

Spring 2018

Introduction to Statistics (GA Southern)

Scott Kersey

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Grants Collection

Georgia Southern University



UNIVERSITY SYSTEM
OF GEORGIA



Scott Kersey and Stephen Carden

Introduction to Statistics





Grants Collection

Affordable Learning Georgia Grants Collections are intended to provide faculty with the frameworks to quickly implement or revise the same materials as a Textbook Transformation Grants team, along with the aims and lessons learned from project teams during the implementation process.

Each collection contains the following materials:

- **Linked Syllabus**
 - The syllabus should provide the framework for both direct implementation of the grant team's selected and created materials and the adaptation/transformation of these materials.
- **Initial Proposal**
 - The initial proposal describes the grant project's aims in detail.
- **Final Report**
 - The final report describes the outcomes of the project and any lessons learned.



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Initial Proposal

Application Details

Manage Application: ALG Textbook Transformation Grants Round 8

Award Cycle: Round 8

Internal Submission Deadline: Sunday, December 11, 2016

Application Title: 277

Application ID: #001278

Submitter First Name: Scott

Submitter Last Name: Kersey

Submitter Title: Associate Professor of Mathematics

Submitter Email Address: skersey@georgiasouthern.edu

Submitter Phone Number: 912-478-1963

Submitter Campus Role: Proposal Investigator (Primary or additional)

Applicant First Name: Scott

Applicant Last Name: Kersey

Co-Applicant Name(s): Stephen Carden

Applicant Email Address: skersey@georgiasouthern.edu

Applicant Phone Number: 912-478-1963

Primary Appointment Title: Associate Professor of Mathematics

Institution Name(s): Georgia Southern University

Submission Date: Monday, December 12, 2016

Team Members (Name, Title, Department, Institutions if different, and email address for each):

Scott Kersey, Associate Professor of Mathematics, Department of Mathematical Sciences, skersey@georgiasouthern.edu

Stephen Carden, Assistant Professor of Statistics, Department of Mathematical Sciences, scarden@georgiasouthern.edu

Sponsor, (Name, Title, Department, Institution):

Sharon Taylor, Professor and Chair, Department of Mathematical Sciences, Georgia Southern University

Proposal Title: 277

Course Names, Course Numbers and Semesters Offered:

Calculus I, Math 1441, Fall, Spring and Summer semesters

Statistics I, STAT 2231, Fall, Spring and Summer semesters

Average Number of Students per Course Section: 40 (Calculus I), 30 (Statistics I)

Number of Course Sections Affected by Implementation in Academic Year: 50 (Calculus I), 50 (Statistics I)

Total Number of Students Affected by Implementation in Academic Year: 2000 (Calculus I), 1500 (Statistics I)

List the original course materials for students (including title, whether optional or required, & cost for each item): Calculus I (MATH 1441) Thomas' Calculus with MyMathLab access (\$288.40) or MyMathLab Student Access Kit (\$106.90). Required. Introductory Statistics I (STAT 2231) Basic Practice of Statistics with Launchpad access (\$169.35) or Launchpad access code (\$91.75). Required.

Requested Amount of Funding: \$10,800

Original per Student Cost: \$106.90 -- \$288.40 (Calculus I), \$91.75-\$169.35 (Statistics I)

Post-Proposal Projected Student Cost: 0

Projected Per Student Savings: \$106.90 -- \$288.40 (Calculus I), \$91.75-\$169.35 (Statistics I)

Projected Total Annual Student Savings: \$351,425 -- \$830,825

Creation and Hosting Platforms Used ("n/a" if none):

WeBWork [3]: Open-source online homework management system with Open Problem Library. The library currently contains over 35,000 mathematics and statistics problems [4], and includes an editor for writing problems tailored to one's course. The program is currently installed on a server maintained by a team member (S. Kersey), who has completed a WeBWork system administrator training course hosted by the Mathematical Association (MAA). Both team members have experience using WeBWork in the classroom setting.

Desire2Learn (D2L, Folio) [5]: Virtual Classroom at Georgia Southern University. This will be used for additional notes, handouts, modules and videos associated with the implementation of this project.

Departmental Storage (R: Drive): Hard drive space shared by all faculty within the Department of Mathematical Sciences at Georgia Southern University. This will be used, along with faculty web pages, to archive and share materials with other faculty at GSU upon completion of this project.

Proposal Category: No-Cost-to-Students Learning Materials

Final Semester of Fall 2017

Instruction:

Project Goals:

Save students money on textbooks by replacing the current textbooks with the free OpenStax textbooks *Calculus Volume I* and *Introductory Statistics* [2].

Save students money on online homework systems by replacing MyMathLab (used in Calculus) and LaunchPad (used in Statistics) with the free WebWork homework management system [3] with Open Problem Library (OPL) [4].

Support student success by developing additional course materials and online content adapted to our institutional course learning objectives, including notes, modules and videos that conform to the Quality Matters (QM) [6] standard for online courses. One of the team members (S. Kersey) of this project has completed a QM training course and is certified to develop online course content.

Redesign course syllabi, class schedules, course notes and other materials to coincide with the OpenStax textbooks and WebWork. The flexibility of WebWork's Open Problem Library and custom question creation allows for the development of course content that meets the needs of our students.

