Adult Basic Education (ABE)

Level III Mathematics

Mathematics 2101B

Radicals/Statistics/Quadratic Functions

Curriculum Guide

Student Resource: *Principles of Mathematics 11. Nelson. 2011. ISBN-13: 978-0-17-650412-0.*

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

Contents

General Information

Introduction

Mathematics 2101B when completed with **Mathematics 2101A** and **C** is equivalent to the Newfoundland and Labrador senior high school **Mathematics 2201 (Academic**) course.

Pre-requisite

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

Resources

The student resource for this course is*:*

- *Principles of Mathematics 11. Nelson. 2011. ISBN-13: 978-0-17-650412-0.*

The instructor resources for this course are:

- *Principles of Mathematics 11. Nelson. 2011. ISBN-13: 978-0-17-651402-0.*
- *Principles of Mathematics 11 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 indicators 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 2101B Outcomes/Achievement Indicators

Unit 1: Radicals

1. Solve problems that involve operations on radicals and radical expressions with numerical and variable radicands (limited to square roots).
    a) Express a mixed radical with a numerical radicand as an entire radical.
    b) Compare and order radical expressions with numerical radicands.
    c) Express an entire radical with a numerical radicand as a mixed radical.
    d) Identify values of the variable for which the radical expression is defined.
    e) Express an entire radical with a variable radicand as a mixed radical.
    f) Perform one or more operations to simplify radical expressions with numerical or variable radicands.
    g) Rationalize the monomial denominator of a radical expression.
2. Solve problems that involve radical equations (limited to square roots).
    a) Determine any restrictions on values for the variable in a radical equation.
    b) Determine, algebraically, the roots of a radical equation, and explain the process used to solve the equation.
    c) Verify, by substitution that the values determined in solving a radical equation are roots of the equation.
    d) Explain why some roots determined in solving a radical equation are extraneous.
    e) Solve problems by modelling a situation with a radical equation and solving the equation.

Unit 2: Statistics

1. Demonstrate an understanding of normal distribution, including standard deviation and z-scores.
    a) Use dispersion to describe the differences between two sets of data.
    b) Create frequency tables and graphs from sets of data.
    c) Explain, using examples, the meaning of standard deviation.
    d) Calculate, using technology the population standard deviation of a data set.
    e) Solve a contextual problem that involves the interpretation of standard deviation.
    f) Explain, using examples, the properties of a normal curve, including the mean, median, mode, standard deviation, symmetry and the area under the curve.
    g) Determine if a data set approximates a normal distribution and explain the reasoning.
    h) Compare the properties of two or more normally distributed data sets.
    i) Solve a contextual problem that involves normal distribution.
    j) Determine, with or without technology, and explain the z-score for a given value in a normally distributed data set.
    k) Explain, using examples representing multiple perspectives the application of standard deviation for making decisions in situations such as warranties, insurance or opinion polls.
2. Interpret statistical data, using: confidence intervals, confidence levels, and margin of error.
    a) Explain, using examples, the significance of a confidence interval, margin of error or confidence level.
    b) Explain, using examples, how confidence levels, margin of error and confidence intervals may vary depending on the size of the random sample.
    c) Make inferences about a population from a sample data, using confidence intervals, and explain the reasoning.

d) Provide examples from print or electronic media in which confidence intervals and confidence levels are used to support a particular position.
e) Interpret and explain confidence intervals and margin of error, using examples found in print or electronic media.
f) Support a position by analyzing statistical data presented in the media.

Unit 3: Quadratic Functions

1. Demonstrate an understanding of the characteristics of quadratic functions, including: vertex, intercepts, domain and range, and axis of symmetry.
    a) Determine the characteristics of a quadratic function (y= $ax^2 + bx^2 + c$, a≠0) through manipulation of the parameters a, b, and c.
    b) Determine, with or without technology, the coordinates of the vertex of the graph of a quadratic function.
    c) Determine the coordinates of the vertex of the graph of a quadratic function, given the equation of the function and the axis of symmetry, and determine if the y-coordinate of the vertex is a maximum or a minimum value.
    d) Determine the equation of the axis of symmetry of the graph of a quadratic function using the x-intercepts of the graph.
    e) Sketch the graph of a quadratic function.
    f) Determine the domain and range of a quadratic function.
2. Solve problems that involve quadratic equations.
    a) Determine, with or without technology, the intercepts of the graph of a quadratic function.
    b) Express a quadratic equation in a factored form, given the zeroes of the corresponding quadratic function or the x-intercepts of the graph of the function.
    c) Determine the quadratic function given the characteristics of its graph.
    d) Solve a contextual problem that involves the characteristics of a quadratic function.

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: Radicals—Suggestions for Teaching and Learning

- Ensure that students can simplify radicals with numerical and variable radicands, and then perform operations with numerical and variable radicands.
- Ensure that students understand that every positive number has two roots.
- Ensure students understand absolute value notation and what it represents.
- Ensure that students understand the difference when an exponent is even and when it's odd in a polynomial expression.
- Ensure that students understand radicals containing numerical radicands and coefficients before moving on to radicals containing variables.
- Ensure that students understand that adding and subtracting radical expressions is comparable to combining variable expressions with like terms.
- Ensure that students understand that the distributive property can also be used when simplifying sums and differences of radical expressions.
- Ensure that students understand that even when adding or subtracting radicals, the solution can require further simplifying.
- Ensure that students understand how to multiply and divide radicals beginning with numerical radicals.
- Advise students that they are less likely to make simplifications even if they simplify radicals before multiplying.
- Ensure students understand how to analyze solutions that contain errors; e.g., when multiplying radical expressions, students sometimes incorrectly apply the distributive property and/or the order of operations.
- Ensure students understand how to rationalize denominators containing radicals.
- Ensure students are able to solve radical equations involving a single radical equation involving a single radical expression containing variables that are first degree.

