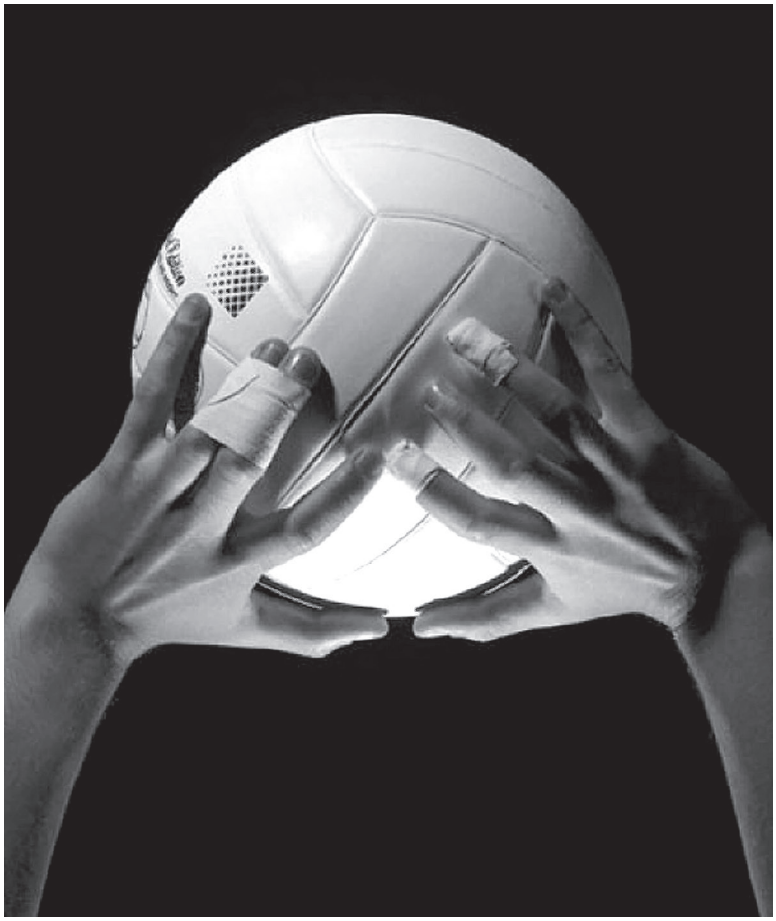
Pure Mathematics 30

Teacher Notes: City Volleyball Leagues



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Alberta Education

Pure Mathematics 30

City Volleyball Leagues—Teacher Notes

Introduction

This project portrays some of the various factors involved in the design of organizational structures for volleyball in a typical large city. In addition, the project portrays the application of conic sections to the arrangement of players on the volleyball court and to the flight path of a volleyball service. Students have a practical opportunity to see how some of their understanding of permutations and combinations, exponential functions, and conic sections can be applied to designing organizational structures for volleyball and to analyzing the arrangement of players on a volleyball team and the flight path of a volleyball service. Sample solutions for the project questions can be found on the Alberta Education extranet at https://phoenix.edc.gov.ab.ca. A hard copy will be mailed to your school in late August. The general scoring guide for the project is the same as the one issued in September 2000.

The first written-response question on the Pure Mathematics 30 January 2009 diploma examination will be related to this project. This question is worth 10% of the total mark on the diploma examination. Students who do not complete the project but who have completed the course will have the knowledge to answer the written-response question; however, students who do complete the project will gain experience with the related mathematical skills.

Specific Notes

Teachers may want to

- have students show when league play gives rise to permutations and when it gives rise to combinations (part A, questions 1, 2, and 3)
- review probabilities associated with the binomial distribution (part A, question 4)
- review the relationship $b = 1 + \frac{i}{100}$, connecting the parameter b in the exponential regression function to i, the percentage annual rate of increase or decrease (part B, question 2)
- have students identify the need to provide initial assumptions and mathematical procedures when attempting to extrapolate into the future when predicting enrolment trends (part B, questions 3 and 5)
- have students discuss how different assumptions lead to different predictions (part B, questions 3 and 5)
- encourage the use of spreadsheets in extending the table to 2010 and beyond (part B, question 5)
- have students discuss the rounding requirements implicit in the intersection point of the two regression graphs (part B, question 6)
- remind students that they need to use data from both point S and point F to determine the values of the two parameters a and k in the equation of the parabola (part C, question 3)

Program of Studies

The project relates to mathematics learned in the following units of Pure Mathematics 30.

Transformations of Functions

Specific Outcome 1.5: Describe and perform single transformations and combinations of transformations on functions and relations.
[C, T, V]

Exponents, Logarithms, and Geometric Series

Specific Outcomes 2.2: Connect geometric sequences to exponential functions over the natural numbers.
[E, R, V]

2.4: Use the laws of exponents and logarithms to

- solve and verify exponential equations and identities
- solve logarithmic equations
- simplify logarithmic expressions [R]

2.6: Model, graph, and apply exponential functions to solve problems.
[PS, T, V]

Conic Sections

Specific Outcomes 4.2: Classify conic sections according to a given equation in general form or standard (completed square) form (vertical or horizontal axis of symmetry only).
[CN, T, V]

4.3: Convert a given equation of a conic section from general form to standard form and vice versa.
[R, T]

Permutations and Combinations

Specific Outcomes 5.1: Use the fundamental counting principle to determine the number of different ways to perform multistep operations.
[PS, R]

5.3: Determine the number of combination of n distinguishable objects taken r at a time, and use this to solve problems.
[PS, R, V]

Statistics

Specific Outcome 6.2: Solve probability problems, using the binomial distribution.
[PS, R, T]

ICT Program of Studies

C.1—Students will access, use, and communicate information from a variety of technologies.

Specific Outcome 4.2: Select information from appropriate sources, including primary and secondary sources.

C.6—Students will use technology to investigate and/or solve problems.

Specific Outcomes 4.1: Investigate and solve problems of prediction, calculation, and inference.

4.2 Investigate and solve problems of organization and manipulation of information.

Mathematical Processes

The seven mathematical processes identified in the Program of Studies are addressed in this project in the following manner.

Communication	Connect the graphical parameters of an equation/function to a real-life context.
Connections	Understand the connections between the features of the graphs of an exponential function and several conic sections to the parameters of their corresponding equations.
Estimation and Mental Mathematics	Compare the values of an exponential function to the specifications required for membership in a particular division of the city league.
Problem Solving	Develop graphs and equations for an ellipse and a parabolic trajectory from real-life dimensions.
Reasoning	Decide and justify the initial assumptions as the basis for predicting future enrolments.
Technology	Use an appropriate window on a graphing calculator to generate graphs of exponential functions. Use features on the graphing calculator to find values of points on each curve.
Visualization	Visualize the graphs of several exponential functions and use these visualizations to solve problems.