Develop assessment methods to measure the impact of these changes on student success. In doing so, we will first assess the effectiveness of the learning materials using current (non-free) materials using a pre-test and post-test in each of the spring and summer sessions. In the fall we will repeat the tests with classes using the open-source (free) materials.

Sustain student impact by making all materials openly available to colleagues through university storage, Desire2Learn exported course modules, WebWork exported problem sets, and faculty web pages.

Upon completion of this project, we will plan an expansion of open-source course content to other mathematics and statistics courses, such as Calculus II and Statistics II, in both the traditional and online formats.

Statement of Transformation:

Description: Replace the current (non-free) textbooks and homework systems with new open-source (free) alternatives for Calculus I and Introduction to Statistics I, and create

additional course content, such as notes, modules and videos, following Quality Matters guidelines [6].

The primary stakeholders are the students who will benefit from a reduced financial burden and more accessible open source content. Students will have access to all course materials (including textbook, homework problems, notes, etc.) on the first day of class, and no longer suffer delays in acquiring course materials because of Financial Aid and other factors.

The secondary stakeholders are faculty. With all resources on-line, there will be no delay in acquiring textbooks or homework access codes, so the instruction and assignment can begin on day one of the semester. Additionally, because it is open-source, instructors will have more control over course content, allowing adaption for different teaching styles.

The primary impact for students is reduced financial burden on students. With 90% of incoming students at Georgia Southern receiving some kind of financial aid in 2014-2015 [8], costs are clearly a major factor affecting student success. As well, by giving students a better learning experience in Calculus I and Statistics I, they will be better prepared to follow the course sequence to upper level classes.

The impact for faculty includes a shorter start-up time each semester and better prepared students entering the upper level classes. As well, with course material freely available and adaptable (including notes, worksheets and homework sets), our courses will be taught more uniformly, and faculty will spend less time in preparation.

The impact for our department and institution includes easier access and greater enrollment for students in the courses that use the free open-source material. As well, with course materials centrally located and shared among faculty, course instruction will be more consistent among different faculty. This is particularly important at Georgia Southern where we have relatively small class sizes rather than large lecture-run classes.

Upon success of our pilot run, the free open-source model can be adapted to other mathematics and statistics classes. This may apply to both face-to-face and online formats. This has the potential to greatly impact the enrollment of students at our institution, as well as their success in their degree programs.

Transformation Action Plan:

As a first step to our action plan, team members have already selected the textbooks (OpenStax' *Calculus I* and *Introductory Statistics*) and homework system (WeBWork) to be used in the transformation.

The next step is the creation of course syllabi, schedules, and materials. This will include course organization, expectations, and goals for new open-source transformation.

Team members will administer standard testing instruments in the semester prior to implementing the new open-source materials. For statistics, the CAOS test [7] will be used, and an existing departmental assessment test will be used for Calculus.

S. Kersey will be creator of course material and instructor of record for Calculus I, and S. Carden will be creator of course material and instructor of record for Statistics I. Team members will collaborate on all other aspects of the transformation, including the creation of new WeBWork problem sets.

The new materials will be set up prior to the first day of class. This includes pre-registering students in WeBWork using class rosters and hosting of course materials in Desire2Learn. At the final stages of implementation, open-source materials will be stored in central locations and made available to faculty.

Quantitative & Qualitative Measures: Upon completion of this project at the end of the Fall 2017 semester, both quantitative and qualitative measures will be applied to assess the efficacy of the transformation to open-source materials. We will compare results from classes using non-free materials to those using the open-source materials outlined in this proposal. Quantitative measures: Comparison of pre- and post-content tests for each class, broken down by course learning objectives, including calculation of a confidence interval estimating the difference between the two samples. Comparison of scores on a common Final Exam. Comparison of DFW (Drop, Fail, Withdrawal) rates between classes. Qualitative measures: Comparison of surveys on student attitudes and opinions regarding course materials. Examination of course/instructor evaluations for comments and feedback regarding the course materials for each course.

Timeline:

January 2017	Give content pre-test to students using current (non-free) course materials.
January 30, 2017	Attend kick-off meeting.
February 2017	Match course objectives with OpenStax text sections and modify syllabi and course schedules accordingly.
March 2017	Complete creation and modification of existing electronic materials, including lecture note outlines to be consistent with OpenStax text notation and terminology.
May 2017	Give content post-test to students using current (non-free) course materials. Give survey to students concerning use of current(non-free) course materials.

June 2017	Complete creation of homework problems sets for WebWorks, including modification of existing (either custom created or from Open Library) problems to be consistent with OpenStax textbook notation and terminology.
July 2017	Upload electronic materials to Desire2Learn for use in Fall 2017 semester.
August 2017	Give content pre-test to students using new (free) course materials.
November 2017	Departmental presentation to faculty introducing open source materials (OpenStax, WeBWorK, lecture notes, etc.). In the following weeks, additional individual meetings for faculty interested in adoption.
December 2017	Give content post-test to students using new (free) course materials. Give survey to students concerning use of new (free) course materials. Analyze data from both courses to evaluate efficacy of open-source materials

Budget:

Dr. Scott Kersey	Compensation for preparation time	\$5,000
Dr. Stephen Carden	Compensation for preparation time	\$5,000
Travel	Kick-off meeting and conference travel	\$800

Sustainability Plan:

After completion of this project, no additional costs are required. Course information and materials will be posted at central locations for faculty to use, including university storage (R: drive), a Desire2Learn exported course, and on faculty web pages.

