Spring 2016

Precalculus (Albany State University)

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Grants Collection
Albany State University

UNIVERSITY SYSTEM
OF GEORGIA

Wanjun Hu, Li Feng

Precalculus

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.

Syllabus

ALBANY STATE UNIVERSITY
ALBANY, GEORGIA
Course Syllabus

COURSE INFORMATION

COURSE NUMBER/SECTION	MATH 1113.02
COURSE TITLE	Pre-calculus
CREDIT HOURS	3 SEMESTER HOURS
COURSE PREREQUISITES	MATH 1111 College Algebra
SEMESTER, YEAR	Fall 2015

RECOMMENDED TEXTBOOK

RECOMMENDED TEXTBOOK

Pre-calculus
OpenStax College
The PDF files are provided in D2L and at
http://www.asurams.edu/pre-calculus

Remark: Also at that site, students can find a pamphlet separated into 16 webpages. Students can use them as supplementary materials, a study guide or even a textbook. In addition, there is also a sample test for each of the topics in Pre-calculus.

INSTRUCTOR CONTACT INFORMATION

CLASS MEETING	MW 9:50am-11:05am
CLASS LOCATION	BB Building Room 189
INSTRUCTOR INFORMATION	Wanjun Hu
TITLE	PROFESSOR
E-MAIL	Wanjun.Hu@ASURAMS.EDU
OFFICE PHONE	430-4751
ALTERNATE PHONE	None
OFFICE LOCATION	Simmons Hall 341
OFFICE HOURS	T,R: 9:30am-12:30pm, M,W: 11:10am-1:10pm

COURSE DESCRIPTION

COURSE DESCRIPTION FROM CATALOG: This course is the study of functions and their graphs. Topics include trigonometric functions, exponential and logarithmic functions and polar coordinates.

PREREQUISITES

MATH 1111(College Algebra)

ASU CONCEPTUAL FRAMEWORK MODEL:

This course supports the College of Education Conceptual Framework Model by helping the student to:

1. Develop ability to apply principles and generalizations already learned to new problems and situations.

2. Develop analytic skills.
3. Develop problem-solving skills.
4. Develop the ability to concentrate.
5. Develop appropriate study skills, strategies, and habits.
6. Improve mathematical skills.
7. Learn terms and facts of the subject.
8. Learn concepts and theories in this subject.
9. Develop skill in using materials, tools and technology central to this subject.
10. Prepare for transfer or graduate study.
11. Develop an informed understanding of the role of science and technology.
12. Develop ability to work productively with others.
13. Develop a commitment to accurate work.
14. Improve ability to organize and use time effectively.
15. Develop ability to perform skillfully.
16. Cultivate a sense of responsibility for one's own behavior.
17. Cultivate an active commitment to honesty.
18. Develop capacity to think for one's self.
19. Develop the ability to be tolerant of others.
20. Develop an appreciation of values of oneself and others.

GOAL OF THE COURSE :

Students will acquire knowledge and understanding of trigonometric functions, exponential functions, logarithmic functions, and their graphs and apply these concepts to higher-level courses and real-life situations.

LEARNING OUTCOMES:

1. The students will understand and use exponential and logarithmic functions and trigonometric functions.
2. The students will understand and use ideas related to analytic trigonometry.
3. The students will use the law of sine and the law of cosine.
4. The students will communicate their understanding of the topics in oral and written forms.
5. The student will apply technology to solve problems.

COURSE OBJECTIVES:

Upon satisfactory completion of this course the students should:

1. Be able to demonstrate the understanding of basic exponential function and its applications.
2. Do interactive simulation exercises on the solution of exponential equation using graphing calculators or math software.
3. Be able to demonstrate the understanding of the definition of logarithmic function to a given base and inverse function to an exponential function.
4. Apply rules of logarithm in doing problems.
5. Solve exponential and logarithmic equations.
6. Be able to convert an angle in degrees minutes and seconds to radians and vise versa, using a calculator.

7. Define six trigonometric functions of an angle.
8. Be able to find the trigonometric functions of an angle in a right triangle.
9. Do simulation application problem exercises using graphing calculators or math software.
10. Prove the three trigonometric Pythagorean identities.
11. Find trigonometric function values of a real number using a calculator or math software.
12. Use technology on graphing trigonometric functions.
13. Demonstrate the understanding of amplitude and phase shift in the graph of sine and cosine function.
14. Demonstrate the understanding of reference angle and reference number and its relation to the value of a trigonometric function.
15. Draw the graphs of sine, cosine, and tangent functions and describe their domain and range.
16. Be able to apply the trigonometric identities in the simplification of trigonometric expressions.
17. Be able to solve trigonometric equations.
18. Use technology to solve trigonometric equations and interpret their solutions.
19. Be able to state and prove multiple-angle sum formulas, and double and half angle formulas.
20. Be able to apply sum to product and product to sum formulas.
21. Define inverse trigonometric functions of sine, cosine, and tangent functions.
22. Use technology to find the value of inverse trigonometric functions.
23. State and prove the Law of Sine and Law of Cosine.
24. Be able to apply the Law of Sine and the Law of Cosine in solving a triangle.
25. Be able to state and apply the Heron's Area Formula.

