JOLIET JUNIOR COLLEGE
1901
DEPARTMENT OF MATHEMATICS

Math 127
Math for General Education

Course Description
This is a survey course of mathematical concepts used widely in the physical and social sciences. Intended for students whose programs do not specify a particular mathematics course. The course focuses on mathematical reasoning and the solving of real-life problems. Three or four topics from the following general areas are studied in depth: graph theory, mathematics of finance, voting methods, probability, statistics, and math in nature.

Illinois Articulation Initiative (IAI) number: M1 904

Credit and Contact Hours:

Lecture	**3**
Lab	**0**
Credit Hours	**3**

Prerequisites: Satisfactory placement test score or grade of "C" in Math 098 or equivalent.

Books, Supplies, and Supplementary Materials

A. **Required Textbooks**
MyMathLab Direct Digital Access. The eText is included in MyMathLab so if you are comfortable reading the textbook on the computer, you may use the eText alone. **There is no need to purchase a physical textbook for this course; the direct digital access fee for the eText was included in your course fees. Registration instructions are posted in our iCampus/Canvas site.**

B. **Other Required Materials**
TI-83+ or TI-84+ graphing calculator is recommended.

C. **Methods of Instruction:**
Lecture, Hybrid, or Online

General Education Student Learning Outcome

1. Quantitative Literacy: Students possess the ability to reason and solve quantitative problems from an array of contexts.

Course Learning Outcomes (CLOs)

Note: Three or Four of the following topics will be chosen by the instructor.

Voting

1. Determine the winner and ranking from an election using various methods of counting ballots
2. Determine and explain if an election is fair

Finance
1. Understand and apply real-life applications of money, including percent change, savings, investments, and consumer debt.

Graph theory
1. Apply, analyze, and evaluate characteristics of graph models, including Euler and Hamilton paths and circuits
2. Solve traveling salesman problems using a variety of algorithms
3. Apply, analyze, and evaluate characteristics of networks, including using algorithms to find minimum spanning trees

Probability
1. Quantify uncertainty and risk using probability models
2. Use various counting principles to determine the number of outcomes in an event or in a sample space

Statistics
1. Explain the purposes and strategies of data collection
2. Organize, present, and summarize data
3. Model, analyze, and make predictions on bell-shaped distributions

Sets
1. Represent sets using a variety of representations including Venn diagrams
2. Apply properties of sets and set operations to solve applications

Math in Nature
1. Explore patterns and real-life applications of the Fibonacci numbers and its connection to the golden ratio
2. Explore shape and form that occurs in nature, including symmetries and self-similarity in geometric fractals

Lesson Learning Outcomes (LLOs)

Note: Three or Four of the following topics will be chosen by the instructor to match the CLOs.

Voting
1. Create and understand a preference ballot/schedule
2. Explain the plurality method of voting
3. Explain the difference between the words "majority" and "plurality"
4. Apply the plurality method of picking a winner in an election
5. Give some advantages and disadvantages to the plurality method of voting
6. Explain the process in a runoff election (plurality with runoff elimination) and when it is used
7. Explain strategic voting and when it is used
8. Explain a preference ranking for a voting situation
9. Explain the Borda method of voting
10. Determine the Borda count winner from a preference ranking
11. Give the formula to check that a Borda count is correct
12. Give some advantages and disadvantages to the Borda method of voting
13. Explain what is meant by a Condorcet winner
14. Explain the method of pair wise comparisons

15. How to determine the number of pair wise comparisons
16. Apply the method of pair wise comparisons for picking the winner of an election
17. Give advantages and disadvantages to the pair wise comparison method of voting
18. Explain the idea of extended ranking methods and its uses
19. Discuss Arrow's impossibility theorem
20. Discuss fairness criteria that are basic standards in a fair election

Finance

1. Understand percentages and percentage increase and decrease
2. Use the simple interest formula to determine future values, annual interest rates, and time periods
3. Explain the difference between future value and the present value
4. Use the compound interest formula to determine future values, annual interest rates, periods of compounding, and time periods
5. Explain the difference between simple interest and compounded interest
6. Explain the periodic interest rate
7. Explain the difference between annual yield and annual interest rate; give the formula for Annual Percentage Yield
8. Given an annual interest rate and period of compounding, determine the annual percentage
9. Explain the difference between a regular savings account and an installment plan
10. Use the systematic savings formula to determine future values, annual interest rates, periods of compounding, and time periods
11. Explain an amortized loan
12. Use the loan formula to determine present values, loan payments, annual interest rates, periods of compounding, and time periods