OpenStax textbooks are open source and free to the public.

TheWeBWorK homework management system and Open Problem Library is open source, and free to install on a local server.

TheWeBWork problems created or modified for our courses will be submitted to WeBWork's Open Problem Library for use by other faculty and institutions, as well as having their source code available on faculty web pages.

Course materials, such as syllabi, weekly schedules, additional notes, modules, videos, and surveys will be made freely available to faculty through university storage, Desire2Learn course templates, and faculty web pages.

Team members will remain departmental point of contact for faculty interested in adoption of our open-source materials for future years.

**Affordable Learning Georgia Textbook Transformation Grants
Rounds Six, Seven, and Eight
For Implementations Beginning Fall Semester 2016
Running Through Fall Semester 2017**

Proposal Form and Narrative

Submitter Name	Scott Kersey
Submitter Title	Associate Professor of Mathematics
Submitter Email	skersey@georgiasouthern.edu
Submitter Phone Number	912-478-1963
Submitter Campus Role	Proposal Investigator (Primary)
Applicant Name	Scott Kersey
Applicant Email	skersey@georgiasouthern.edu
Applicant Phone Number	912-478-1963
Primary Appointment Title	Associate Professor of Mathematics
Institution Name(s)	Georgia Southern University
Team Members	Scott Kersey, Associate Professor of Mathematics, Department of Mathematical Sciences, skersey@georgiasouthern.edu Stephen Carden, Assistant Professor of Statistics, Department of Mathematical Sciences, scarden@georgiasouthern.edu
Sponsor, Title, Department, Institution	Sharon Taylor, Professor and Chair, Department of Mathematical Sciences, Georgia Southern University

Proposal Title	A Sustainable Open Source Implementation of Calculus and Statistics Using Zero-Cost Course Materials and Homework System				
Course Names, Course Numbers and Semesters Offered	Calculus I, MATH 1441, Fall, Spring, and Summer semesters Statistics I, STAT 2231, Fall, Spring, and Summer semesters				
Final Semester of Instruction	Fall 2017				
Average Number of Students Per Course Section	Calc 40 Stat 30	Number of Course Sections Affected by Implementation in Academic Year	Calc 50 Stat 50	Total Number of Students Affected by Implementation in Academic Year	Calc 2000 Stat 1500
Award Category (pick one)	<input checked="" type="checkbox"/> No-or-Low-Cost-to-Students Learning Materials <input type="checkbox"/> OpenStax Textbooks <input type="checkbox"/> Interactive Course-Authoring Tools and Software <input type="checkbox"/> Specific Top 100 Undergraduate Courses				
List the original course materials for students (including title, whether optional or required, & cost for each item)	Calculus I (MATH 1441) <i>Thomas' Calculus</i> with MyMathLab access (\$288.40) or MyMathLab Student Access Kit (\$106.90). Required. Introductory Statistics I (STAT 2231) <i>Basic Practice of Statistics</i> with Launchpad access (\$169.35) or Launchpad access code (\$91.75). Required.				
Requested Amount of Funding	\$10,800				
Original Per Student Cost	Calculus I: \$106.90-\$288.40 Statistics I: \$91.75-\$169.35				

Post-Proposal Projected Per Student Cost	\$0
Projected Per Student Savings	Calculus I: \$106.90-\$288.40 Statistics I: \$91.75-\$169.35
Projected Total Annual Student Savings	\$351,425-\$830,825
Creation and Hosting Platforms Used	<p>WeBWork [3]: Open-source online homework management system with Open Problem Library. The library currently contains over 35,000 mathematics and statistics problems [4], and includes an editor for writing problems tailored to one's course. The program is currently installed on a server maintained by a team member (S. Kersey), who has completed a WeBWork system administrator training course hosted by the Mathematical Association (MAA). Both team members have experience using WeBWork in the classroom setting.</p> <p>Desire2Learn (D2L, Folio) [5]: Virtual Classroom at Georgia Southern University. This will be used for additional notes, handouts, modules and videos associated with the implementation of this project.</p> <p>Departmental Storage (R: Drive): Hard drive space shared by all faculty within the Department of Mathematical Sciences at Georgia Southern University. This will be used, along with faculty web pages, to archive and share materials with other faculty at GSU upon completion of this project.</p>

NARRATIVE

1.1 PROJECT GOALS

- Save students money on textbooks by replacing the current textbooks with the free OpenStax textbooks *Calculus Volume I* and *Introductory Statistics* [2].
- Save students money on online homework systems by replacing MyMathLab (used in Calculus) and LaunchPad (used in Statistics) with the free WebWork homework management system [3] with Open Problem Library (OPL) [4].
- Support student success by developing additional course materials and online content adapted to our institutional course learning objectives, including notes, modules and videos that conform to the Quality Matters (QM) [6] standard for

online courses. One of the team members (S. Kersey) of this project has completed a QM training course and is certified to develop online course content.