GENERAL STATEMENTS

(Specific rules and regulations required by the department. Omitted)

UNIVERSITY WRITING REINFORCEMENT POLICY

(Specific policy required by Albany State University, omitted)

TECHNOLOGY REQUIREMENT

(Specific policy required by Albany State University, omitted)

CLASS ATTENDANCE POLICY

(Specific policy required by Albany State University, omitted)

ADDITIONAL INFORMATION

(Specific policy required by Albany State University, omitted)

CLASS CANCELLATION POLICY

(Specific policy required by Albany State University, omitted)

TENTATIVE SCHEDULE

Dates	Assignments	
	Tuesday	**Thursday**
Week 1	Rational Functions https://gateway.asurams.edu/affordable-learning-program/5-RationalFunctions/index.html https://gateway.asurams.edu/affordable-learning-program/5-RationalFunctions.pdf	Non-linear inequalities
Week 2- Week 3	Exponential functions & graphs https://gateway.asurams.edu/affordable-learning-program/6-ExponentialFunctions/index.html https://gateway.asurams.edu/affordable-learning-program/6-ExponentialFunction.pdf	Logarithmic functions and graphs **TEST 1 ON THAT FRIDAY IN D2L**
Week 4	Properties of logarithms https://gateway.asurams.edu/affordable-learning-program/7-LogarithmicFunctions/index.html https://gateway.asurams.edu/affordable-learning-program/7-LogarithmicFunctions/7-LogarithmicFunctions.pdf	Exponential and logarithmic equations **TEST 2 ON THAT FRIDAY IN D2L**
Week 5- Week 6	Radian and degree measure https://gateway.asurams.edu/affordable-learning-program/8-	Trigonometric functions: unit circle **TEST 3 ON THAT FRIDAY IN D2L**

Dates	Assignments	
	Tuesday	**Thursday**
	MeasuringAndIdentifyingAngles/index.html https://gateway.asurams.edu/affordable-learning-program/8-MeasuringAndIdentifyingAngles/8-MeasuringAngles.pdf	
Week 7	Right triangle Trigonometry https://gateway.asurams.edu/affordable-learning-program/9-TrigonometricFunctionsUsingUnitCircle/index.html https://gateway.asurams.edu/affordable-learning-program/9-TrigonometricFunctionsUsingUnitCircle/9-TrigonometricFunctions.pdf	Trigonometric functions of any angle **TEST 4 ON THAT FRIDAY IN D2L**
Week 8-Week 9	Graphs of sine and cosine functions https://gateway.asurams.edu/affordable-learning-program/10-GraphsOfCosineSineTangentFunctions/index.html https://gateway.asurams.edu/affordable-learning-program/10-GraphsOfCosineSineTangentFunctions/10-GraphTrigonometricFunctions.pdf	Inverse trigonometric functions **TEST 5 ON THAT FRIDAY IN D2L**
Week 10-Week 11	Using fundamental identities https://gateway.asurams.edu/affordable-learning-program/12-TrigonometricFunctionIdentities/index.html https://gateway.asurams.edu/affordable-learning-program/11-InverseTrigonometricFunctions/index.html	Verifying trigonometric identities **TEST 6 ON THAT FRIDAY IN D2L**

Dates	Assignments	
	Tuesday	**Thursday**
	https://gateway.asurams.edu/affordable-learning-program/12-TrigonometricFunctionIdentities/12-TrigonometricIdentities.pdf https://gateway.asurams.edu/affordable-learning-program/11-InverseTrigonometricFunctions/11-InverseTrigonometricFunctions.pdf	
Week 12- Week 13	Sum and difference formulas https://gateway.asurams.edu/affordable-learning-program/13-SumAndDifferenceFormulas/index.html	Product to sum formulas
Week 14	Multiple-angle and product-to-sum formulas https://gateway.asurams.edu/affordable-learning-program/14-SumToProductAndProductToSumFormulas/index.html	Law of since / law of cosine **TEST 7 IN D2L** https://gateway.asurams.edu/affordable-learning-program/15-LawOfSineCosine/index.html
December 3	Class ends	
December 3-7		**FINAL EXAM!**

Amendment to Syllabus of Pre-calculus Section Two

INSTRUCTOR CONTACT INFORMATION

INSTRUCTOR	Wanjun Hu
OFFICE LOCATION	Simmons Hall 341
OFFICE PHONE	430-4751
E-MAIL	Wanjun.Hu@ASURAMS.EDU

COURSE EVALUATION

Test1	10%
Test2	10%
Test3	10%
Test4	10%
Test5	10%
Test6	10%
Test7	10%
Attendance	10%
Final	20%
Total	100%

USING D2L

All course information and tests will be on D2L. It is a free service. Depending on the departmental requirements, we may have paper test for final exam.

