Saint Leo University

LBS 330
Mathematical Inquiry

Course Description:
Topics include rigorous thought, number contemplation, geometry and contortions, meaning from data and uncertainty.

Prerequisite:
MAT 131

Textbook:
Burger, E., & Starbird, M. (2013). *The heart of mathematics: An invitation to effective thinking* (4th ed.). Hoboken, NJ: Wiley Higher Education. ISBN-13: 978-1-118-56639-8, Binder Set with WileyPlus Access Kit

WileyPlus:
This course makes use of the online website WileyPlus, URL: http://www.wileyplus.com/. The text specified comes with the access codes to the WileyPlus site. WileyPlus has some great resources for this class and it is also the site for homework, quizzes, and tests for this course, so access to WileyPlus is required.

Learning Outcomes:
By the end of this course:

1. Students will be able to use the terminology and concepts of some fundamental areas at the heart of mathematics, including logic, number, statistics, and geometry.
2. Students will be able to clearly communicate analytical and mathematical ideas to others.
3. Students will be able to use effective thinking and their repertoire of problem-solving strategies to analyze situations that require rigorous thought and to comprehend mathematical arguments.
4. Students will be able to comprehend uncertainties and make predictions based on a strong comprehension of the situation.
5. Students will communicate and work together to solve problems and develop a Christian learning community as outlined in Saint Leo's core value of Community.

Core Value:
Community: Saint Leo University develops hospitable Christian learning communities everywhere we serve. We foster a spirit of belonging, unity, and interdependence based on mutual trust and respect to create socially responsible environments that challenge all of us to listen, to learn, to change, and to serve.

Students are expected to be mindful of the Benedictine core values of Saint Leo University when submitting work, interviewing outside resources, and working in groups. Excellence, Respect, and Community shall be emphasized in this course. The supplement, “The Value of Thinking Mathematically,” (wrapped with the Pearson textbook package) contains exercises and discussion questions to actively develop and strengthen these core values specifically related to the content of this course.

Grading Scale:

A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76

C-	70-73
D+	67-69
D	60-66
F	0-59

In determining the final grade the following weights will apply:

Chapter Assessments (3)	45%
Homework Sets (6)	12%
Projects (3)	15%
Final Exam (1)	18%
Discussion (5)	10%
TOTAL	100 %

Module Breakdown of Percentages:
Module 1: Homework = 2%, Introduction = 1%,
Module 2: Homework = 2%, Discussion = 2%,
Module 3: Homework = 2%, Project = 4%, Chapter Assessment= 15%,
Module 4: Homework = 2%, Discussion = 2%
Module 5: Homework = 2%, Discussion = 2%
Module 6: Homework = 2%, Project = 4%, Chapter Assessment=15%
Module 7: Homework = 2%, Discussion = 2%
Module 8: Project = 4%, Chapter Assessment = 15%, Final Exam=20%

Projects:

Our first project assignment is centered on RSA Public and Private Encryption covered in Section 2.5. **This project is to be posted to the Project 1 Assignment box no later than Sunday 11:59 EST in Module 3**.

Write a research paper on digital signatures and certifying authorities including their relation to RSA Public and Private Key encryption. This research paper should be at least 800 - 1100 words and include references to the legal status in developed nations, the mathematics behind the technology, what are the major recognized authorities, and the likely future for this technology/business practice. The researcher should find the major US entities and how they relate and trust each other. On the legal topic, the researcher should find national and state laws and standards. You may also find laws from other countries and international organizations. Since many of these laws are now a decade or more old, we could also find legal interpretations of the law itself. The grading rubric remains unchanged from the syllabus.

The grading rubric for the research paper includes the following:

Quality of Research 25%
- At least 2 peer-reviewed sources plus recent developments in the area; is any critical and easily accessible information omitted?

Quality of Analysis 25%
- Are summarizations and conclusions made by student clear, well thought out, and based on the cited research?

Mathematical Explanations 30%
- Is the math behind the topic explained well and with sufficient depth?

Writing Quality 20%
- Length within amounts provided, spelling, grammar, following the APA style guide?

Project 2 (Fractal Art) Description:

When was the last time you had an art project in your math class? Your assignment is to use a fractal art program to create a fractal picture. The objective is to develop the most inspiring picture as voted on by your classmates (no, you cannot vote for your own picture!).

Your picture can be any type of fractal art including Mandelbrot Sets, Julia Sets, fractal landscapes, or nature pictures made of self-replicating fractals. The option is yours. Extra credit is provided for including the Saint Leo color scheme, logos, or landscape.

Since this is a math class, you also need to provide a one-page summary of how you created this image including the algorithms used, the values for those algorithms, and the software used to generate the image. In addition, any comments or recommendations on this project for future students are appreciated (such as useful and useless software!).

This project is to be posted to the Project 2 Discussion Board no later than Sunday 11:59 EST in Module 6. PLEASE, do not wait until the last minute. This can be a really fun project, but not if you attempt it on Saturday night!

Obviously, since you are creating this image, you will own the copyright for the image you create. Digital watermarks on the image are acceptable (this allows evaluation versions of several programs to avoid purchase).

To help you get started, the links below include some software that might help.

http://fractalarts.com/ - They have many images and also a page with software available on the Internet. The gallery might give you some ideas and the software page has links to several programs that could be useful.

http://www.fractalartcontests.com/ - This site has some award-winning fractal art for inspiration. Also, it lists the software used. Some of this software is powerful, but has a high learning curve.

http://www.ultrafractal.com/index.html - This appears to be a popular application for artwork. There is an evaluation version that includes a watermark, which is ugly, but acceptable.

http://www.download.com/ - This site has links to Fractal DRAW Pro and will perform self-replicating fractals. You can also find links to Genesis II software that will create fractal landscapes.