- Redesign course syllabi, class schedules, course notes and other materials to coincide with the OpenStax textbooks and WebWork. The flexibility of WebWork's Open Problem Library and custom question creation allows for the development of course content that meets the needs of our students.
- Develop assessment methods to measure the impact of these changes on student success. In doing so, we will first assess the effectiveness of the learning materials using current (non-free) materials using a pre-test and post-test in each of the spring and summer sessions. In the fall we will repeat the tests with classes using the open-source (free) materials.
- Sustain student impact by making all materials openly available to colleagues through university storage, Desire2Learn exported course modules, WebWork exported problem sets, and faculty web pages.
- Upon completion of this project, we will plan an expansion of open-source course content to other mathematics and statistics courses, such as Calculus II and Statistics II, in both the traditional and online formats.

1.2 STATEMENT OF TRANSFORMATION

- Description: Replace the current (non-free) textbooks and homework systems with new open-source (free) alternatives for Calculus I and Introduction to Statistics I, and create additional course content, such as notes, modules and videos, following Quality Matters guidelines [6].
- The primary stakeholders are the students who will benefit from a reduced financial burden and more accessible open source content. Students will have access to all course materials (including textbook, homework problems, notes, etc.) on the first day of class, and no longer suffer delays in acquiring course materials because of Financial Aid and other factors.
- The secondary stakeholders are faculty. With all resources on-line, there will be no delay in acquiring textbooks or homework access codes, so the instruction and assignment can begin on day one of the semester. Additionally, because it is open-source, instructors will have more control over course content, allowing adaption for different teaching styles.
- The primary impact for students is reduced financial burden on students. With 90% of incoming students at Georgia Southern receiving some kind of financial aid in 2014-2015 [8], costs are clearly a major factor affecting student success. As well, by giving students a better learning experience in Calculus I and Statistics I, they will be better prepared to follow the course sequence to upper level classes.
- The impact for faculty includes a shorter start-up time each semester and better prepared students entering the upper level classes. As well, with course material freely available and adaptable (including notes, worksheets and homework sets), our courses will be taught more uniformly, and faculty will spend less time in preparation.

- The impact for our department and institution includes easier access and greater enrollment for students in the courses that use the free open-source material. As well, with course materials centrally located and shared among faculty, course instruction will be more consistent among different faculty. This is particularly important at Georgia Southern where we have relatively small class sizes rather than large lecture-run classes.
- Upon success of our pilot run, the free open-source model can be adapted to other mathematics and statistics classes. This may apply to both face-to-face and online formats. This has the potential to greatly impact the enrollment of students at our institution, as well as their success in their degree programs.

1.3 TRANSFORMATION ACTION PLAN

- As a first step to our action plan, team members have already selected the textbooks (OpenStax' *Calculus I* and *Introductory Statistics*) and homework system (WeBWork) to be used in the transformation.
- The next step is the creation of course syllabi, schedules, and materials. This will include course organization, expectations, and goals for new open-source transformation.
- Team members will administer standard testing instruments in the semester prior to implementing the new open-source materials. For statistics, the CAOS test [7] will be used, and an existing departmental assessment test will be used for Calculus.
- S. Kersey will be creator of course material and instructor of record for Calculus I, and S. Carden will be creator of course material and instructor of record for Statistics I. Team members will collaborate on all other aspects of the transformation, including the creation of new WeBWork problem sets.
- The new materials will be set up prior to the first day of class. This includes pre-registering students in WeBWork using class rosters and hosting of course materials in Desire2Learn.
- At the final stages of implementation, open-source materials will be stored in central locations and made available to faculty.

1.4 QUANTITATIVE AND QUALITATIVE MEASURES

Upon completion of this project at the end of the Fall 2017 semester, both quantitative and qualitative measures will be applied to assess the efficacy of the transformation to open-source materials. We will compare results from classes using non-free materials to those using the open-source materials outlined in this proposal.

- Quantitative measures:
 - Comparison of pre- and post- content tests for each class, broken down by course learning objectives, including calculation of a confidence interval estimating the difference between the two samples.
 - Comparison of scores on a common Final Exam.
 - Comparison of DFW (Drop, Fail, Withdrawal) rates between classes.
- Qualitative measures:

- Comparison of surveys on student attitudes and opinions regarding course materials.
- Examination of course/instructor evaluations for comments and feedback regarding the course materials for each course.

1.5 TIMELINE

January 2017	Give content pre-test to students using current (non-free) course materials.
January 30, 2017	Attend kick-off meeting.
February 2017	Match course objectives with OpenStax text sections and modify syllabi and course schedules accordingly.
March 2017	Complete creation and modification of existing electronic materials, including lecture note outlines to be consistent with OpenStax text notation and terminology.
May 2017	Give content post-test to students using current (non-free) course materials. Give survey to students concerning use of current (non-free) course materials.
June 2017	Complete creation of homework problem sets for WeBWorK, including modification of existing (either custom created or from Open Problem Library) problems to be consistent with OpenStax textbook notation and terminology.
July 2017	Upload electronic materials to Desire2Learn for use in Fall 2017 semester.
August 2017	Give content pre-test to students using new (free) course materials.
November 2017	Departmental presentation introducing open source materials (OpenStax, WeBWorK, lecture notes, etc.).

