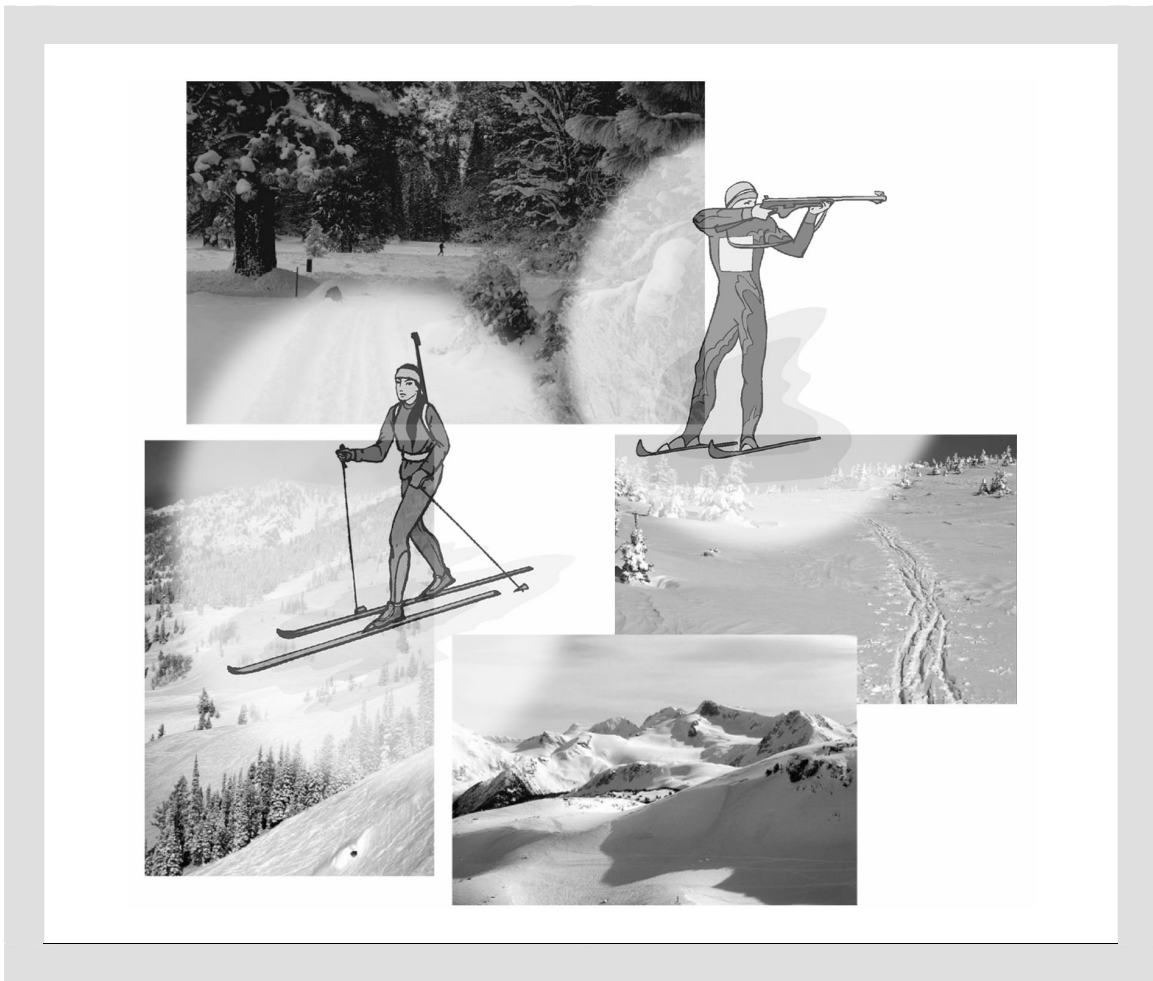


Pure Mathematics 30

**Teacher Notes:
The Winter Sport
of Biathlon**



February 2006

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Pure Mathematics 30

The Winter Sport of Biathlon—Teacher Notes

Introduction

This project explores the Winter Olympic sport of biathlon wherein an athlete cross-country skis, stops, shoots at targets, skis, shoots again, and skis again and so on depending on the event. It allows students to use the knowledge they have gained from Transformations, Conic Sections, Permutations and Combinations, and Statistics units. The project is designed to be completed in three to five hours of student time. The use of this project is optional; however, if you do choose to use it, you may include it as part of your assessment. Sample solutions for the project questions can be found on the Alberta Education extranet <https://phoenix.edc.gov.ab.ca>. A hard copy will be mailed to your school in late February. The general scoring guide for the project is the same as the one issued in September 2000 and can be found on the Alberta Education web site at http://www.education.gov.ab.ca/k_12/testing/diploma/projects.

The first written-response question, which is worth 10%, on the Pure Mathematics 30 June 2006 diploma examination will be related to this project. 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 might want to

- give students specific instructions on how to set up lists on a graphing calculator and do the calculation of mean and standard deviation with List 2 being the list of frequencies (Part A, Question 1)
- discuss why the distribution of misses shown in Part A is neither a normal distribution nor a binomial distribution (i.e., it cannot be normal because the distribution is discrete, not continuous; it cannot be binomial because the different athletes have different probabilities, p , of missing a target)

Program of Studies

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

Transformations of Functions

- Specific Outcomes**
- 1.2: Describe how various stretches of functions (compressions and expansions) affect graphs and their related equations:
- $y = af(x)$
 - $y = f(kx)$
- [C, T, V]
- 1.5: Describe and perform single transformations and combinations of transformations on functions and relations. [C, T, V]

Conic Sections

- Specific Outcomes**
- 4.2: Classify conic sections according to a given equation in general 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**
- 5.2: Determine the number of linear permutations of n objects taken r at a time, and use this to solve problems. [PS, R, V]
- 5.3: Determine the number of combinations of n distinguishable objects taken r at a time, and use this to solve problems. [PS, R, V]

Statistics

- Specific Outcomes**
- 6.1: Find the population standard deviation of a data set, using technology. [CN, E, T, V]
- 6.2: Solve probability problems, using the binomial distribution. [PS, R, T]

ICT Program of Studies

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.
 - 4.3: Manipulate data by using charting and graphing technologies in order to test inferences and probabilities.

F.1—Students will demonstrate an understanding of the nature of technology.

- Specific Outcome**
- 4.2: Solve mathematical and scientific problems by selecting appropriate technology to perform calculations and experiments.

P.2—Students will organize and manipulate data.

- Specific Outcome**
- 4.1: Manipulate and present data through the selection of appropriate tools, such as scientific instrumentation, calculators, databases, and/or spreadsheets.

Mathematical Processes

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

Communication Explain the transformations from the small prone target to the large standing target and the transformation from the small prone target to the ellipse formed by the shooting pattern.

Connections Find the mean and standard deviation, and relate these to how well one does in a sport of this type. Use these values to make further predictions about typical athlete performance.

Estimation and Mental Mathematics Check reasonableness of calculator solutions.

Problem Solving Determine the likelihood that an athlete would miss at least 7 targets. Answer questions involving permutations and combinations.

Reasoning Students should realize that shooting plays a large role in how competitors finish. The students will also have to appropriately round answers.

Technology Use a calculator to enter lists, and determine the mean and standard deviation of the data. Students could also use calculator functions to determine the exact probability of hitting an exact number of targets.

Visualization Visualize the size of the targets and the changes in shape from circle to ellipse.