TRUMBULL PUBLIC SCHOOLS
Trumbull, Connecticut

Practical Applications in Mathematics
Grades 11-12
Mathematics Department
2021

Curriculum Writing Team

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Practical Application in Mathematics
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The Trumbull Board of Education will continue to take Affirmative Action to ensure that no persons are discriminated against in its employment.

CORE VALUES AND BELIEFS

The Trumbull High School community engages in an environment conducive to learning which believes that all students will **read** and **write effectively**, therefore communicating in an articulate and coherent manner. All students will participate in activities **that present problem-solving through critical thinking**. Students will use technology as a tool applying it to decision making. We believe that by fostering self-confidence, self-directed and student-centered activities, we will promote **independent thinkers and learners**. We believe **ethical conduct** to be paramount in sustaining the welcoming school climate that we presently enjoy.

Approved 8/26/2011

INTRODUCTION & PHILOSOPHY

The primary goal of Practical Applications in Mathematics is to have students apply mathematical concepts to solve real-world problems. The students will build upon previous mathematical knowledge learned in Algebra II and apply these skills in future situations such as car loans, installment buying,mortgages, and statistics. Practical Applications in Mathematics provides an alternative senior mathematics course for students who do not intend to study calculus in college. This course reinforces necessary math skills and introduces new topics to prepare them adequately not only for college, but for real-world situations.

Topics covered in this course include: personal loans, simple and compound interest, installment buying, investing in annuities, mortgages, and statistics. Each of these topics will be explored and students will be applying skills learned in these units to solve problems involving real-world data.

Practical Applications in Mathematics is designed to prepare students with an understanding of complex mathematics they will inevitably deal with in everyday life. Students will be given instruction in reading and writing the notation, as well as vocabulary, associated with the various topics. Particular attention will be given to the understanding of the processes involved and the students' ability to communicate these procedures both orally and in written form.

COURSE GOALS

The following Course Goals derive from the 2010 Connecticut Core Standards for Mathematical Practice, which describe varieties of expertise that all teachers of mathematics will develop in their students. These practices rest on important "processes and proficiencies" that have long been valued in mathematics education.

At the completion of this course, students will:

 1. Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary.

2. Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize – to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents – and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects

3. Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and – if there is a flaw in an argument – explain what it is.

4. Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or

course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and the tools' limitations.

6. Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, expressing numerical answers with a degree of precision appropriate for the problem context.

7. Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

8. Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

The following Course Goals derive from the 2016 International Society for Technology in Education Standards.

Standard 5: Computational Thinker
Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

       5b. Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision making.
       5c. Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem solving.

COURSE ENDURING UNDERSTANDINGS
Students will understand that...
- Paying for something with a loan has an added cost
- Interest can help in investing toward long-term goals
- There are financial obligations to consider prior to and after obtaining a home loan
- Statistics can be valuable, but also misinterpreted

COURSE ESSENTIAL QUESTIONS
- How can calculating interest help in planning for the future?
- How can statistics help inform the decisions we make?

COURSE KNOWLEDGE & SKILLS

Students will know…
- The difference between simple and compound interest
- That buying with a loan changes the total cost
- The costs involved in purchasing a home
- The breakdown of monthly loan payments to principal and interest
- The methods of sampling in statistics
- How to utilize graphs and central tendency in statistics

Students will be able to…
- Calculate simple and compound interest
- Calculate percentage yield and present value
- Determine the finance charge of an installment loan
- Compare total cost using different methods for calculating finance charge
- Calculate monthly payments to principal and interest
- Calculate the total interest paid on a mortgage
- Determine if a sample is biased and if statistics are being misused
- Construct a variety of graphs to display statistical data

COURSE SYLLABUS

Course Name: Practical Applications in Mathematics

Course Level: College Preparatory/Advanced College Preparatory

Prerequisites:
Students enrolled in Practical Applications in Mathematics should have successfully completed Advanced College Preparatory Algebra II with a B+or better or College Preparatory Algebra II with a teacher recommendation.

General Description of Course Content:
Practical Applications in Mathematics is a course designed for students who have completed Algebra II and are not planning to take calculus in college. It is designed as preparation for the first year of non-calculus college math courses. Students will learn about the following topics: personal loans, simple and compound interest, installment buying, mortgages, and statistics. Real world applications and connections between topics are stressed. This class is intended for students who have not taken PreCalculus.

Assessment:
Students are evaluated by their performance on classroom problem sets, journal tasks, tests, quizzes, projects, and departmental midyear and final exams.

