1 Course Information

- Location and Time: ONLINE
- Professor: Dr. Martin Malandro
- Department: Mathematics and Statistics
- Office: 433 Lee Drain Building
- E-mail (preferred method of contact): malandro@shsu.edu
- Phone number: (936) 294-1580
- Office Hours: This is an online course. E-mail me, by Wednesday evening, your questions about work that is due on Saturday. I will respond (usually publicly) on Thursday.

- Required Materials:
  - Calculator: hand held scientific calculator or better recommended. Calculators on phones will NOT be allowed on exams.
  - A laptop or desktop computer with web cam + microphone. This is required for “Respondus LockDown Browser with Monitor,” which is required for exams in this course. This is to protect the integrity of the course. I take cheating seriously because I want to preserve the value of your degree! Unfortunately, Respondus does not work right on things like iPads (or even the computers in the SHSU computer labs), so you will need to have your own private desktop or laptop computer with web cam + microphone.

Course Description: This course is designed to meet the objectives of Component Area 2 of the Core curriculum for non-business and non-science related majors. Topics may include sets, counting principles, probability, logic, linear algebra, linear programming, and mathematics of finance, geometry, and calculus. Prerequisite: Passing score on the MATH TSI Assessment or equivalent. Credit 3.

This course is not College Algebra. This is College Mathematics, a course intended to be an alternative to college algebra for non-science majors. We will do some algebra in this course, but when we do algebra it will always be to do something else. We will not study algebra for its own sake.

You’ve been on the algebra-to-calculus track your entire life because that’s what the engineers need. That’s not what you need, though, so it’s finally time to step off that track and see some interesting mathematics. There are many exciting topics in this course that are very different from the math you’ve seen before. Most people taking this course have had a bad experience with math before. I want you to have a good experience with math, and I’ve chosen the topics for the course with the hope that everything in the course will be either interesting or useful to you (and some things might even be both!).

There are four units in the course, each about a different subject. The first subject is Basics, which will be the most like the “normal” math classes you’ve had before. It forms the foundation needed for the other three units. The other three units are independent. They will cover the subjects of Voting Theory (the mathematics of group decision making), Number Theory (primes, divisibility, cryptography, etc), and Graph Theory (social networks, routing, etc).

Instructors of this course have a large amount of leeway in the topics they select for the course. If you have taken this course before, or if you have a friend who is currently taking the course with a different instructor, chances are...
there won’t be very much overlap in the material. I’ve chosen the topics for this course partly because I genuinely enjoy them, and partly because I think they will resonate with you.

**Course Objectives:** Math 1332 is designed to meet the objectives of Component area 2 of the core curriculum for non-business and non-science related majors. Students completing this course should expect to improve upon their:

- **Critical Thinking Skills:** Students will analyze and synthesize mathematical concepts and ideas. Students will be able to solve mathematical problems as related to the topics of percentages and proportions, weighted averages, logical arguments, number theory, voting theory, and graph theory.

- **Quantitative Skills:** Students will be able to compute percentages and proportions. Students will be able to use percentages and proportions to describe growth and decay. Students will be able to compute weighted averages and solve for values in weighted averages. Students will be able to decide the validity of logical arguments. Students will be able to compute with modular arithmetic, compute greatest common divisors and least common multiples, predict the simultaneous recurrence of differently-timed events, compute check digits in bar codes, and predict the effects of perfect shuffles. Students will be able to decide winners of elections under different election systems. Students will be able to identify the fairness criteria that various election systems satisfy, and will be able to identify violations of these fairness criteria. Students will be able to identify isomorphic graphs, use graph colorings to resolve resource allocation problems, identify Eulerian paths in graphs, and find shortest circuits in graphs.

- **Communication Skills:** Students will communicate their expectations and goals for the course to the professor. Students will report their progress in the course to the professor. Students will learn standard terminology in higher mathematics and use this terminology to answer questions about open problems in mathematics. Students will analyze English logical arguments and use mathematics to decide the validity of these arguments.

