Adult Basic Education (ABE)

Level III Mathematics

Mathematics 3101A

Set Theory/Counting Methods/Probability

Curriculum Guide

Resource: *Principles of Mathematics 12. Nelson. 2012. ISBN-13: 978-0-17-654038-8*

Level III Degree and Technical/Business-Related College Profiles Mathematics Courses (Academic)
Mathematics 1101A: Measurement/Trigonometry/Factors and Products
Mathematics 1101B: Roots and Powers/Relations and Functions
Mathematics 1101C: Linear Functions/Systems of Linear Equations
Mathematics 2101A: Reasoning/Angles and Triangles/Trigonometry
Mathematics 2101B: Radicals/Statistics/Quadratic Functions
Mathematics 2101C: Quadratic Equations/Proportional Reasoning
Mathematics 3101A: Set Theory/Counting Methods/Probability
Mathematics 3101B: Rational Expressions and Equations/Polynomial Functions/Exponential Functions
Mathematics 3101C: Logarithmic Functions/Sinusoidal Functions/Borrowing Money

Newfoundland Labrador

Contents

General Information

Introduction

Mathematics 3101A when completed with **Mathematics 3101B** and **C** is equivalent to the Newfoundland and Labrador senior high school **Mathematics 3201 (Academic**) course.

Pre-requisite

Students must have passed **Mathematics 2101C**.

Resources

The student resource for this course is*:*

- *Principles of Mathematics 12. Nelson. 2012. ISBN-13: 978-0-17-654038-8.*

The instructor resources for this course are:

- *Principles of Mathematics 12 Teacher's Resource. Nelson. 2012. ISBN-13: 978-0-17-654044-9.*
- *Principles of Mathematics 12 Teacher's Resource CD-ROM.*

Instructors may also supplement with other resources at their discretion.

Study Guide

The Study Guide provides the student with Required Work for the course. It guides the student through the course by assigning relevant reading and exercises from the student resource. Sometimes the Study Guide provides important points for students to think about, to remember or to note. The Study Guide is designed to give students some degree of independence in their work. There is information in the Curriculum Guide applicable to teaching, learning and assessment that is not included in the Study Guide. Instructors should review this information and decide how to use it when teaching students.

Instructors can also exercise professional judgment and make minor alterations to the Required Work in the Study Guide. For example, an instructor may decide that it is unnecessary to assign students all the exercises to complete within each lesson.

Curriculum Guide

The Curriculum Guide includes the specific curriculum outcomes and achievement indicators for the course. The specific curriculum outcomes are listed numerically, and the achievement outcomes are listed alphabetically. Suggestions for teaching, learning and assessment are also provided to support student achievement of the outcomes. Some of these suggestions will also be repeated in the curriculum guides for other mathematics courses as appropriate. The curriculum guide also states the pre-requisite for each Level III mathematics course.

Mathematics 3101A Outcomes/Achievement Indicators

Unit 1: Set Theory

1. Solve problems that involve the application of set theory.
    a) Provide examples of the empty set, disjoint sets, subsets and universal sets in context, and explain the reasoning.
    b) Organize information such as collected data and number properties, using graphic organizers, and explain the reasoning.
    c) Explain what a specified region in a Venn diagram represents, using connecting words (and, or, not) or set notation.
    d) Determine the elements in the complement, the intersection or the union of two sets.
    e) Solve a contextual problem that involves sets, and record the solution, using set notation.
    f) Identify and correct errors in a solution to a problem that involves sets.
    g) Explain how set theory is used in applications such as internet searches, database queries, data analysis, games, and puzzles.

