



Modeling Project

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Overview:

Esoterica, Inc. has developed some powerful mathematical modeling tools. To help market the tools, a series of application notes (reports) must be developed to demonstrate the capabilities of these tools. Each team has been assigned the task of developing an application note (report).

Learning Objectives or Student Outcomes:

By the end of this lesson or activity, student teams will be able to

1. plan, develop, and write an application note (report) to demonstrate the capabilities of mathematical marketing tools.

Length of Lesson:

Approximately 8 weeks

Assignment(s) to Ensure Student Preparation:

Although there are no specific assignments to ensure student preparation, knowledge gained in prior and concurrent related courses, such as mathematics, will be drawn upon.

Team Size/Composition:

Teams of 4 work best; if necessary, a few teams of 3 or 5 students may be formed.

How is *positive interdependence* ensured?

Each team works together to develop one project proposal, one progress report (which includes the team design notebook), one final report, and one application note.

How is *individual accountability* ensured?

Individual accountability may be ensured through the completion of peer assessments or through making individual members of the team responsible for completing different portions of the team assignments.

Components of Assessment:

Project grades will be based upon the each team's deliverables (the proposal, the progress report, the final report and the application note) and on any peer assessments that are conducted.

Team Skills Needed for Success:

All team members must have the ability to communicate, cooperate and collaborate; they must also feel free to share their own ideas and to give and receive constructive feedback.

How Are These Skills Emphasized?

These skills are emphasized by the need for the entire team to work together to complete one

final product—the application note—and all of the steps leading up to that product.

Instructions to Students:

1	Project Description Esoterica, Inc. has developed some powerful mathematical modeling tools. To help market the tools, a series of application notes (reports) must be developed to demonstrate the capabilities of these tools. Each team has been assigned the task of developing an application note (report).
2	Developing the Application Note The application note will contain <ul style="list-style-type: none">• a description of a physical process;• a description of quantity or quantities which change over time;• a description of an apparatus to measure the selected quantity (quantities);• two or more mathematical models, e.g., differential equations, functions, which predict the measured behavior of the quantity (quantities); and• graphs showing how well the models predict the behavior and a comparison of two or more examples of the physical process. <p>At least one of the mathematical models should be based on physical principles: Newton's laws of motion, conservation of mass, conservation of charge, etc. That is, you should explain why one particular form of the model was chosen. Additional models may be constructed solely through empirical methods, for example, curve fitting. To stimulate your thinking consider the following examples.</p> <p>Example 1: Measure the position of bouncing balls as functions of time and estimate velocity, acceleration, and coefficient of restitution as a result of the measurements. The coefficients of restitution for many different types of balls, e.g., golf balls, soccer balls, basketballs, may be compared.</p> <p>Example 2: Measure rate of heat transfer from a flask containing vinegar and sodium bicarbonate. Rates of heat transfer for flasks of different shapes may be compared.</p> <p>Example 3: Count the number of popcorn kernels in a package of microwave popcorn that have popped as a function of time. The curves for different brands could be compared.</p> <p>Example 4: Measure the mass of growing crystals as a function of time. The curves for different compounds may be compared.</p> <p>Example 5: Measure the mass of wood that has burned as a function of time. Burning rate for different types of wood may be compared.</p> <p>Example 6: Measure the number of cars that pass a point on a road as a function of time. Curves for various roads or different times of day may be compared.</p>

	Esoterica, Inc. believes the originality and creativity of your application, e.g., nature of the physical process, approach to measuring the selected quantity or quantities, uniqueness of the model proposed, will encourage sales of its mathematical modeling tools. Therefore, your application note cannot use any of the examples that have been provided. In addition, several teams of employees prepared application notes in 1995-96. Systems on which application notes were based should not be duplicated.
3	<p>Project Tools</p> <p>Here are some of the tools which could be used in preparing your application note: Maple, Excel, ultrasonic ranging equipment in the physics laboratory, audio input and processing capabilities of your notebook computer, and chemistry laboratory equipment.</p>
4	<p>Project Deliverables</p> <ul style="list-style-type: none"> • Proposal: A one-page proposal that describes the physical process, the quantity (quantities) to be measured as functions of time, and the proposed measuring scheme. Proposals will be reviewed and returned. If the proposal is unacceptable, a second proposal must be submitted. • Progress Report: Progress reports, including submission of project notebook and brief oral presentation. • Final Report • Application Note
5	<p>Review Criteria</p> <p>The coin of the realm is competency blocks. Therefore, numerous competency blocks may be awarded depending on the quality of your application note. Factors that will be used in determining the quality of the application note include the following.</p> <ul style="list-style-type: none"> • Creativity. Esoterica, Inc. believes originality and uniqueness of the application will stimulate sales. • Thoroughness and organization of your project notebook. Esoterica, Inc. is interested in patents that may be derived from your work. Patents must have documentation supporting dates of discovery. Entries in a bound project notebook must be dated and signed by the person making the entry. • Scientific soundness of your measurement technique and model development. • Mathematical creativity and depth of your model selection and analysis. • Presentation quality. Appearance, organization, and validity of the application note will impact sales. • Punctuality. Final application notes must be ready by the deadline or Esoterica, Inc. may be overtaken by the competition. • Contributions to the team effort. Each team member will be asked to assess the contributions of each member of the team. These assessments will be used in awarding competency blocks to each member of the team. Not all team members will receive the same number of competency blocks. The number of competency blocks that each team receives will depend on the assessment of member's contributions by the faculty and the members of the team. • Team effectiveness. Esoterica believes that its employees should become

	<p>more effective team members. Therefore, your ability to improve team maintenance and team effectiveness will impact the number of competency blocks earned. Ways in which team maintenance will be assessed include direct observation, records in the project notebook, and performance during oral presentations.</p>
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