SUBSTITUTE TEST

We may have a substitute test at the end of the semester. You can use it to substitute one of the tests and final exam. In other words, you can use it to replace the lowest grade of the tests and final exam. No grade will be dropped.

EXCESSIVE ABSENCE

According to the student handbook, if you miss more than 3 credit hours in this course, then you are subject to a downgrade of the final grade, i.e., from "A" to "B", "B" to "C", "C" to "D", "D" to "F". In this course, that policy is administrated by the percentage of absence in the final grade (see Course Evaluation above).

WRITTEN HOMEWORK

There are written homework assignments. I will hand them out in the first two weeks. Homework assignments will not be counted to the final grade. However, you still need to do them in order to prepare yourself for tests and exams. You can turn them in for me to check.

GRADING SCALE

The final score is calculated by

Final score = test1 * 10% + test2 * 10% + test3 * 10% + test4 * 10% test5 * 10% + test6 * 10% + test 7 * 10% + final * 20% + attendance * 10%.

Score	Letter
89.00-100	A
79.00-88.99	B
69.00-78.99	C
59.00-68.99	D
0 - 58.99	F

Initial Proposal

Affordable Learning Georgia Textbook Transformation Grants (Round 2)

Institution Name(s)	Albany State University				
Team Members (Name, Title, Department, Institutions if different, and email address for each)	Wanjun Hu, Professor of Math/CS, Department of Math &CS, Albany State University, Wanjun.hu@asurams.edu Li Feng, Professor of Math, Department of Math & CS, Albany State University, li.feng@asurams.edu				
Sponsor, Title, Department, Institution	Seyed Roosta, Department of Math and Computer Science, Albany State University				
Course Names, Course Numbers and Semesters Offered (Summer 2015, Fall 2015, or Spring 2016)	MATH 1113, Pre-calculus, Summer 2015, Fall 2015, Spring 2016.				
Average Number of Students Per Course Section	35	**Number of Course Sections Affected by Implementation in Academic Year 2016**	**10**	**Total Number of Students Affected by Implementation in Academic Year 2016**	350
Award Category (pick one)	☒ No-Cost-to-Students Learning Materials ☐ OpenStax Textbooks ☐ Course Pack Pilots ☐ Transformations-at-Scale				
List the original course materials for students (including title, whether optional or required, & cost for each item)	*Precalculus by Larson, 8th edition, Brooks/Cole, Cengage Learning, required*	*$228* ***Total Cost***			
Plan for Hosting Materials	☐ OpenStax CNX ☒ D2L ☐ LibGuides ☐ Other _____				
Projected Per Student Cost	**$10**	**Projected Per Student Savings (%)**	100%		

1. PROJECT GOALS

The proposed project will re-design the learning modules in association with the online textbook from OpenStaxCollege.com. At the meantime, a separate pamphlet of concepts, skills and list of problem types will be created as a useful study guide for students. That pamphlet will be around 60 pages. Students can print it by themselves at a cost of $10.

1.1 STATEMENT OF TRANSFORMATION

Pre-calculus at Albany State University is required for all science majors. Each semester, four section of pre-calculus are offered, with a total of about 120 students. However, majority of students do not purchase textbooks, which, combined with other factors, results in a very high failing rate at about 40%. Because of the hierarchy of course preparations in science degree programs, high failing rate in this course also contributes to low retention and graduation rate (about 65%) in Math and Science majors. Recently, the department of math and computer science negotiated a tailored version of textbook with Cengage. However that requires students to register with WebAssign, which does not reduce the total cost for students. For instance, students need pay $75 for an ebook plus the extra cost for accessing the WebAssign.

Both proposers received their college education in China in 1980s, where a totally different education system was prevailing. In that system, textbooks are usually thin and inexpensive. Textbook contents are very succinct, usually in less than 100 pages. Organization of course materials flows as learning modules. Both proposers also have extensive experience in teaching in American education system. Textbooks in that system are very thick, usually in 400 pages or more. They are very costly. Textbook contents are very extensive. These two different types of textbooks are very complementary to each other. We feel a good combination of both can be a solution to textbook problem.