Graph Theory

1. Identify vertices and edges of a given graph
2. Determine by observation if a graph is connected
3. Given two vertices on a graph, determine if they are adjacent
4. Given two edges on a graph, determine if they are adjacent
5. Given a vertex on a graph, determine its degree
6. Given a sequence of vertices, determine if the sequence forms a path
7. Given a sequence of vertices, determine if the sequence forms a circuit
8. Given a path, determine if it is an Euler path
9. Given a circuit, determine if it is an Euler circuit
10. Apply Euler's theorem to determine if a graph has an Euler circuit
11. Apply Euler's theorem to determine if a graph has an Euler path
12. Explain an algorithm
13. Explain what is meant by eulerizing a graph
14. Given a graph, find an optimal eulerization for it
15. Explain what is meant by the Konigsberg bridge problem
16. Apply the theory of Euler circuits and Euler paths to practical management science problems such as routing mail delivery and garbage pickup
17. Understand and apply Fleury’s algorithm for finding an Euler circuit or path on a graph
18. Define a Hamilton circuit
19. Define a Hamilton path
20. Determine whether a given graph has an Euler circuit, Hamilton circuit, both, or neither
21. Define what is meant by a complete graph
22. Know the formula for the number of edges in a complete graph
23. Determine the number of Hamilton circuits in a complete graph with N vertices

24. Explain what is meant by a traveling salesman problem
25. Explain what is meant by a weighted graph
26. Give some examples of real world problems that can be formulated as traveling salesman problems
27. Explain an approximate algorithm
28. Apply the nearest neighbor algorithm to find an optimal Hamilton circuit
29. Apply the brute-force algorithm to find an optimal Hamilton circuit
30. Apply the repetitive nearest-neighbor algorithm to find an optimal Hamilton circuit
31. Apply the cheapest-link algorithm to find an optimal Hamilton circuit
32. Define sub graph
33. Define a tree
34. State some properties of trees
35. Given a graph, determine if it is a tree
36. Define spanning tree
37. Define minimum spanning tree
38. Given a graph, find all possible spanning trees
39. Give a real world example that uses networks
40. Apply Kruskal's Algorithm to find a minimum spanning tree

Probability

1. Define an experiment, sample space, outcome, and event
2. Define permutations and combinations
3. Determine the probability of an event in an equiprobable space
4. Define the "odds in favor of an event"
5. Define the "odds against an event"
6. Given the probability of an event, find the odds in favor of the event
7. Given the probability of an event, find the odds against the event
8. Given the odds in favor of an event, find the probability of the event
9. Given the odds against an event, find the probability of the event
10. Determine probabilities using the multiplication rule
11. Explain events that are independent; determine probabilities using the multiplication rule for independent events.
12. Determine the number of permutations of n objects taken *r* at a time
13. Determine the number of combinations of n objects taken *r* at a time
14. Determine probabilities using counting techniques

Statistics

1. Define a population and the n-value of a population
2. Define a popular opinion poll
3. Explain sampling of data (convenience sampling, quota sampling, simple random sampling, and stratified sampling)
4. Understand and use the capture-recapture method for estimating the n-value of a population
5. Name two variables used in describing data
6. Given a set of data, construct a frequency table summarizing the information
7. Given a set of data, construct a bar graph to represent the data
8. Given a set of data, construct a relative frequency bar graph to represent the data
9. Given a set of data, construct a pie chart to represent relative frequencies
10. Given a set of data, group the data into class intervals
11. Given a set of data, find the mean
12. Given a set of data, find the median

13. Given a set of data, find the quartiles
14. Given a set of data, give the five number summary and box plot
15. Define a percentile and know how to find the *p*th percentile of a data set
16. Estimate the mean from grouped data
17. Given a set of data presented by a frequency distribution, find the mean
18. Given a set of data, find the range and interquartile range
19. Given a set of data, find the standard deviation
20. Given a set of data presented by a frequency distribution, find the standard deviation
21. Estimate the standard deviation from grouped data

Math in Nature

1. Define the Fibonacci numbers
2. Understand a recursive rule
3. Give examples of Fibonacci numbers in nature
4. Define the Golden Ratio
5. Understand how the Golden Ratio and Fibonacci numbers are related
6. Define a gnomon
7. Understand the golden rectangle and the Fibonacci rectangle
8. Give examples of spiral growth in nature

Final Course Grading Scale

Grade	Percentage
A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	lower than 60%

Faculty Commitment

Faculty members are committed to providing a quality learning experience through thoughtful planning, implementation, and assessment of course activities. They are also committed to being readily available to students throughout the semester by returning e-mails and phone calls within 48 hours and to returning graded course work within a week. Furthermore, they are committed to selecting appropriate course materials and making them available in an organized and timely manner.

Student Commitment

For every credit hour a student is enrolled in, they should expect to spend at least 2 hours outside of class studying, working on assignments, and preparing for class each week of the fifteen-week semester. For example, for this three credit-hour class, students can expect to spend three hours per week in class actively engaged in learning the material by participating in face-to-face classes or viewing lectures and instructional material online. In addition, students should expect to spend another six hours per week outside of class completing homework and assignments, posting to discussion boards online, or studying for quizzes and tests. This means students should spend a minimum of 9 hours per week engaged in achieving the learning outcomes for this course. If you are not achieving your desired results in this class, you should consider increasing your prep time outside of class, in addition to using available resources such as instructor office hours and tutoring services.

By registering for this course, you commit yourself to active participation in course activities as well as the submission of all assignments and exams on time. Furthermore, you commit to accessing the course site and checking your JJC e-mail several times a week.