Grading Rubric for Project 2 (Fractal Art):

Explanation of the process and software use to create the image 33%
Explanation of the algorithms and repetition behind the image 33%
Beauty and complexity of the image 33%

Extra credit:
- Using Saint Leo Colors 5%
- Using Saint Leo Images 5%
- Voted “best picture” 10%

Project 3 Data Analysis

This project is to determine who is the **greatest of all time!** Well, sort of. We will look at the NFL quarterbacks from 2000 – 2011 and attempt to determine who was the best and worst over this time period.

In the Doc Sharing area, you will find:

- Advanced NFL Stats Glossary – This provides some definitions on the statistics we will use, from http://www.advancednflstats.com/ .
- NFL QB Data – an Excel file containing the NFL quarterback statistics.

Your job in this project is to answer the simple questions:

- Which quarterback had the best single season during this period?
- Which quarterback had the worst single season?

When answering these questions, please use the WP statistic to determine a quarterback's performance. Also, please justify how you determine the best performance for each year. Remember that defenses, weather, rules, number of QBs considered, etc., change each year. Please look at how, in the book, section 9.3, they compare baseball batting averages over time using the **z-score**.

This project is to be posted to the Project 3 Assignment box no later than Sunday 11:59 EST in Module 8.

Grading Rubric:

Calculation accuracy, 15%, Justification of best each year 20%
Determination of new metric 15%, Calculation accuracy, 15%, Justification of best each year 15%
Overall clarity and explanations of the analysis and conclusions, 20%

Course Schedule:

Module 1 **Fun and Games: An Introduction to Rigorous Thought**

Objectives

At the conclusion of this module, students will be able to:

- Use effective thinking and problem-solving strategies to analyze situations that require rigorous thought.
- Use simple proof techniques on everyday questions.
- Demonstrate and calculate Fibonacci numbers and apply them to the world around us.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Post introduction to the class	Thursday 11:59 PM EST/EDT
Post responses to at least two classmates' introductions	Sunday 11:59 PM EST/EDT
Complete homework assignment	Sunday 11:59 PM EST/EDT

Module 2 **Number Contemplation**

Objectives

At the conclusion of this module, students will be able to:

- Use concepts that relate to number sense, counting, patterns, prime numbers, and applications.
- Explain the concept of modulus and how it can be applied.
- Explain and be able to use public and private encryption.
- Develop an approach to developing proofs.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Post initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least two classmates	Sunday 11:59 PM EST/EDT
Complete homework assignment	Sunday 11:59 PM EST/EDT

Module 3 **Geometric Gems**

Objectives

At the conclusion of this module, students will be able to:

- Prove Pythagoras' Theorem.
- Identify the golden rectangle in the world around you.
- Identify and construct patterns with rigid symmetry and symmetry of scale.
- Explain and apply the fourth dimension.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Complete homework assignment	Sunday 11:59 PM EST/EDT
Complete module assessment	Sunday 11:59 PM EST/EDT
Submit Project 1	Sunday 11:59 PM EST/EDT

Module 4 **Contortions of Space**

Objectives

At the conclusion of this module, students will be able to:

- Use rubber sheet geometry to determine equivalence by distortion.
- Analyze and visualize the unique properties of a Möbius strip and a Klein bottle.
- Apply Euler's Circuit Theorem to solve simple graph problems.
- Apply Euler's Characteristic Theorem to analyze vertices, edges, and regions on a connected graph.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Post initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least two classmates	Sunday 11:59 PM EST/EDT
Complete homework assignment	Sunday 11:59 PM EST/EDT

Module 5 **Fractals**

Objectives

At the conclusion of this module, students will be able to:

- Analyze how nature uses self-replicating patterns.
- Perform calculations with complex numbers.
- Explain and create fractal images.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Post initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least two classmates	Sunday 11:59 PM EST/EDT
Complete homework assignment	Sunday 11:59 PM EST/EDT
Start Fractal Art Project	Module 6

Module 6 **Taming Uncertainty**

Objectives

At the conclusion of this module, students will be able to:

- Explain the concept of probability.
- Explain how probability can determine chance occurrences.
- Explain probability of multiple events.
- Explain how to use Bayesian Analysis to increase accuracy as new information is learned.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Complete homework assignment	Sunday 11:59 PM EST/EDT
Complete module assessment	Sunday 11:59 PM EST/EDT
Post Project 2	Thursday 11:59 PM EST/EDT
Vote on classmates' Project 2	Sunday 11:59 PM EST/EDT

Module 7 **Meaning from Data**

Objectives

At the conclusion of this module, students will be able to:

- Create random samples resulting in valid statistical representations of a population.
- Display data without bias.
- Use statistical analysis for normal distributions.
- Use statistical inference to determine if a result is statistically significant.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Post initial response to the discussion question	Thursday 11:59 PM EST/EDT
Post responses to at least two classmates	Sunday 11:59 PM EST/EDT
Complete homework assignment	Sunday 11:59 PM EST/EDT
Start working on Project 3	Module 8

Module 8 **Deciding Wisely**

Objectives

At the conclusion of this module, students will be able to:

- Analyze the future value of a probabilistic event.
- Determine the expected cost or value of actions.
- Determine the future value of interest-bearing investments or loans.

Assignments

Items to be Completed:	**Due No Later Than:**
Read the assigned materials	
Complete module assessment	Sunday 11:59 PM EST/EDT
Submit Project 3	Sunday 11:59 PM EST/EDT
Complete Final Exam	Sunday 11:59 PM EST/EDT