	In the following weeks, additional individual meetings for faculty interested in adoption.
December 2017	<p>Give content post-test to students using new (free) course materials.</p> <p>Give survey to students concerning use of new (free) course materials.</p> <p>Analyze data from both courses to evaluate efficacy of open-source materials.</p>

1.6 BUDGET

Dr. Scott Kersey	Compensation for preparation time.	\$5000
Dr. Stephen Carden	Compensation for preparation time.	\$5000
Travel	Kick-off meeting and conference travel.	\$800

1.7 SUSTAINABILITY PLAN

After completion of this project, no additional costs are required. Course information and materials will be posted at central locations for faculty to use, including university storage (R: drive), a Desire2Learn exported course, and on faculty web pages.

- OpenStax textbooks are open source and free to the public.
- TheWeBWork homework management system and Open Problem Library is open source, and free to install on a local server.
- TheWeBWork problems created or modified for our courses will be submitted to WeBWork's Open Problem Library for use by other faculty and institutions, as well as having their source code available on faculty web pages.
- Course materials, such as syllabi, weekly schedules, additional notes, modules, videos, and surveys will be made freely available to faculty through university storage, Desire2Learn course templates, and faculty web pages.
- Team members will remain departmental point of contact for faculty interested in adoption of our open-source materials for future years.

1.8 REFERENCES & ATTACHMENTS

On-line Resources:

1. Georgia Southern: www.georgiasouthern.edu/
2. OpenStax Textbooks: openstax.org/subjects/math
3. Webwork: webwork.maa.org/
4. Open Problem Library: webwork.maa.org/wiki/Open_Problem_Library
5. Desire2Learn (Folio): <https://georgiasouthern.desire2learn.com/>
6. Quality Matters: www.qualitymatters.org
7. CAOS (Comprehensive Assessment of Outcomes in a first Statistics Course): <https://apps3.cehd.umn.edu/artist/caos.html>
8. National Center for Educational Statistics (NCES): nces.ed.gov/collegenavigator.

See attached letter of support from sponsoring Department Chair, Dr. Sharon Taylor.



DEPARTMENT OF
MATHEMATICAL SCIENCES

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<http://cosm.georgiasouthern.edu/math>

December 6, 2016

To Whom It May Concern:

This letter is in support of the Affordable Learning Grant submitted by Dr. Scott Kersey and Dr. Stephen Carden. I find their proposal to have significant merit in terms of decreasing the financial burden of textbooks for students as well as contributing to the collection of online homework problems for a broad audience.

Drs. Kersey and Carden have been using the WeBWorK online homework system from the Mathematical Association of America (MAA) for several semesters. Each has found the problems already created to be quite useful. When they feel the need to add problems for their students, the process of adding to the database is also quite easy.

Their experiences with the WeBWorK system, as well as the costly and not as easy to use commercial online homework systems available with textbooks, prompted their desire to pursue the ALG opportunity. By capitalizing on their previous successes with WeBWorK, utilizing existing OpenStax materials, and adding to these resources, Drs. Kersey and Carden can lower the costs for many of our students.

Anticipating Drs. Kersey and Carden's successful implementation of their efforts during Fall 2017, we expect to recruit additional faculty to participate in the program. In the past, faculty have expressed dissatisfaction with the limitations of the commercial products as well as the high cost of these materials. With the no-cost OpenStax and WeBWorK options, participation by other faculty in the department is a given. This project can be sustained at no cost to the department, USG, or the students. Long term financial relief for students can be easily attained through this project.

I support Drs. Kersey and Carden's efforts to transform not only the way homework is handled in our department, but to use the OpenStax resources to transform teaching and learning in our department.

Please feel free to contact me if you need additional information.

Sincerely,

A handwritten signature in cursive script that reads "Sharon Taylor".

Sharon Taylor
Department Chair

Syllabus

Course Syllabus for STAT 2231, Section D, Fall 2017

Instructor: Dr. Steve Carden **Email:** scarden@georgiasouthern.edu Use your georgiasouthern.edu account.

Office Hours: Math/Physics 2042A, 12:30 – 1:30 Monday through Thursday, and other times by request.

Class Meeting Time: 11:15-12:05 Monday, Wednesday, Friday **Class Location:** Math/Physics 2021

Course Materials:

Textbook: *Introductory Statistics* from OpenStax. This textbook is free to download as a pdf from <https://openstax.org/details/books/introductory-statistics>, and cheap to purchase a hard copy.

Lecture Notes: I'll be posting a skeleton document for taking notes on Folio for each lecture. You'll need these for the daily group quizzes after lecture.

Organization: A 3-ring binder for lecture note skeletons. I'll hole-punch anything I hand back. Bring some notebook/printer paper for scratch work.

Software: Homework is assigned through WebWorks, a free and open-source online homework system. It may be accessed through the "Homework" module in Folio.

Technology:

- A calculator with statistical capabilities. I will be using the TI-84 during demonstrations, but the TI-83, 89, 92, Nspire, and Casio FX-9750GII, FX-9760GII are also capable. If you have some other model, check with me to see if it has the necessary capabilities. Almost any graphing calculator will work. Exam problems will assume you have one of these calculators.
- An iClicker2. This will be used for daily quizzes and exams.