Our approach will use free online textbook and a pamphlet to reduce the textbook cost. We will use the free OpenStax College textbook of pre-calculus and align required course work with chapters in that (American style) book. Meanwhile, a printable (Chinese style) pamphlet of the basic concepts, important formulas, problem types and problem-solving techniques will be developed. Students can use the pamphlet as a reference book or as a handy study guide for tests and exams. The pamphlet will be freely available in D2L. If a student chooses to print out a hard copy, he or she may print it in less than $10.00.

The transformation will produce several benefits: (1) reduce the cost of textbook to less than $10; (2) establish a better connection of lecture contents, test materials and students' preparation; (3) easy instructor's burden on closing the gap between teaching and students' learning; (4) potentially improve the passing rate and retention rate in the STEM (Science, Technology, Engineering and Mathematics) programs.

1.2 TRANSFORMATION ACTION PLAN

OpenStatCollege textbook adoption: All course contents for MATH 1113 Pre-Calculus required at ASU can be found in an online free textbook at OpenStax College. For this project, we will separate that textbook into several small files. Each file will cover one topic and it will be provided in our D2L as part of a learning module.

Supplemental Pamphlet: A mini-book of about 60 pages will be created to include all learning modules for this Pre-calculus course. Each learning module will start with concepts, the very basic calculations related to those concepts, the typical calculative and logical skills used in those calculations, and basic problem types. Students can use it as a reference textbook, or a study guide for tests. Students shall find almost all basic problem types in the book. Furthermore, we will integrate the pamphlet with the online free textbook. We will provide links to exercises and sample tests from the online textbook.

Course Structure Redesign: Other than the regular chapter and section structures, we will redesign the course structure to following the learning module structure. For each leaning module, we will use the successful model developed and tested in the countries such as formal Soviet Unions, China. Each learning module will include definition, typical examples, typical calculation, typical problem solving techniques and list of problem types. Then a set of exercise and sample tests will be created based on the online textbook.

Roles of Team Members: Dr. Hu has been teaching College Algebra, Precalculus using Blackboard, Vista, D2L, Moodle, WebAssign for more than 10 years. He is also an expert on educational technology. He will take care of the online math content delivery such as online tests, pamphlet preparation and learning module designs.

Dr. Feng has been teaching math courses for more than 15 years. He has worked with students with extreme diverse background. He will be responsible for course contents, pamphlet material selections, and test problems.

Open Access Plan: All materials will be freely available in D2L during summer 2015. Starting Fall 2015, the pamphlet will be posted to the department website at http://www.asurams.edu/academics/college-of-science-health-professions/mathematics-computer-science/ for public access. We will also present our study to Georgica Academy of Science Annual Meeting.

1.3 QUANTITATIVE AND QUALITATIVE MEASURES

Quantitative measures: For the project, both team members will follow the same course work scheme and lecture schedule. While one follows the regular course design, the other will follow the new design. Students' performance on all tests and exams will be analyzed. In particular, data of students' usage of the online resources and the pamphlet will be collected.

At the end of semester, we will compare the grade distributions of both sections and the failing rate on each learning module. Further analysis will be on the students' performance on each problem type. The collected data will help us to update the course structure and the pamphlet.

Qualitative measures: Around midterm exam and at the end of the semester, a survey will be conducted. Among other questions, we will ask students' opinions on the usefulness of the pamphlet, the preparation for tests and exams, the cost of this new course structure.

1.4 TIMELINE

Summer 2015

a. May 1-May 15 (before summer 2015 starts): Course structure will be redesigned and provided in D2L. The first part of the pamphlet will be handed out to students.
b. May 15-June 15 (first month of summer 2015): Three sample tests and three actual tests (with respect to the first set of learning modules) will be provided online. Students' performance on those tests will be analyzed.
c. June-12-June 15 (around midterm): a survey will be conducted. The other part of the pamphlet will be handed out to students.
d. June 15-July 15(second month of summer 2015): Additional three sample tests and three actual tests (with respect to the second set of learning modules) will be provided online.
e. July 12-July 15(around final exam): a survey will be conducted.
f. Interim report

Fall 2015 & Spring 2016

g. Update the course structure in D2L and each learning modules according to students' feedback and students' performance on each learning module.
h. Update the pamphlet according to students' feedback and students' performance.
i. Final report

1.5 BUDGET

BUDGET Personnel	**Specifics**	**Expenses ($)**
Li Feng	Content, Instruction, Assessment, Data Analysis & Collection	5,000.00 (Overload)
Wanjun Hu	Report, D2L and Technology, Instruction	5,000.00
Subtotal		**$10,000.00**
Project Items	**Breakdowns**	**Subtotal**
Paper	$20x2	40.00
Ink Cartridges	$38.75x4	155.00
Hard-copies of the Learning Materials	$15x3	45.00
GERA 2015 Conference Registration	$100x1 person	100.00
Travel to GERA Conference Mileage	380 miles x .25 cents/milex2	190.00
GERA Conference Hotel	135x2 nights	270.00
Subtotal		**$800.00**
Total		**$10,800.00**