Unit 2: Counting Methods

1. Solve problems that involve the Fundamental Counting Principal.
    a) Represent and solve counting problems, using a graphic organizer.
    b) Generalize, using inductive reasoning, the Fundamental Counting Principle.
    c) Identify and explain assumptions made in solving a counting problem.
    d) Solve a contextual counting problem using the Fundamental Counting Principle, and explain the reasoning.
2. Solve problems that involve permutations.
    a) Represent the number of arrangements of n elements taken n at a time, using factorial notation.
    b) Determine, with or without technology, the value of a factorial.
    c) Simplify a numeric or an algebraic fraction that contains factorials in both the numerator and the denominator.
    d) Solve an equation that involves factorials.
    e) Determine the number of permutations of n elements taken r at a time.
    f) Generalize strategies for determining the number of permutations of n elements taken r at a time.
    g) Determine the number of permutations of n elements taken n at a time where some elements are not distinct.
    h) Explain, using examples, the effect on the total number of permutations of n elements when two or more elements are identical.
3. Solve problems that involve combinations.
    a) Explain, using examples, why order is or is not important when solving problems that involve permutations or combinations.
    b) Determine the number of combinations of n elements taken r at a time.
    c) Generalize strategies for determining the number of combinations of n elements taken r at a time.
    d) Solve an equation that involves factorials.

e) Solve a contextual problem that involves combinations and probability.

Unit 3: Probability

1. Interpret and assess the validity of odds and probability statements.
    a) Provide examples of statements of probability and odds found in fields such as media, biology, sports, medicine, sociology and psychology.
    b) Explain, using examples, the relationship between odds (part-part) and probability (part-whole).
    c) Determine the probability of, or the odds for and against, an outcome in a situation.
    d) Express odds as a probability and vice versa.
    e) Solve a contextual problem that involves odds or probability.
    f) Explain, using examples, how decisions may be based on probability or odds and on subjective judgments.
2. Solve problems that involve permutations and combinations.
    a) Solve a contextual problem that involves probability and permutations.
    b) Solve a contextual problem that involves probability and combinations.
3. Solve problems that involve the probability of mutually exclusive and non-mutually exclusive events.
    a) Classify events as mutually exclusive or non-mutually exclusive, and explain the reasoning.
    b) Determine if two events are complementary, and explain the reasoning.
    c) Represent, using set notation or graphic organizers, mutually exclusive (including complementary) and non-mutually exclusive events.

d) Solve a contextual problem that involves the probability of mutually exclusive (including complementary) or non-mutually exclusive events.
e) Create and solve a problem that involves mutually exclusive or non-mutually exclusive events.

4. Solve problems that involve the probability of two events.
   a) Compare, using examples, dependent and independent events.
   b) Determine the probability of two independent events.
   c) Determine the probability of an event, given the occurrence of a previous event.
   d) Create a contextual problem that involves determining the probability of dependent or independent events.

Recommended Evaluation

Written Notes (Including all the Required Work)	10%
Assignments	20%
Tests	20%
Final Exam (entire course)	50%
Total	**100%**

Instructors have the discretion to make minor changes to this evaluation scheme.

Unit 1: Set Theory—Suggestions for Teaching and Learning

- In this unit, students will arrange information into sets and subsets. Venn diagrams will be used to illustrate relationships between sets and subsets and set notation will be used to describe sets.
- Discuss with students that sets are a mathematical way to represent a group of elements (numbers, books, music collections, etc.).
- Discuss with students that the number of elements in a set A is denoted by n(A).
- Discuss the following types of sets with students: universal set, subset, empty set, disjoint set and complement of a set.
- Discuss with students that Venn diagrams are used to organize elements into sets.
- Discuss the different regions of a Venn diagram and introduce students to the intersection and union of sets by using symbols and words.
- Ensure that students are able to construct an appropriate Venn diagram where given set notation.
- Ensure that students understand the *principal of inclusion and exclusion*.
- Discuss with students that a very common error occurs when students do not take into account the overlapping region of different sets.