Text and Supplementary Materials:
1. A Survey of Mathematics with Applications, Pearson Education, Inc., by Angel, Abbott, and Runde, 2009.
2. TI-84 plus calculators
3. Microsoft Word, Excel

UNIT 1
Personal Loans, Simple and Compound Interest

Unit Goals

At the completion of this unit, students will:
1. Be able to calculate real world percent problems.
2. Calculate the simple interest on a personal loan and the cost of obtaining a personal loan.
3. Determine the difference between simple and compound interest.
4. Calculate compound interest and show how it can be used to help with investing for some long-term goals.

Unit Essential Questions
How can mathematical analysis help while making important financial decisions?

Focus Questions:
1. How is percent change calculated?
2. How is percent markup used in solving real world problems?
3. How is the simple interest formula calculated?
4. How is the simple interest formula used to solve problems?
5. What is the difference between simple and compound interest?
6. What is the Annual Percentage Yield?
7. What is the present value and how it is calculated?
8. How is the compound interest formula used to solve real world problems?

Scope and Sequence

1. Calculate simple interest
2. Solve problems using the concept of percent change
3. Calculate the percent markup within a real world problem
4. Define the vocabulary used with respect to simple and compound interest
5. Calculate compound interest
6. Determine the annual percentage yield
7. Calculate present value

Assured Assessments
Homework, Classwork Problem Sets, Quizzes, and a Unit Test.

Resources
 Core- Textbook: A Survey of Mathematics with Applications, Pearson Addison Wesley, by
Allen R. Angel, Christine D. Abbot, Dennis C. Runde
TI-84 Graphing calculator
Teacher resource package

Time Allotment

- Approximately 10 days

Unit 2
Installment Buying, Ordinary Annuities and Retirement Investing

Unit Goals

At the completion of this unit, students will:

1. Be able to calculate the finance charge on an installment loan.
2. Be able to determine the Annual Percentage Rate given they know the monthly payment.
3. Be able to calculate the savings on the finance charge if the loan is paid off early.
4. Calculate the monthly payment on a credit card using either the unpaid balance method or the average daily balance method.
5. Calculate the amount of money saved over a period of time by investing in an Ordinary Annuity or a Sinking fund.

Unit Essential Questions
What is the actual cost of a loan?

Focus Questions:
1. How does the interest rate affect the true cost of the loan?
2. What is the actual price of an item bought on an installment plan?
3. What is the annual percentage rate (APR)?
4. What is a finance charge and how is it calculated?

5. What are the two methods used to determine the finance charge and how do they differ?
6. What is an open-end installment loan?
7. What is the unpaid balance method for calculating finance charge?
8. What is the average daily balance method for calculating a finance charge?
9. How can the understanding of installment help in the real world?
10. What is the difference between an ordinary annuity and a sinking fund?
11. Why does saving money on a regular basis lead to a comfortable retirement?

Scope and Sequence
1. Determine the finance charge on installment buying using a variety of methods and conditions.
2. Use the vocabulary associated with installment buying.
3. Understand how the down payment affects the total cost of the loan.
4. Use different methods to calculate the finance charge on open installment loans.
5. Use the Actuarial method to find the unearned interest when a loan is paid off early.
6. Use the two methods of saving for retirement by investing in an Ordinary Annuity and a Sink Fund.

Assured Assessments
Homework, Classwork Problem Sets, Quizzes, and a Unit Test.

Resources
 Core- Textbook: A Survey of Mathematics with Applications, Pearson Addison Wesley, by Allen R. Angel, Christine D. Abbot, Dennis C. Runde
TI-84 Graphing calculator
Teacher resource package

Time Allotment

15 days

Unit 3
Mortgages

Unit goals
At the completion of this unit, students will:
1. Understand how to qualify for a mortgage and read a credit report.
2. Calculate the monthly payment of a conventional mortgage or a variable mortgage.
3. Create a budget for all the expenses of owning a home and all the expenses that go along with it.
4. Buy a house (virtually).

Unit Essential Questions
How much money are you really paying for that house?

Focus Questions:
1. How does the amount of a down payment affect the total cost of the mortgage?
2. What is the difference between an adjustable rate loan and a conventional loan?
3. What are points?
4. How do points affect the total cost of the amount mortgaged?
5. What is the adjusted monthly income?
6. How do I calculate my take home pay?
7. How does the bank determine if you qualify for a loan?
8. How much of your monthly mortgage payment goes to interest versus principal?
9. What is the process of buying a house?
10. How do I calculate a monthly budget with my take home pay?