1.6 SUSTAINABILITY PLAN

After we develop the new course materials, we will offer the Math 1113 Pre-calculus sessions using the new material along with the free textbook. In summer 2015, we will offer one such section. Before fall 2015, we will modify and improve the material accordingly using the result of the comparing data and students' feedback. In fall 2015, we will offer two such sections. After that, we will work with all the instructors of the course to update and improve the course module, after a year of modification and revision, only a minimal maintenance is required. Gradually, the old textbook system will be replaced by the new material along with the free online textbook and its D2L course design.

1.7 REFERENCES & ATTACHMENTS

Albany State University

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

From: Seyed Roosta
Professor & Chairperson
Department of Math & Computer Science
Albany State University
Albany GA 31705

To Who It May Concern,

I am writing this letter to support Dr. Feng and Dr. Hu's proposal for the Affordable Learning Georgia Textbook Transformation Grant.

High cost textbook has been a major problem in college education at Albany State University. Research has shown that students' success in the lower level math classes is closely related to their access to a textbook. Historical data in this department tells that the rate of student's possession of textbook is very low due to its very high cost, which subsequently becomes a major factor of students' failing rate in those classes at Albany State University. Both of the proposers have experience in two different education systems, i.e., American education system where textbooks are usually extensive and expensive, and the Chinese education system where textbooks are succinct and inexpensive. The proposed approach is a synthesis of both systems. It can be a good solution to the problem.

The department will provide necessary resources to facilitate their activities. We will monitor the implementation process, and recommend the same strategy to all sections of Pre-calculus.

Sincerely Yours,

Seyed Roosta

Seyed Roosta, Ph.D.

Albany State University, 504 College Drive, Albany GA 31705. Tel: (229)430-4600

Albany State University

College of Sciences and Health Profession

November 28, 2014

From: Joyce Johnson
Dean and Professor
College of Sciences and Health Profession
Albany State University
Albany GA 31705

To: Affordable Learning Textbook Grant reviewers,

I am writing this letter to support Dr. Feng and Dr. Hu's proposal for the Affordable Learning Georgia Textbook Transformation Grant. Math courses are challenging and learner-friendly learning materials are critical to promoting student success.

High cost textbook has been a major problem in college education at Albany State University and institutions across the country. Students' success in lower level math classes is greatly impacted by their access to a textbook. Anecdotal data in the college reveals that the rate of students' possession of textbooks is low often due to the high cost of the books. The lack of a textbook subsequently becomes a major factor of students' failure rate in those classes.

Both of the proposers have experience with textbooks that are usually extensive and expensive, and textbooks that are succinct and inexpensive. The proposed approach to teaching materials for mathematics is a synthesis of both textbook types which may provide a solution to the problem.

The college and department will provide necessary resources to facilitate the activities of Drs Feng and Hu in developing the proposed packet. We will monitor the implementation process, and if successful will recommend use of the same materials and teaching strategy in all sections of Pre-calculus.

Thank you for your consideration.

Joyce Y Johnson

Dr. Joyce Y Johnson, Dean and Professor

College of Sciences and Health Professions

Albany State University, 504 College Drive, Albany GA 31705. Tel: (229)430-4600

Final Report

Affordable Learning Georgia Textbook Transformation Grants

Final Report

Date: *12/17/15*

Grant Number: *96*

Institution Name(s): *Albany State University*

Team Members (Name, Title, Department, Institutions if different, and email address for each): *(1) Li Feng, Professor, Department of Math & CS, li.feng@asurams.edu; (2) Wanjun Hu, Professor, Department of Math & CS, Wanjun.Hu@asurams.edu.*

Project Lead: *Wanjun Hu*

Course Name(s) and Course Numbers: *MATH 1113 Pre-calculus*

Semester Project Began: *Summer 2015*

Semester(s) of Implementation: *Fall 2015*

Average Number of Students Per Course Section: *30*

Number of Course Sections Affected by Implementation: *2*

Total Number of Students Affected by Implementation: *60*

1. Narrative

The goal of our project is to evaluate free OpenStax textbook for Pre-calculus with a supplementary pamphlet of our own making. We start working on our pamphlet in Spring 2015. The pamphlet contains 16 selected topics. They are listed below:

1. Factoring
2. Linear Functions
3. Quadratic Functions
4. Polynomial Functions
5. Rational Functions
6. Exponential Functions
7. Logarithmic Functions
8. Measuring of Angles and Identifying Angles
9. Trigonometric Functions Using Unit Circle
10. Graphs of Cosine, Sine and Tangent Functions
11. Inverse Trigonometric Functions
12. Trigonometric Function Identities

13. Sum Formulas and Difference Formulas
14. Sum-to-Product Formulas and Product-to-Sum Formulas
15. Law of Cosine and Law of Sine
16. Solve Trigonometric Equations

The first five topics are basically a quick review of major contents in College Algebra. In our course design, the test 1 will cover those contents. Test 1 is also served as a quick preparation for students to get familiar with online tests in D2L settings. The rest of contents are divided into 6 groups. Each group of contents will have one test associated.