Unit 1: Set Theory—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
- Instructors have discretion to combine the last unit test with the final exam if beneficial to the student.
- Students must pass the final exam with a minimum grade of 50% to receive credit for this course.
- Instructors should encourage students to reflect on the math concepts in this unit to relate to everyday life.
- Instructors should engage students in discussions to verbalize student thinking on the math concepts.
- Instructors should require students to always show complete calculations with correct units when relevant.
- Instructors can use their own professional judgment to design assessment tools (additional exercises, word problems, assignments, reflections, math journals, etc.) to meet individual student needs.

Unit 2: Counting Methods—Suggestions for Teaching and Learning

- In this unit students will solve counting problems that involve the *Fundamental Counting Principle*, permutations and combinations.
- Ensure students understand that the *Fundamental Counting Principle* is a means to find the number of ways of performing two or more operations together.
- Discuss with students that "And" implies multiplication and the use of the *Fundamental Counting Principle* and "Or" implies addition and the use of the *principle of inclusion and exclusion*, depending on whether the tasks are mutually exclusive or not.
- Discuss with students that problems involving the fundamental counting principle sometimes contains restrictions. For example, when arranging items, a particular position must be occupied by a particular item.
- Ensure students understand factorial notation and how it relates to the concept of permutation.
- Discuss with students examples where numbers must be used in specific sequence (order is important), such as a combination lock.
- Ensure that students understand that permutations are an ordered arrangement of all a part of a set.
- Ensure students understand that when working with permutations, it is important to make the connection to the *Fundamental Counting Principal* and factorial notation n!
- Ensure students are able to simplify factorial expressions.

Unit 2: Counting Methods—Suggestions for Teaching and Learning

- Ensure students understand how to solve algebraic equations that involve factorial notation.
- Ensure students understand that when working with permutation formula, it is important to use factorial notation and common factors.
- Discuss with students problems where only some of the objects are used in each arrangement (i.e., arranging a subset of items).
- Ensure that students are able to solve problems where arrangements are created with and without repetition.
- Discuss with students that permutation problems sometimes involve conditions when certain items are to be kept together. Treat the joined items as if they were only one object.
- Discuss with students that combinations are an arrangement of objects without regard to order.

Unit 2: Counting Methods—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
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- Instructors should require students to always show complete calculations with correct units when relevant.
- Instructors can use their own professional judgment to design assessment tools (additional exercises, word problems, assignments, reflections, math journals, etc.) to meet individual student needs.

Unit 3: Probability—Suggestions for Teaching and Learning

- In this unit, students will distinguish between probability and odds. They will calculate probability and odds, and use this information to make decisions.
- Discuss with students that statements about probability and odds are often referred in media and texts such as newspaper, magazines, websites and television. Probability statements may relate to political polls, games of chance, sports and statistics.
- Discuss with students that the probability of an event is the ratio of favorable outcomes to the total possible outcomes.
- Discuss with students the difference between odds for and odds against. Odds of an event show the ratio of favorable outcomes to unfavorable outcomes. Odds against is the reciprocal of finding odds in favor of an even occurring.
- Discuss with students that all odds and probability calculations begin with two of three values: total possibilities, favorable outcomes and non-favorable outcomes.
- Ensure that students understand how to solve a contextual problem that involves probability and permutations.
- Ensure that students understand how to solve a contextual problem that involves probability and combinations.

Unit 3: Probability—Suggestions for Teaching and Learning

- Discuss with students the use of *set theory* to the study of *probability theory*. Students can use Venn diagrams for illustrating unions and intersections of sets.
- Encourage students to discuss their own examples that involve determining the probability of two mutually exclusive or non-mutually exclusive events.
- Use numerical examples with students to discuss why the sum of the probability of an event and its compliment equal 1.
- Ensure that students are able to distinguish independent and dependent events; and use this information when determining if one event will affect the probable outcome of the other.
- Ensure that students are able to analyze different events and judge whether the outcome of the first event has an effect on the probability of the second event occurring.
- Ensure that students can determine the probability of two dependent events by multiplying their individual probabilities.

Unit 3: Probability—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
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