Unit 1: Radicals—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: Statistics—Suggestions for Teaching and Learning

- Discuss with students situations where the measures of central tendency are not always sufficient to represent or compare sets of data.
- Introduce frequency distribution as a set of intervals that can be displayed as these forms: a table, a histogram and a frequency polygon.
- Discuss with students that histograms and frequency polygons provide a pictorial representation of the data. This provides an opportunity for students to draw conclusions and make inferences from the data.
- Discuss with students that frequency polygons are especially helpful when comparing multiple sets of data because they can be graphed on top of each other.
- Discuss with students that there are no gaps between the bars in a histogram, where there are such gaps in a bar graph.
- Ensure that students understand how to calculate standard deviation using technology such as scientific calculators, graphing calculators or computer programs.
- Discuss with students that in many situations, if a controlled experiment is repeated and the data is collected to create a histogram, the histogram becomes bell-shaped as the number of data in the distribution increases.
- Students should understand the following characteristics of a normal distribution curve:
    1. Normal distribution are symmetrical with a single peak at the mean of the data, and
    2. The curve is bell shaped with the graph falling off evenly on either side of the mean.
- Ensure students understand that in a normal distribution the data is symmetrical about the mean and since the mean lies in the middle of the data, it is also the median.
- Ensure that the students understand that the mean in a normal distribution is located when the curve is at its highest point and is also the mode.
- Ensure students understand that in a manual distribution, the mean, median and mode are equal for normal distribution.

Unit 2: Statistics—Suggestions for Teaching and Learning

- Ensure that students understand that in a normal distribution, 50% of the distribution lies to the left of the mean and 50 % lies to the right of the mean, 95% is within two SD of the mean and 99.7% is within three SD of the mean.
- Ensure that students understand if a data set approximates a normal distribution and are able to explain their reasoning.
- Ensure that students understand how z-scores can be used to solve statistical problems and how to use the z-score formula.
- Discuss with students how SD is used in real-life scenarios such as length of warranties, cost of insurance, quality control and opinion polls.
- Discuss with students that an entire population is often difficult to study. A statistician uses a representative population called a sample.
- Discuss with students that surveys are used to draw conclusions from a sample. How well the sample represents the larger population depends on two factors:
    1. The margin of error, and
    2. The confidence error.
- Discuss with students that the sample size of a random sample will affect confidence interval and margin of error. An increase in the sample size would decrease the margin of error and would decrease the range on the confidence interval, thereby getting closer to the actual result. If the entire population were surveyed, theoretically, there should be no actual margin of error.
- Discuss with students that there are many examples from newspapers and the internet, such as quality control or public opinion polls, in which confidence intervals, coefficient levels, and margin of errors are used.
- Discuss with students how interpreting and analyzing statistical data can be used to form an opinion on a topic.

Unit 2: Statistics—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
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- Students must pass the final exam with a minimum grade of 50% to receive credit for this course.
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- 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 3: Quadratic Functions—Suggestions for Teaching and Learning

- Discuss with students the concept of degree of polynomials.
- Ensure that students understand how to factor differences of squares, perfect square trinomials and polynomials of the form x^2+bx+c and ax^2+bx+c.
- Students will study quadratic functions expressed in the following form in this unit: standard form, factorial form, and vertex form.
- Discuss with students how projectile motion can be used to explain the path of a baseball or a skier in flight and that this motion can be represented mathematically as a quadratic equation.
- Discuss with students the characteristics of a parabola, including the mirror image of points, the vertex, the axis and etc.
- Discuss with students the quadratic term, linear term and constant term of a quadratic equation. Ensure students understand the term "coefficient."
- Ensure students understand the effects of changing the values of a, b, and c in a quadratic function. ($f(x)=ax^2+bx+c$)
- Ensure that students understand how to determine the coordinates of the vertex of a quadratic function with and without technology.
- Ensure that students understand how to use a graphing calculator and/or FX Draw to identify the coordinates of the vertex, direction of opening, and the x and y-intercepts.
- Ensure students understand how to create a table of values to graph a quadratic function. Students should be able to recognize from a table of values the point at which the parabola changes direction.
- Ensure that students understand the axis of symmetry.
- Ensure the students understand how to use the formula $x=-b/2a$ to find the x-coordinate of the vertex for the quadratic functions of the form $y=ax^2+bx+c$. This value can then be used to determine the equation of the axis of symmetry.
- Discuss with students that the vertex can be either a maximum or minimum point depending if the quadratic function is positive or negative.
- Encourage students to think about what the graph of the quadratic function should look like before actually sketching the graph.

Unit 3: Quadratic Functions—Suggestions for Teaching and Learning

- Ensure the students are able to determine the domain and range of the quadratic function.
- Ensure that students are able to use factoring to determine the zeroes of a quadratic function, and that they understand the zero product property.
- Discuss with the students that whether the quadratic equation is written in standard form or factored form, once the x-intercepts are determined, the vertex and y-intercept can be found. Using this information, students can graph the quadratic function.
- Ensure the students understand how quadratic equation can be translated vertically and horizontally by changing the values of k and h when given in an equation written in vertex form, $y=a(x-h)^2+k$.
- Discuss with students how these translations affect the vertex (h,k).
- Ensure that students are able to determine the quadratic function given the vertex and an additional point on the parabola.

Unit 3: Quadratic Functions—Suggestions for Assessment

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