- Group 1: Exponential functions and equations, interest accumulations (assessed by Test 2)
- Group 2: Logarithmic functions, change of base (assessed by Test 3)
- Group 3: Measuring angles, identifying special angles on unit circles (assessed by test 4)
- Group 4: Graphs of cosine and sine functions (assessed by test 5)
- Group 5: Identities, inverse functions (assessed by test 6)
- Group 6: Sum formulas and related formulas, law of cosine and sine, trigonometric equations (assessed by test 7)

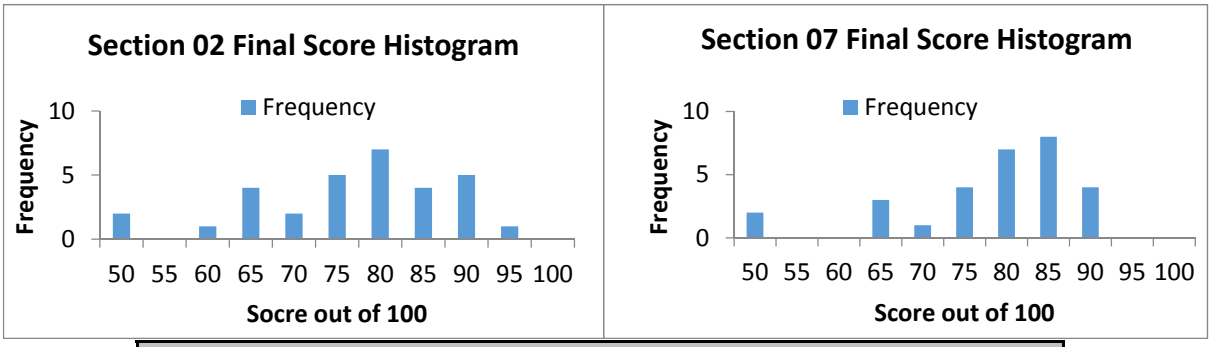
A website http://www.asurams.edu/pre-calculus is available for students' reference. Students can also access the same contents within the D2L environment where they will also take online tests.

Our project will compare students' performance in the same semester, instead of two consecutive semesters. The reason for that is because of the coordinate of course lecture contents and test schedules. For a comparison, we schedule two sections of pre-calculus, i.e., section 2 and section 7. Section 2 was taught using this newly designed course and section 7 was taught in traditional way using traditional hard copy of textbook. Both sections will follow pretty much the same schedule, same syllabus, and same D2L content design. There is slightly difference however regarding the policy for making up tests. Students in section 7 were allowed to make up tests, while students in section 2 were not. Another difference is extra credits. Students in section 2 were allowed to receive extra credits for attending supplementary instructions and taking (online) surveys, while students in section 7 did not have them.

Students' performance is evaluated by 7 tests, one final exam and attendance. Each test is counted 10%. Final exam is counted 20% and attendance is counted 10%. Disregarding other difference, the histograms of final score calculated using the actual weight assignment are provided in the charts below.

Using Students' T statistical test (see results below), we have 95% confidence level to claim that we cannot rule out the fact that the average scores for these two different course designs are any different. The calculation is done in Excel using Data Analysis add-ins.

Final Score Calculated Using Actual Weight



t-Test: Two-Sample Assuming Unequal Variances (alpha=0.05)		
	Section 2	Section 7
Mean	73.15323	75.58621
Variance	188.713	124.9199
Observations	31	29
Hypothesized Mean Difference	0	
Degree of freedom	57	
t Stat	-0.75461	
P(T<=t) one-tail	0.226794	
t Critical one-tail	1.672029	
P(T<=t) two-tail	0.453588	
t Critical two-tail	2.002465	

As a conclusion, we are 95% confident that the new design of this pre-calculus class does not show significantly difference to traditional pre-calculus classes. It proves that our original project goal has been achieved, i.e., using OpenStax free textbook and a self-made pamphlet is sufficient to replace traditional expensive commercial textbook for this Pre-calculus class in community colleges.

Overall, our project went very well. We almost finished the pamphlet before summer term and tried to implement in summer 2015. However, due to low enrollment of one section of Pre-calculus, we postponed the implementation to fall 2015. With the section of a good enrollment, we adopted the materials, and course design in D2L. Students like that new design very much. From students' feedback and our own experience to use the free textbook, we update the topics to covered and provide sample tests so that students can prepare themselves well.