Scope and Sequence

1. Use vocabulary associated with mortgages.
2. Know the difference between conventional loans and adjustable rate loans.
3. Read a credit report and understand what the number means.
4. Determine how to qualify for a mortgage.
5. Calculate the monthly payment on a mortgage.
6. Calculate the total cost of a house after the mortgage is paid off.
7. Determine the amount of principal and interest on the first payment of a mortgage.
8. Home Buying Project. (See Supplement)

Assured Assessments
Homework, Classwork Problem Sets, Quizzes, and a Unit Test.

Resources

Core- Textbook: A Survey of Mathematics with Applications, Pearson Addison Wesley, by Allen R. Angel, Christine D. Abbot, Dennis C. Runde
TI-84 Graphing calculator
Teacher resource package

Supplement

The Home Buying Project is in the common drive under the Mathematics folder.

Time Allotment

18 days

Unit 4
Statistics

Unit Goals
The following Unit Goals align with the 2010 Connecticut Core Standards for Mathematics.

At the completion of this unit, students will:
Understand and evaluate random processes underlying statistical experiments
CCSS.MATH.CONTENT.HSS.IC.A.1
Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
CCSS.MATH.CONTENT.HSS.IC.A.2
Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
Make inferences and justify conclusions from sample surveys, experiments, and observational studies
CCSS.MATH.CONTENT.HSS.IC.B.3
Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
CCSS.MATH.CONTENT.HSS.IC.B.4
Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
CCSS.MATH.CONTENT.HSS.IC.B.6
Evaluate reports based on data.
Summarize, represent, and interpret data on a single count or measurement variable
CCSS.MATH.CONTENT.HSS.ID.A.1
Represent data with plots on the real number line (histograms, and box plots).
CCSS.MATH.CONTENT.HSS.ID.A.2
Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
CCSS.MATH.CONTENT.HSS.ID.A.3

Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
CCSS.MATH.CONTENT.HSS.ID.A.4
Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Unit Essential Questions
How are statistics used to make informed decisions?

Focus questions:
1. What are the methods of sampling?
2. How can the misuses of statistics be identified?
3. What is a frequency distribution?
4. What are the upper class and lower class limits?
5. How is the class width calculated?
6. What are the different statistical graphs?
7. How are the measures of central tendency calculated?
8. What are percentiles and quartiles?
9. What are measures of dispersion?
10. How do you find the percent of data that falls below a particular piece of data in the set of data?

Scope and Sequence

1. Distinguish between the different methods of sampling.
2. Explore the misuses of statistics.
3. Construct a frequency distribution.
4. Determine the class width and class limits of a set of data.
5. Construct a histogram, circle graph, frequency polygon and a stem and leaf display.
6. Calculate the measures of central tendency and which measure best represents the data being studied.
7. Find the percentiles and quartiles.
8. Calculate the standard deviation.
9. Find the percent of data that falls underneath the normal curve.

Assured Assessments
Homework, Classwork Problem Sets, Quizzes, and a Unit Test.

Resources
 Core- Textbook: A Survey of Mathematics with Applications, Pearson Addison Wesley, by Allen R. Angel, Christine D. Abbot, Dennis C. Runde
TI-84 Graphing calculator
Teacher resource package

Supplement

Create a survey, pick a sampling plan, use excel to create a frequency distribution and a circle graph.

Time Allotment
40 days

COURSE CREDIT
One-half credit in Mathematics

One class period daily for a half a year

PREREQUISITES
Successful completion of ACP Algebra II of Honors Algebra II, or a B+ or higher in CP Algebra II with teacher recommendation

TEXT
A Survey of Mathematics with Applications, Pearson Addison Wesley, by Allen R. Angel, Christine D. Abbot, Dennis C. Runde

SUPPLEMENTARY MATERIALS/RESOURCES/TECHNOLOGY
Department and teacher prepared materials
TI-84 Plus graphing calculators

CURRENT REFERENCES
2010 Connecticut Core Standards for Mathematics

http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf

ASSURED STUDENT PERFORMANCE RUBRICS (see pages 14-16)

