12.19%	7.35%	12.72%
		Optimistic	-1.64%	15.25%	19.27%
		Pessimistic	-26.19%	-2.70%	4.86%
Concrete	$20.8	Base	-17.50%	3.25%	9.31%
		Optimistic	-8.01%	10.29%	15.03%
		Pessimistic	-30.26%	-5.88%	2.28%

[a]See the assumptions made for the three scenarios and CAPEXestimations in the Financial Assessment section. The assumptions for building materials are found in the Investment Specifications sections.

8 Looking Ahead

Dunn mulled over the adjusted scenarios. The real economic power comes from unlocking the region's ability to find alternative uses for local resources. Her approach toward rural development focused on the use of land-intensive natural resources, corn and wheat, for economic growth. Dunn's optimism and determination were undeterred. The key questions remained:

- Would development of land-intensive natural resources be worth the needed investment? The plan for high-speed grain-handling equipment was built on the premise of finding alternative uses for local resources that would provide additional grain marketing opportunities.
- What potentially better investment options for employing the county's economic resources should be considered? Should the county consider investments not so focused on the region's resources, such as other grain-handling and storage businesses that involve transloading, third-party logistics, or long-term storage operations?
- How should Dunn compare and contrast financial and economic costs and benefits to uncover new opportunities that would yield a favorable outcome?

Dunn knew that the county had to continually improve. What should she recommend to the county's Board of Commissioners?

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