When implementing the project in fall 2015, we coordinate almost the same schedule of lecture contents and tests. The tests are given every other weekend. Both sections have tests in D2L. Students like the online tests because of the flexibility. It is also good for us, since we can have more time on lectures.

Developing the pamphlet and grouping course contents for tests bring about an unexpected impact to our instructions. We realize new ways to present knowledge to students, so that learning of several topics can be chained to each other. It also impacts students' performance. From the histograms of calculated final score, one can see that there is higher pass rate, i.e., 67% and 79%. The reason for the 79% pass rate is because of allowing students to make-up in Section 7. In our survey given to section 2 where new design is adopted, students in general demonstrate a satisfactory opinion toward the new design of this free textbook math class.

Due to time limit, we are not able to perfect the pamphlet. In the future, we will improve it and try to get it published. Another thing we think can be improved is the sample tests for each topic. We intend to use them as a study guide for students to prepare for real tests. There so many different types of questions. We hope we can have more time to make them more complete.

2. Quotes

In our survey given to students in Section 2 where the new design was adopted, we asked students to provide suggestions for "how to improve this new concept of free online textbook with pamphlet", students responded very positively. Here are some quotes:

> *"this concept is the best i've seen thus far and i'm extremely thankful to professor Hu."*

“I think that all classes should provide them. I do believe that there should be more interactive things in the online textbook.
”

“The online text book was so helpful and saved students a lot of money. Thank you”

3. Quantitative and Qualitative Measures

3a. Overall Measurements

Student Opinion of Materials

Was the overall student opinion about the materials used in the course positive, neutral, or negative?

Total number of students affected in this project: ___60_____

- Positive: ___83.87____ % of ___31_____ number of respondents
- Neutral: ___5____ % of ____31____ number of respondents
- Negative: __0_____ % of ____31____ number of respondents

Student Learning Outcomes and Grades

Was the overall comparative impact on student performance in terms of learning outcomes and grades in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Student outcomes should be described in detail in Section 3b.

Choose One:

- ___ 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

Was the overall comparative impact on Drop/Fail/Withdraw (DFW) rates in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Drop/Fail/Withdraw Rate:

__33_____% of students, out of a total ___31____ students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

- ___ 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

Our data include DFW analysis, test scores, final exam, students' attendance and survey.

DFW Analysis

- There is one student withdrawn from each section.
- The DFW rate for section 2 is 23%, and the DFW rate for section 7 is 10%.
- The average GPA for section 2 is 2.84, and the average GPA for section 7 is 2.59

Test score analysis

We will consider students' score for each test and exam as a sample for each of these two categories: (1) students' performance in the newly designed class, and (2) students' performance in traditional class. Both samples have size more than 10 and roughly follow a normal distribution. Both samples satisfy the random requirements. Hence we can use the Student's T test to test the hypothesis that students' performance in the two categories have no difference.

The calculation was done in Excel using the Data Analysis add-in. The confidence level is 95%, or alpha=0.05. Here are the summary of the statistical analysis.

- **Test 1, conclusion: no difference**
  The mean score for section 2 is 15.8 out of 20 questions, and the mean score for section 7 is 15.3 out of 20. The variance is 2.46 for section 2 and 6.9 for section 7. Using Students' T statistical test, the t-value = 0.96 and both one-tail or two-tail probabilities are greater than 0.05. Hence, we cannot deny that students' performance in two categories are pretty much the same.
- **Test 2, conclusion: no difference**
  The mean score for section 2 is 15.2 out of 20 and the mean score for section 7 is 15.6 out of 20. The variance is 5.13 for section 2 and 4.99 for section 7. The t-value=-0.59 and both one-tail and two-tail probabilities are greater than 0.05. Hence, we cannot deny that students in two categories are pretty much the same.
- **Test 3, conclusion: no difference**
  The mean score for section 2 is 13.9 out of 20 and the mean score for section 7 is 14.5 out of 20. The variance for section 2 is 10.66 and 3.6 for section 7. The t-value is -0.83 and both one-tail and two-tail probabilities are greater than 0.05. Hence, we cannot deny that students in two categories are pretty much the same.
- **Test 4, conclusion: no difference**
  The mean score for section 2 is 17.4 out of 20 and the mean score for section 7 is 17 out of 20. The variance for section 2 is 0.87 and 20 for section 7. The t-value is 0.85 and both one-tail and two-tail probabilities are greater than 0.05. Hence, we cannot deny that students in two categories are pretty much the same.
- **Test 5, conclusion: section 2 is slightly better**
  The mean score for section 2 is 16.2 out of 20 and the mean score for section 7 is 13.4. The variance for section 2 is 4.3 and 28.7 for section 7. The t-value is 2.49 and both one-tail and two-tail probabilities are **less than** 0.05. Hence, we will reject the null hypothesis that students' performances in two categories are the same.
- **Test 6, conclusion: no difference**
  The mean score for section 2 is 18.2 out of 20 and the mean score for section 7 is 17.8. The variance for section 2 is 2.22 and 1.95 for section 7. The t-value is 0.94 and both one-tail and two-tail probabilities are greater than 0.05. Hence, we cannot deny that students in two categories are pretty much the same.