Prerequisite: A minimum grade of "C" in one of MATH 1101, MATH 1111, MATH 1112, MATH 1113, MATH 1232 or MATH 1441.

Course Description: An introductory, 3 credit hour statistics course which covers descriptive statistics, probability, random variables and selected probability distributions, statistical inference including confidence intervals and hypothesis tests. Appropriate technology will be used for simulation and to solve statistical problems. Neither a background in calculus nor experience with computers is required.

Learning Objectives: By the end of this course, students will be able to:

1. Create and interpret visual displays and quantitative summaries for distributions and relationships.
2. Critically assess whether assertions merit acceptance based on statistical data and experimental design.
3. Analyze outcome-specific values as random variables, including the special cases of Binomial and Normal random variables.
4. Apply basic probability concepts and formulae to calculate the probability of events.

5. Explain the role that sampling distributions play in statistical inference.
6. Create confidence intervals, perform hypothesis tests, and correctly interpret the results.
7. Use correlation and linear regression to quantify the relation between two variables and predict the value of one variable given the other.
8. Use modern technology such as graphing calculators and spreadsheets to facilitate calculations.

Grading scale: A: [89.5, ∞)
B: [79.5, 89.5)
C: [69.5, 79.5)
D: [59.5, 69.5)
F : ($-\infty$, 59.5)

Grading Breakdown:

- **60% 4 in-class tests:** One 8.5 x 11 inch formula sheet (front and back) may be used for each exam. Keep the formula sheets for the final exam! Make-up tests will be given only for University sanctioned events and medical or funeral related absences with documentation submitted through the Dean of Student's office.
- **10% Project:** Throughout the semester, we'll talk about a project to tie together all the concepts we'll cover and practice real-life application. It will be officially assigned around the 3rd exam.
- **10% Final exam:** This grade may replace a missed exam or lowest exam grade. Save formula sheets for this exam!
- **10% WeBWork online homework:** Most lectures will have an associated homework assignment. Homework is always due at 11:59PM of the Wednesday the week after assignment.
- **10% Daily group quizzes:** This portion of your grade is intended to measure participation and effort. After each lecture will be a set of iClicker questions. 50% credit is gained by answering all questions, with another 50% earned by getting at least half of the questions correct. Daily grades are not recorded for review or test days. If you must be absent but still want to earn credit, hand in a notecard with your section, name, and quiz answers within a week of the missed class.

Attendance: Daily quizzes serve as a proxy for attendance. If you miss more than 5 lectures, I suggest you drop the course. If the instructor is more than ten minutes late, class is considered dismissed.

Distractions: If the instructor or a student has the floor, pay attention to the discourse. If a conversation goes off-topic or becomes a distraction to your classmates or myself, I will intervene. First offense will elicit a warning, subsequent offenses will reduce the next exam score by 1 point, then 2 points, then 3, etc. Silence your electronics and place them out of sight until class is over. The use of electronic devices during the daily group quiz will result in a grade of zero.

Academic Integrity: You are encouraged to work together on daily quizzes, homework, and exam preparation (be sure you are internalizing, not just copying!)

However, exams are meant to assess YOUR performance and knowledge. Using any information obtained from a classmate, accessing a phone or other communication device, sharing a calculator during an exam, or the use of any item not explicitly allowed by the instructor are all strictly prohibited. Any violations will result in a grade of zero and will be reported to the Office of Student Conduct.

Special Accommodations: If you have a letter outlining classroom or testing accommodations to which you are entitled, please come by my office to discuss this matter. Please provide me a copy of your letter, even if you choose not to use any of the special accommodations to which you are entitled, that I can be prepared should you choose to use this option. More information is available at <http://studentsupport.georgiasouthern.edu/sdrc/>.

Additional Resources: The Academic Success Center sponsors free tutoring with no appointment necessary. For specific hours and locations, visit <http://students.georgiasouthern.edu/asc/tutoring/>. Also, the **Math And S**Tat Enhancement Room (MASTER) in MP-3000 offers tutoring for STAT 2231.

Last Revised 9/13/2017. Yellow means no class, gray means no daily grade.

Date	Topic	Notes
M 8/14	Overview and Syllabus	Attendance verification
W 8/16	Lecture 1: Definitions, Populations, Samples	8/17 is last day of add/drop
F 8/18	Lecture 2: How to Sample	
M 8/21	Lecture 3: Recognizing and Avoiding Bias	
W 8/23	Lecture 4: Experiments vs Observation	
F 8/25	Lecture 5: Variables & Visual Summaries	
M 8/28	Lecture 6: Numerical Summaries I: Center, Spread	
W 8/30	Lecture 7: Numerical Summaries II: Spread, Relative Standing	
F 9/1	Lecture 8: Numerical Summaries III: z-scores, Empirical Rule	
M 9/4	LABOR DAY	
W 9/6	Lecture 9: How to Lie with Statistics	
F 9/8	HURRICANE IRMA	
M 9/11	CLASSES CANCELED	
W 9/13	CLASSES CANCELED	
F 9/15	Review for Exam 1	
M 9/18	Exam 1	
W 9/20	Lecture 10: Scatterplots and Correlation	