The course’s precise student learning objectives are as follows:

1. **Unit 1: Basics.** Students will be able to...
   - compute percentage-based increases and decreases of given quantities,
   - compute the overall effect of several percentage-based changes to a quantity,
   - scale recipes using proportional reasoning,
   - compute weighted average, given a collection of values and weights,
   - compute a student’s final grade in a course, given a list of grades and weights,
   - compute the score you’d need on the final exam to earn a given grade in this course, given all the grades earned before the final,
   - compute with permutations and factorials,
   - compute with combinations,
   - compute using the multiplication principle,
   - identify the contrapositive, converse, and negation of a given logical statement,
   - identify logically equivalent statements,
   - decide whether a given logical argument is valid or invalid, and
   - supply a conclusion to make an argument valid.

2. **Unit 2: Voting Theory.** Students will be able to...
   - compute the winner in an election using the plurality method,
   - compute the winner in an election using the pairwise method,
   - decide whether or not an election has a Condorcet candidate,
   - decide how many votes a candidate would need to win an election given the number of candidates and voters in the election,
• compute the winner in an election using the instant runoff method,
• compute the winner in an election using the Borda count,
• recall which voting systems satisfy the majority, Condorcet, monotonicity, and IIA fairness criteria,
• identify violations of fairness criteria in elections,
• compute the winner of an election using the approval method,
• recall whether approval voting satisfies previously-studied fairness criteria,
• recall whether previously-studied voting systems satisfy the participation fairness criterion, and
• recall the statement of Arrow’s impossibility theorem.

3. Unit 3: Number Theory. Students will be able to...

• compute the reduction of integers, including negative integers, \((\text{mod } n)\) for a given value of \(n\),
• compute the reduction of sums, differences, products, and factorials \((\text{mod } n)\) for a given value of \(n\),
• predict the day of the week and the time displayed on a clock after a given amount of time has passed,
• compute gcd’s of two or three given numbers,
• compute lcm’s of two or three given numbers,
• predict the timing of simultaneous recurrence of differently-timed events,
• identify the connection between gcd’s and lcm’s of two numbers,
• compute the check digit of a bar code,
• recall the formulas that encode where a card goes in a deck after a perfect in- or out-shuffle,
• recall how many perfect in- and out-shuffles are required to return a deck of 52 cards to its original order,
• predict where a card in a given position in a deck will end up after a given sequence of in- and out-shuffles,
• compute the sequence of in- and out-shuffles required to move the top card of a deck to a given position,
• recall the infinitude of the primes,
• define the Goldbach conjecture and twin prime conjecture,
• recall the current status of the Goldbach conjecture and twin prime conjecture,
• recall that the Riemann hypothesis is a million $ question,
• identify the importance of RSA encryption, and
• demonstrate knowledge of how the public and private keys in RSA encryption are formed and used in practice.

4. Unit 4: Graph Theory. Students will be able to...

• decide whether or not a graph is connected,
• identify the degrees of the vertices of a given graph,
• identify whether or not a given pair of graphs are isomorphic,
• identify the neighbors of a vertex in a given graph,
• apply the "sum of degrees" theorem to translate between number of edges and total degree in a graph,
• recall whether or not a given complete graph is planar,
• recall the definition of chromatic number,
• decide the chromatic number of a given graph,
• compute the chromatic number of a given graph to answer real-world questions about resource allocation,
• identify whether or not a given graph has an Euler path or Euler circuit,
• decide how many edges need to be added to a graph to make it have an Euler circuit,
• find Euler paths and Euler circuits in graphs,
• decide whether or not a given graph has a Hamiltonian circuit,
• find a minimal-cost Hamiltonian circuit (i.e., solve the "traveling salesman problem") in a given small graph,
• recognize NP-complete problems in graph theory, and
• recall that the P vs. NP problem is a million $ question.

2 Course Requirements (Grading Policy)

Your grade in the course will be calculated using the following weights:

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
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<tbody>
<tr>
<td>Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Exams</td>
<td>80%</td>
</tr>
</tbody>
</table>

There will be five exams (including the final exam), all of which are equally weighted. There will be roughly 30 quizzes in the course, all of which are equally weighted. Prior to computing your quiz and exam averages, I will drop your lowest 3 quizzes and your lowest exam.

Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>90% or better final average</td>
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<tr>
<td>B</td>
<td>80–89% final average</td>
</tr>
<tr>
<td>C</td>
<td>70–79% final average</td>
</tr>
<tr>
<td>D</td>
<td>60–69% final average</td>
</tr>
<tr>
<td>F</td>
<td>59% or lower final average</td>
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</tbody>
</table>

Make-up policy: You will always have at least three full consecutive days to take every graded assignment in this course. Therefore no make-ups of any kind will be permitted.

