

MTH 151 – Mathematics in Our World

Effective: Fall 2007

Course Objectives

1. Numbers in Our Lives

- 1.1. Give examples of identification numbers such as Social Security Numbers, Vehicle Identification Numbers, International Standard Book Numbers, and Universal Product Codes.
- 1.2. Determine the length of an identification number and if the number is numeric or alphanumeric.
- 1.3. Explain transmission errors and ways to avoid or minimize such errors.
- 1.4. Use the UPC check-digit scheme to determine the check digit, find a missing digit, and check the validity of a number.
- 1.5. Apply the division algorithm for whole numbers and integers to find the quotient and remainder of a given dividend. Use the appropriate notation to express the dividend in terms of its quotient and remainder.
- 1.6. Use the definition of congruence modulo m to verify congruences.
- 1.7. Illustrate and apply the arithmetic properties of congruence modulo m .
- 1.8. Use the mod 9 check-digit scheme to determine the check digit, find a missing digit, and check the validity of a number.
- 1.9. Identify a data coding system as a binary code.
- 1.10. Translate messages from English to Morse code and from Morse code to English.
- 1.11. Given a UPC bar code, determine the Universal Product Code.

2. Voting and Elections

- 2.1. Build a preference table given voters' ballots.
- 2.2. Given a preference table, find the majority winner (if one exists), the plurality winner, the Borda Count winner, the plurality with elimination winner, and the pairwise comparison winner.
- 2.3. Discuss the advantages and disadvantages of the majority method, the plurality method, the Borda Count method, the plurality with elimination method, and the pairwise comparison method.
- 2.4. Define the fairness criteria: the Majority criterion, the Head-to-head criterion, the Monotonicity criterion, and the Irrelevant-Alternatives criterion.
- 2.5. Given a preference table, determine if a fairness criterion has been violated.
- 2.6. Explain the implication of Arrow's impossibility theorem.

3. Routes and Networks

- 3.1. Identify any vertices, edges, loops, adjacent vertices, weights, paths, and circuits in a given graph.
- 3.2. Determine if a graph is connected.
- 3.3. Compute the degree of a vertex.
- 3.4. Sketch a graph from a map (road maps, neighborhoods, floor plans, etc.).
- 3.5. Explain the difference between a path and a circuit. Be able to give examples of a path and a circuit from a given graph.
- 3.6. Define and identify an Euler path and Euler circuit. Give a real-life illustration that requires the use of an Euler circuit.
- 3.7. Use Euler's Theorem to state if a graph has an Euler path, Euler circuit, or neither.
- 3.8. Use Fleury's algorithm to find an Euler path/Euler circuit for a given graph.
- 3.9. Sketch a weighted graph given any of the following: a map, table, or word problem.

- 3.10. Identify a subgraph, tree, and spanning tree.
- 3.11. Use Kruskal's algorithm to find the minimal spanning tree in a weighted graph.
- 3.12. Define and identify a Hamilton path and Hamilton circuit. Give a real-life illustration that requires the use of a Hamilton circuit.
- 3.13. Determine if a graph is complete. Compute the number of edges in a complete graph.
- 3.14. Compute the number of Hamilton paths in a complete graph.
- 3.15. Sketch a complete weighted graph given any of the following: a map, table, or word problem.
- 3.16. Solve a traveling salesperson problem by computing the cost of all possible Hamilton circuits.
- 3.17. Find an approximate solution to a traveling salesperson problem using the Nearest-Neighbor algorithm and the Cheapest-Link Algorithm.

4. Statistical Research Design and Display

- 4.1. Define and identify the elements, population, sample, qualitative (nominal and ordinal) variables, and quantitative variables in a given statistical study.
- 4.2. Explain the use of and need for a sample for statistical inference.
- 4.3. Define and be able to choose a simple random sample using a random number table or a random number generator.
- 4.4. Give reasons for using random sampling in statistical research.
- 4.5. Define bias and identify common sources of bias such as sampling errors, processing errors, and effects of question wording and survey format.
- 4.6. Discuss methods used to avoid or minimize bias.
- 4.7. Critically evaluate a media account or summary of a statistical study
- 4.8. Discuss the advantages and disadvantages of various types of graphs relative to a given data set.
- 4.9. Give examples of graphs which illustrate how choices of categories, scale, and visual design clarify or distort the data.