F 9/22	Lecture 11: Regression and Prediction	
M 9/25	Lab 12: Tiger Hunting	Will meet in computer lab
W 9/27	Lecture 13: Basics of Probability	
F 9/29	Lecture 14: Addition Rules for Probability	
M 10/2	Lecture 15: Conditional Probability and Independence	
W 10/4	Lecture 16: Baye's Rule and Simpson's Paradox	
F 10/6	Review for Exam 2	
M 10/9	Exam 2	Last day to withdraw
W 10/11	Lecture 17: Basics of Random Variables	
F 10/13	Lecture 18: Binomial Random Variables	
M 10/16	Lecture 19: Normal Random Variables, Part I	
W 10/18	Lecture 20: Normal Random Variables, Part II	
F 10/20	Lecture 21: Normal Approximation to the Binomial	
M 10/23	Lecture 22: The Central Limit Theorem, Part I	
W 10/25	Lecture 23: The Central Limit Theorem, Part II	
F 10/27	Lecture 24: Confidence Intervals about Means	
M 10/30	Lecture 25: Confidence Intervals about Proportions	
W 11/1	Project Discussion and Assignment;	
F 11/3	Exam 3 Review	
M 11/6	Exam 3	
W 11/8	Lecture 26: Basics of Hypothesis Testing	
F 11/10	Lecture 27: Hypothesis Tests about Means	
M 11/13	Lecture 28: Hypothesis Tests about Proportions	
W 11/15	Lecture 29: Testing using p-values	
F 11/17	Lecture 30: Two-Sample Tests for Means	
M	THANKSGIVING BREAK	

11/20		
W 11/22	NO CLASSES	
F 11/24	NO CLASSES	
M 11/27	Lecture 31: Two-Sample Tests for Proportions	
W 11/29	Exam 4 Review	
F 12/1	Exam 4	
M 12/4	Project Work Day / Exam 4 handed back	
W 12/6	Final Exam (25 questions). Project due.	

Final Report

Affordable Learning Georgia Textbook Transformation Grants

Final Report

Date: December 18, 2017

Grant Number: 277

Institution Name(s): Georgia Southern University

Team Members:

- **Scott Kersey, Associate Professor, Dept. of Mathematical Sciences, skersey@georgiasouthern.edu**
- **Stephen Carden, Assistant Professor, Dept. of Mathematical Sciences, scarden@georgiasouthern.edu**

Project Lead: Scott Kersey (Calculus) and Steve Carden (Statistics)

Course Name(s) and Course Numbers:

- **Calculus I, Math 1441 (4 sections)**
- **Introduction to Statistics, STAT 2231 (4 sections)**

Semester Project Began: Spring 2017

Semester(s) of Implementation: Fall 2017

Average Number of Students Per Course Section: 38

Number of Course Sections Affected by Implementation: 8

Total Number of Students Affected by Implementation: 304

1. Narrative

As stated in our proposal, the goal of this project was to develop and implement Calculus I and Introductory Statistics classes using free-to-student OER course materials, and to compare with classes run using traditional non-free course materials. The free course materials included the open source WeBWork homework system and OpenStax textbooks, as well as course notes and additional homework assignments.

One hurdle to overcome was the installation of WeBWorK – although we have been using it for years on an external server, the university required that we comply to new security standards. To overcome this, we worked with the Provost and ITS to install WeBWorK on university computers. This installation will improve sustainability of our project.

The implementation included 2 classes each of Statistics and Calculus using our free OER materials, and 2 classes each using traditional materials for comparison. The OER classes used OpenStax textbooks and the WeBWorK open source homework system. In our classes we used some existing WeBWorK problems, and wrote some of our own. Supporting documents include some WeBWorK problems for the OpenStax Calculus I textbook, and WeBWorK problems for Statistics. The free course materials saved our students hundreds of dollars, each.

Our overall conclusion is that the effectiveness of our OER classes were as effective as classes using traditional materials, but probably no better. The benefit therefore comes in other ways: costs, ease of use, adaptability, ... For example, with OER materials students have what they need on day 1 (or earlier) of the semester compared with traditional materials that students wait to purchase until after the semester begins, thereby delaying their start in the courses.

The analysis of our implementation includes a survey (for calculus) and a statistical analysis (for statistics). The data shows in particular that the OER materials were effective, and that the students appreciated the “free” course materials, and would take a free OER course again in the future.

The reliance of the OpenStax texts in our courses was minimal. This is mainly due to having our own course materials (notes, handouts, homework). Moreover, both of us do not prefer the OpenStax textbooks, and will not use them in the future for these courses. We will continue to develop our OER courses and materials, using different textbooks.

The experience and impact for ourselves as instructors and students was mostly positive. We are both committed to OER and the potential to develop high-quality courses with free course materials, and our students

benefit from the cost-savings with no apparent loss in quality of the course.

2. Quotes

Calculus I students who used OER materials

- This was my 1st free course materials class and I was so thankful! This was a huge burden off my shoulders because I had to purchase more books.
- I very much appreciated that webwork was free. Although I do believe it is not as good an experience as MyMathlab, which gives you examples and more help with each problem. But webwork is not terrible. And thank you Dr. Kersey, I found your teaching style and attitude helpful!
- I really enjoyed webwork as it made easier to study and gave me lots of practice.

