Marshall University

College of Science

Mathematics Department

# MTH 121: Concepts and Applications (CT)

**Course catalog description**

Critical thinking course for non-science majors that develops quantitative reasoning skills. Topics include logical thinking, problem-solving, linear modeling, beginning statistics and probability, exponential and logarithmic models, formula use, and financial concepts.

**Credit hours**

3 hours

**Prerequisites**

ACT Math 19 or MTH 099

***Critical thinking (CT) designator***

This course carries a CT designator, and students who complete the course receive 3 hours of CT credit towards their general education requirements.

**List of topics**

- Introduction to quantitative literacy
- Logical thinking
- Fallacies of relevance
- Fallacies of numbers and statistics
- Problem solving through unit analysis
- Problem solving strategies
- Systems of standardized units; rounding numbers
- Scientific notation, order of magnitude
- Scaling factors
- Uncertainty

- Applications in large numbers and unit analysis
- Relations; rates of change
- Linear equations; creating linear models
- Counting techniques
- Probability theory
- Expected valued and the binomial probability formula
- Statistics; graphings statistical data
- Measures of central tendency; normal distribution
- Sample issues in statistical research
- Exponential growth
- Applications of exponential models
- Using formulas
- Logarithmic scales
- Financial formulas

**Learner outcomes**

**Introduction**- Students will be able to:

- define quantitative literacy;
- recognize the importance of quantitative literacy in their lives;
- discuss several misconceptions about mathematics.

**Logical Thinking-** Students will be able to:

- know the difference between a deductive and inductive argument;
- be able to test if a deductive argument is valid or invalid;
- determine if a valid argument is sound or unsound.
- determine if an inductive argument is weak or strong;
- use truth tables to determine the truth value of a compound proposition;
- use Venn diagrams to determine the validity of a deductive argument.

**Fallacies of Relevance**- Students will be able to:

- define fallacy and recognize many different common fallacies.

**Fallacies of Number and Statistics**- Students should be able to:

- distinguish between necessary and sufficient cause;
- define and use the concepts of absolute and relative change.

**Problem Solving through Unit Analysis**- Students should be able to:

- use appropriate units to assist them in problem solving;
- apply Polya's four-step procedure for solving problems.

**Problem Solving Strategies-** Students should be able to:

- Students should recognize that not every problem can be solved using the four-step procedure;
- Students should be able to solve certain problems that they haven't seen before by carefully thinking them through.

**Systems of Standardized Units; Rounding Numbers**- Students should be able to:

- convert commonly used units from the US Customary System to the Metric System and vice versa;
- round numbers.

**Scientific Notation; Order of Magnitude**- Students should be able to:

- change large or small numbers to scientific notation;
- make simple estimates using the four-step procedure for problem solving;
- determine order of magnitude estimates.

**Scaling Factors**- Students should be able to

- measure a distance on a map or model and determine the actual distance or size using the given scale;
- put large numbers in perspective using different techniques.

**Uncertainty**- Students should be able to

- determine uncertainty ranges that derive from measurements and be able to state a level of confidence in the measurement;
- determine the number of significant digits for measurements and exact numbers;
- combine approximate numbers;
- interpret the graphs that are commonly found in weekly news magazines.

**Applications in Large Numbers and Unit Analysis-** Students should be able to:

- use the quantitative skills developed earlier to solve problems.

**Relations; Rates of Change**- Students should be able to:

- identify the independent and dependent variables in a relation;
- draw the graphs of relations and use relations as models of real world problems;
- determine the slope of a linear relation and be able to graph a linear relation.

**Linear Equations; Creating Linear Models-** Students should be able to:

- solve linear equations with numbers;
- solve literal linear equations;
- make a linear model from two or more data points.

**Counting Techniques**-Students should be able to:

- use the Multiplication Principle;
- compute the number of arrangements possible allowing repetition;
- compute simple permutations;
- compute simple combinations;
- know when to apply each idea.

**Probability Theory**- Students should be able to:

- compute probabilities for independent events, dependent events, mutually exclusive events, non-mutually exclusive events using a priori techniques.

**Expected Values and Binomial Probability Formula**-Students should be able to:

- compute the expected value;
- compute the probability of success in an experiment.

**Statistics; Graphing Statistical Data**- Students should be able to:

- explain the difference between inferential and descriptive statistics;
- interpret data from different types of graphs.

**Measure of Central Tendency; Normal Distribution**- Students should be able to:

- use the properties of the normal distribution and be able to decide if it is an appropriate model of given data;
- explain how standard deviation and margin of error relate to statistical surveys.

**Sample Issues in Statistical Research**- Students should be able to:

- recognize abuses of statistics after studying many examples.

**Exponential Growth**- Students should be able to:

- explain the difference between exponential growth and linear growth;
- explain why exponential growth cannot continue indefinitely in real world situations;
- solve and interpret doubling time and half-life problems.

**Applications of Exponential Models**- Students should be able to:

- use exponential growth and decay models to predict a quantity after any time t;

- use exponential growth and decay models to find the time t given the other variables;
- create models of exponential growth or decay from given data points.

**Using Formulas**- Students should be able to:

- use given formulas;
- tell if a formula makes sense when described in words or pictures;
- determine the correct units when manipulating a formula.

**Logarithmic Scales**- Students should be able to:

- give two examples of natural phenomena whose models are logarithmic;
- solve simple logarithmic equations;
- manipulate common logarithms.

**Financial Formulas**- Students should be able to:

- make a personal budget;
- compute compound interest for the discrete and continuous cases;
- compute the amount in a retirement account;
- compute the monthly car or house payments and understand how accelerating a loan will save on interest.

**Technology**

Students must have a calculator that can perform exponentiation (e.g. $x^y$).

**Suggested textbooks**

Bennett, *Using and Understanding Mathematics*, 5th edition, ISBN 978-0-321-65279-9

**Last updated**

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