Academic Honesty Policy: All work you submit for credit in this course must be your own. You may not use your phone or any other communication device during exams. You may not communicate with anyone else in any way when taking exams. The penalty for cheating in this course is a grade of F in the course. You may also be referred to the dean on academic dishonesty charges.

Extra Credit Policy: The dropped exam and quiz policy is quite generous. Therefore, no additional extra credit is available.

Grade Dispute Policy: All grade issues need to be brought to my attention within one week of having your grade returned/posted.

Final Exam Schedule: May 3–May 7

3 Classroom Policies

Attendance Policy: This is an online class. I expect you to watch the lecture videos and keep up on the assigned work. Work will be due every week.

Technology Policy: You may not use your phone or any other communication device during the exams.
4 Schedule

<table>
<thead>
<tr>
<th>Unit 1: Basics Week 1: Percentages and Proportions, Hardware Check</th>
<th>Jan 15–Jan 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1: Basics Week 2: Weighted Averages</td>
<td>Jan 27–Feb 1</td>
</tr>
<tr>
<td>Unit 1: Basics Week 3: Counting Formulas, Logical Statements</td>
<td>Feb 3–Feb 8</td>
</tr>
<tr>
<td>Unit 1: Basics Week 4: Logical Arguments, Practice Exam</td>
<td>Feb 10–Feb 15</td>
</tr>
<tr>
<td>EXAM 1: Choose a 4-hour window in this range:</td>
<td>Feb 10–Feb 15</td>
</tr>
<tr>
<td>Unit 2: Voting Theory Week 1: Plurality voting, Condorcet Criterion</td>
<td>Feb 17–Feb 22</td>
</tr>
<tr>
<td>Unit 2: Voting Theory Week 2: IRV and the Borda Count, Fairness Criteria</td>
<td>Feb 24–Feb 29</td>
</tr>
<tr>
<td>EXAM 2: Choose a 4-hour window in this range:</td>
<td>March 2–March 7</td>
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<tr>
<td>SPRING BREAK</td>
<td>March 8–March 15</td>
</tr>
<tr>
<td>Unit 3: Number Theory Week 1: Modular arithmetic</td>
<td>March 16–March 21</td>
</tr>
<tr>
<td>Unit 3: Number Theory Week 2: GCD’s and LCMs, Bar Codes</td>
<td>March 23–March 28</td>
</tr>
<tr>
<td>Unit 3: Number Theory Week 3: Perfect Shuffles</td>
<td>March 30–April 4</td>
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<tr>
<td>Unit 3: Number Theory Week 4: Cryptography, Practice Exam</td>
<td>April 6–April 11</td>
</tr>
<tr>
<td>EXAM 3: Choose a 4-hour window in this range:</td>
<td>April 6–April 11</td>
</tr>
<tr>
<td>Unit 4: Graph Theory Week 1: Graphs and Coloring</td>
<td>April 13–April 18</td>
</tr>
<tr>
<td>Unit 4: Graph Theory Week 2: Coloring Applications, Euler Paths</td>
<td>April 20–April 25</td>
</tr>
<tr>
<td>Unit 4: Graph Theory Week 3: Hamilton Circuits, Practice Exam</td>
<td>April 27–May 2</td>
</tr>
<tr>
<td>EXAM 4: Choose a 4-hour window in this range:</td>
<td>April 27–May 2</td>
</tr>
<tr>
<td>Final Exam: Choose a 4-hour window in this range:</td>
<td>May 3–May 7</td>
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The date/time of the final exam is set by official SHSU policy. All other dates in this list are tentative and subject to change. However, I do not anticipate the need to make any changes.

5 Additional Information

Disabilities policy: Any student with a disability that affects his/her academic performance should contact the Office of Services for Students with Disabilities in the SHSU Lee Drain Annex (telephone 936-294-3512, TDD 936-294-3786) to request accommodations.

All information on this syllabus is subject to change. All changes will be announced in class. Further university policies regarding academic dishonesty, student absences on religious holy days, disabilities, and visitors in the classroom which apply to this course may be found at [http://www.shsu.edu/syllabus/](http://www.shsu.edu/syllabus/) If there is a conflict between information on this syllabus and official university policy, university policy takes precedence.