Introductory Statistics Students

- The homework being free, as well as allowing multiple attempts, taught me how to solve problems more confidently. The layout of the notes was extremely neat and made focusing on the main points a breeze!
- I really liked the organization and lecture outlines. It helped a lot when taking notes and looking back at what to study
- ...great organization, loved the outlines because they helped me stay focused instead of writing note after note.

3. Quantitative and Qualitative Measures

3a. Overall Measurements

Student Opinion of Materials

Total number of students affected in this project: 228

Calculus in two sections who use OER materials

(based on questions III.7 through V.5 of Calculus survey)

- Positive: 66.4 % of 53 number of respondents
- Neutral: 18.4 % of 53 number of respondents
- Negative: 15.2 % of 53 number of respondents

Statistics

- Positive: 96.7 % of 76 number of respondents
- Neutral: 3.3 % of 76 number of respondents
- Negative: 0 % of 76 number of respondents

Student Learning Outcomes and Grades

Calculus

- ___ Positive: Higher performance outcomes measured over previous semester(s)
- X Neutral: Same performance outcomes over previous semester(s)
- ___ Negative: Lower performance outcomes over previous semester(s)

Statistics

- ___ Positive: Higher performance outcomes measured over previous semester(s)
- X Neutral: Same performance outcomes over previous semester(s)
- ___ Negative: Lower performance outcomes over previous semester(s)

Student Drop/Fail/Withdraw (DFW) Rates

Calculus

33 % of students, out of a total 75 students affected, dropped/failed/withdrew from the course in the final semester of implementation.

- ___ Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- X Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- ___ Negative: This is a higher percentage of students with D/F/W than previous semester(s)

Statistics

18.4% of students, out of a total 76 students affected, dropped/failed/withdrew from the course in the final semester of implementation.

- Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- X Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- Negative: This is a higher percentage of students with D/F/W than previous semester(s)

3b. Narrative

The main takeaway from a comparison of classes from before to after adoption of OER materials is that the main performance summaries are essentially unchanged, while student attitudes have improved due to the cost-savings and accessibility of OER materials.

We mention one more important qualitative observation. While both the calculus and statistics course used materials (lecture notes, homework sets, etc.) that were consistent with and followed the OpenStax texts, virtually all of the students seem to have interacted primarily with the lecture notes rather than the text. We speculate this may be part of a trend with the newer generation of students to view the textbook as the last, rather than the first, source of information for a course.

We should mention that the fall semester experienced 6 days of canceled classes due to Hurricane Irma, and some students did not return to class, which could influence the results.

Calculus

In Calculus, the student DWF rates were about the same (perhaps a little lower) for the OER group. Student attitudes, however, were different. The attached survey contains many questions concerning the course and methods of instruction. In particular, by a very high percentage, students who used the OER course materials prefer to use them again, and students who did not use the OER course materials would prefer an OER course. As well, the

results from pre-tests and post-tests were about the same for the OER and non-OER groups.

Statistics

For statistics, the DFW rate went from 15% of 68 students to 18% of 76 students. This difference is well with the range of standard random variation between samples; indeed, the p-value for a test of difference of proportions is .55, providing practically no evidence of a difference.

Similarly, a comparison of questions from the final exam were practically identical. The statistics faculty have a set of eight questions used on final exams to assess student outcomes. The results of two sections of statistics each from spring and fall were compared. The results are summarized in the table in the attached file.

As can be seen from the last row on the attached table, the overall results are slightly higher using OER materials, but are still within the range of ordinary random variation from sample to sample.

Student opinions in the statistics sections were collected via a survey giving the prompt “The organization and clarity of the course material was...”, with answer options on a Likert scale: very poor, poor, satisfactory, good, and very good”. For the purposes of the results in section 3a., we classified “very poor” and “poor” as a negative opinion, “satisfactory” as neutral, and “good” and “very good” as positive. 62 students completed the survey. No students were in the negative opinion classification, two students were in the neutral classification, and the remaining 60 students were in the positive classification.

4. Sustainability Plan

To provide sustainability with our implementation, our course materials and the newly installed WeBWorK are available for other faculty. During a department meeting this Fall, we demonstrated our materials, and invited faculty to adopt these in the Spring 2018 semester. Indeed, for Statistics, this has happened sooner than expected. Two first-time instructors used the OpenStax text with the lecture notes and WeBWorK sets created/compiled by Dr. Carden. These sections had different instructors and were not included in the previous evaluation to prevent confounding, but it shows a willingness to use open-access resources in the department.

All course materials (including notes and homework problems in WeBWorK) will be made available on our faculty web pages (Calculus on Dr. Kersey’s, and Statistics on Dr. Carden’s). Secondary hosting will be on the shared

network drive used by Georgia Southern's math department.

5. Future Plans

Our foray into teaching with free OER course materials has been positive. We were optimistic going into the project, and are enthusiastic looking forward. There are a lot of open-source course materials available and publishing possibilities that we will utilize in our courses in the future, as we continue to develop and improve our own course materials. We are proponents of WeBWork, and will continue to write problems and get more faculty involved. In the future we will consider developing OER for other courses, and consider about how to improve our current classes.

6. Description of Photograph

Dr. Steve Carden (left) taught Introductory Statistics and Dr. Scott Kersey (right) taught Calculus I using OER course materials during the Fall 2018 semester at Georgia Southern University.