- **Test 7, conclusion: section 2 is slightly better**
  The mean score for section 2 is 18.3 out of 20 and the mean score for section 7 is 15.2. The variance for section 2 is 3.03 and 13.56 for section 7. The t-value is 3.87 and both one-tail and two-tail probabilities are **less than** 0.05. Hence, we will reject the null hypothesis that students' performances in two categories are the same.
- **Final exam, conclusion: section 2 is slightly better**
  The mean score for section 2 is 18.3 out of 20 and the mean score for section 7 is 15.7. The variance for section 2 is 2.93 and 3.95 for section 7. The t-value is 5.45 and both one-tail and two-tail probabilities are **less than** 0.05. Hence, we will reject the null hypothesis that students' performances in two categories are the same.
- **Attendance, conclusion: section 7 is slightly better**
  The mean score for section 2 is 7.04 out of 10 and the mean score for section 7 is 8.9 out of 10. The variance for section 2 is 7.11 and 6.09 for section 7. The t-value is -2.675 and both one-tail and two-tail probabilities are **less than** 0.05. Hence, we reject the null hypothesis that students' performances in two categories are the same.
- **Final score calculated using assigned weight, conclusion: no difference**
  The mean score for section 2 is 73.15 out of 100 and the mean score for section 7 is 75.59 out of 100. The variance for section 2 is 188.71 and 124.92 for section 7. The t-value is -0.75 and both one-tail and two-tail probabilities are greater than 0.05. Hence, we cannot deny that students in two categories are pretty much the same.

- **Substitute test, conclusion: section 2 is slightly better**
  The mean score for section 2 is 18.897 out of 20 and the mean score for section 7 is 15.06 out of 20. The variance for section 2 is 2.45 and 3.68 for section 7. The t-value is 6.992 and both one-tail and two-tail probabilities are less than 0.05. Hence, we reject the null hypothesis that students' performances in two categories are the same.

Survey result analysis

We have 8 questions on the survey. The last two allow students to provide comments.

- **Question 1: Did you have textbook for previous College Algebra class?**
  Result and analysis: 74% students said that they purchased textbook for College Algebra. 25% said no.
- **Question 2: Do you know that there are free textbook chapters provided online?**
  Result and analysis: 97% said yes. Only 3% (one student) said no.
- **Question 3: Do you know that there is an pamphlet for this course provided online?**
  Result and analysis: 90% said yes. Only 10% (three students) said no.
- **Question 4: How often do you read the online free textbook chapters?**

- Result and analysis: 13% said “always. 42% said “frequently”. 42% said “sometime”. Only 3% (one students) said “seldom”.
- **Question 5 How do you rate the free textbook chapters and the pamphlet?**
- Result and analysis: 48% said “very helpful”. 35.5% said “helpful”. 16% said “somewhat helpful”. No one said “not helpful”.
- **Question 6 In the future, will you refer this class with free textbook chapters and pamphlet to other students?**
  Result and analysis: 67.7% said “strongly recommend”. 29% said “recommend”. Only 3% (one student) said “no opinion”. No one select “not recommend”.

4. Sustainability Plan

We have setup a website for our project. It is located at http://www.asurams.edu/pre-calculus. On that main page, there is a table that contains links to the pamphlet, the free OpenStax textbook chapters, and sample tests for the topics. All of them are freely available without any restrictions. The website is hosted at the Albany State University’s website. It is maintained by the IT department at Albany State University.

In the future, the department will continue the support to recommend the online free resources to all sections.

5. Future Plans

The free textbook initiative has gained some popularity recently. During our implementation, faculties in our department were encouraged. Some of them have succeeded in Round 4 funding. From our experience and the departmental consensus, we believed this free textbook concept is especially useful for community college such as Albany State University, where some students usually have full time jobs, and many students are not well prepared.

Our unique design of this free textbook with pamphlet has its own merit. We have registered for one conference (poster) presentation. We may also have future presentations to share our experience with the society.

6. Description of Photograph

Left: Dr. Li Feng, Team member and instructior for section 7

Right: Dr. Wanjun Hu, team lead and instructor for section 2