Rubric 2: Write Effectively

Category/ Weight	Exemplary 4 Student work:	Goal 3 Student work:	Working Toward Goal 2 Student work:	Needs Support 1-0 Student work:
Purpose X_____	• Establishes and maintains a clear purpose • Demonstrates an insightful understanding of audience and task	• Establishes and maintains a purpose • Demonstrates an accurate awareness of audience and task	• Establishes a purpose • Demonstrates an awareness of audience and task	• Does not establish a clear purpose • Demonstrates limited/no awareness of audience and task
Organization X_____	• Reflects sophisticated organization throughout • Demonstrates logical progression of ideas • Maintains a clear focus • Utilizes effective transitions	• Reflects organization throughout • Demonstrates logical progression of ideas • Maintains a focus • Utilizes transitions	• Reflects some organization throughout • Demonstrates logical progression of ideas at times • Maintains a vague focus • May utilize some ineffective transitions	• Reflects little/no organization • Lacks logical progression of ideas • Maintains little/no focus • Utilizes ineffective or no transitions
Content X_____	• Is accurate, explicit, and vivid • Exhibits ideas that are highly developed and enhanced by specific details and examples	• Is accurate and relevant • Exhibits ideas that are developed and supported by details and examples	• May contain some inaccuracies • Exhibits ideas that are partially supported by details and examples	• Is inaccurate and unclear • Exhibits limited/no ideas supported by specific details and examples
Use of Language X_____	• Demonstrates excellent use of language • Demonstrates a highly effective use of standard writing that enhances communication • Contains few or no errors. Errors do not detract from meaning	• Demonstrates competent use of language • Demonstrates effective use of standard writing conventions • Contains few errors. Most errors do not detract from meaning	• Demonstrates use of language • Demonstrates use of standard writing conventions • Contains errors that detract from meaning	• Demonstrates limited competency in use of language • Demonstrates limited use of standard writing conventions • Contains errors that make it difficult to determine meaning

Rubric 3: Problem Solving through Critical Thinking

Category/Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Understanding X_____	Student demonstrates clear understanding of the problem and the complexities of the task	Student demonstrates sufficient understanding of the problem and most of the complexities of the task	Student demonstrates some understanding of the problem but requires assistance to complete the task	Student demonstrates limited or no understanding of the fundamental problem after assistance with the task
Research X_____	Student gathers compelling information from multiple sources including digital, print, and interpersonal	Student gathers sufficient information from multiple sources including digital, print, and interpersonal	Student gathers some information from few sources including digital, print, and interpersonal	Student gathers limited or no information
Reasoning and Strategies X_____	Student demonstrates strong critical thinking skills to develop a comprehensive plan integrating multiple strategies	Student demonstrates sufficient critical thinking skills to develop a cohesive plan integrating strategies	Student demonstrates some critical thinking skills to develop a plan integrating some strategies	Student demonstrates limited or no critical thinking skills and no plan
Final Product and/or Presentation X_____	Solution shows deep understanding of the problem and its components. Solution shows extensive use of 21st Century Technology Skills.	Solution shows sufficient understanding of the problem and its components. Solution shows sufficient use of 21st Century Technology Skills.	Solution shows some understanding of the problem and its components. Solution shows some use of 21st Century Technology Skills.	Solution shows limited or no understanding of the problem and its components. Solution shows limited or no use of 21st Century Technology Skills.

Rubric 5: Independent Learners And Thinkers

Category/Weight	Exemplary 4	Goal 3	Working Toward Goal 2	Needs Support 1-0
Proposal X_____	Student demonstrates a strong sense of initiative by generating compelling questions, creating uniquely original projects/work.	Student demonstrates initiative by generating appropriate questions, creating original projects/work.	Student demonstrates some initiative by generating questions, creating appropriate projects/work.	Student demonstrates limited or no initiative by generating few questions and creating projects/work.
Independent Research & Development X_____	Student is analytical, insightful, and works independently to reach a solution.	Student is analytical, and works productively to reach a solution.	Student reaches a solution with direction.	Student is unable to reach a solution without consistent assistance.
Presentation of Finished Product X_____	Presentation shows compelling evidence of an independent learner and thinker. Solution shows deep understanding of the problem and its components. Solution shows extensive and appropriate application of 21st Century Skills.	Presentation shows clear evidence of an independent learner and thinker. Solution shows adequate understanding of the problem and its components. Solution shows adequate application of 21st Century Skills.	Presentation shows some evidence of an independent learner and thinker. Solution shows some understanding of the problem and its components. Solution shows some application of 21st Century Skills.	Presentation shows limited or no evidence of an independent learner and thinker. Solution shows limited or no understanding of the problem. Solution shows limited or no application of 21st Century Skills.