Quantitative Reasoning in the Arts and Humanities

At Hollins University

## Hollins' New General Education Program: Education through Skills and Perspectives (ESP)

**ESP Skills**
Writing
Oral Communication
Quantitative Reasoning
Information Technology

**ESP Perspectives**
Aesthetic Analysis
Creative Expression
Ancient and/or Medieval Worlds
Modern and/or Contemporary Worlds
Social and Cultural Diversities
Scientific Inquiry
Global Systems and Languages

## Hollins' Definition for Quantitative Reasoning

Quantitative reasoning is the application of mathematical concepts and skills to solve real-world problems. In order to perform effectively as professionals and citizens, students must become competent in reading and using quantitative data, in understanding quantitative evidence and in applying basic quantitative skills to the solution of real-life problems.

## Basic Quantitative Reasoning Requirement (q)

Goals

- To understand mathematical and statistical reasoning.
- To use appropriate mathematical and/or statistical tools in summarizing data, making predictions, and establishing cause-and-effect relationships

## Applied Quantitative Reasoning Requirement (Q)

Goals

- To give students the opportunity to apply mathematical and statistical reasoning in a chosen discipline
- To involve students in the application of quantitative skills to problems that arise naturally in the discipline, in a way that advances the goals of the course in a manner that is not merely a rote application of a procedure.

## Course Criteria for Q courses

- A quantitative reasoning skills course must involve students in the application of quantitative skills to problems that arise naturally in the discipline, in a way that advances the goals of the course and in a manner that is not merely a rote application of a procedure.
- In order to be approved as QR applied, a course must include at least two QR projects and devote class time to the proper use of quantitative skills, building on what is taught in Math 100. The class discussions and the students' work on these projects must address a significant application of quantitative skills to problem solving within the given discipline.
- The end result of each QR project should be a written assignment that includes a statement of the problem, an explanation of the methods used, and a summary of the results. When appropriate, the written assignment should discuss any limitations encountered and possible improvements to the procedure and/or results.

## Hollins Q-Courses from the Mathematical, Natural, and Physical Sciences

Biology: Ecology; Plant Biology
Chemistry: Experience Chemistry; General Chemistry I and II; Principles of Chemistry; Environmental Analysis; Analytical Chemistry
Computer Science: Computer Science I
Mathematics: Mathematical Modeling in Today's World; Precalculus; Intuitive Calculus; Calculus I and II; Linear Algebra
Physics: Physical Principles I and II; Analytical Physics I and II
Psychology: Human Memory; Analysis of Behavioral Data
Statistics: Introduction to Statistics; Statistical Methods

## Hollins Q-courses from the Humanities, Social Sciences and Fine Arts

Business: Corporate Finance; Investments; International Finance
Classics/Art: Ancient Art
Communications: Research Methods in Communication
Dance: Performance Workshop
Economics: Economics of Social Issues; Economics of Health Care; Public Finance; Money, Credit and Banking; Macroeconomic Theory and Policy
History: US Social History; France Since the Revolution; European Imperialism; The Renaissance Humanities: France and the French
International Studies: Global Systems
Philosophy: Symbolic Logic
Political Science: Research Methods in Political Science; International Political Economy
Sociology: Sociology of Health, Illness and Medicine; Methods of Social Research
Theatre: Lighting Design; Scene Painting
Women's Studies: Women and Economics

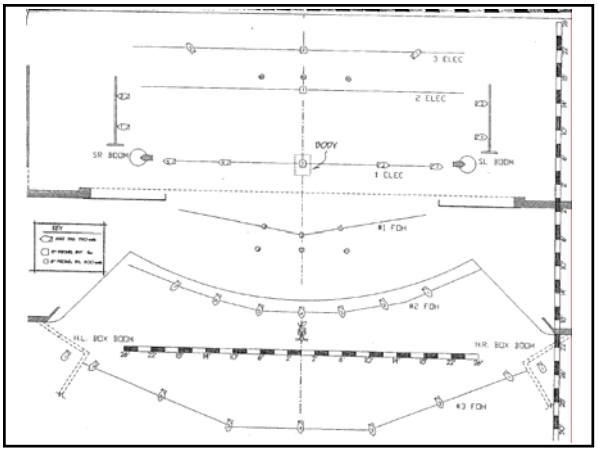
## Lighting Design
## Professor Laurie Powell-Ward

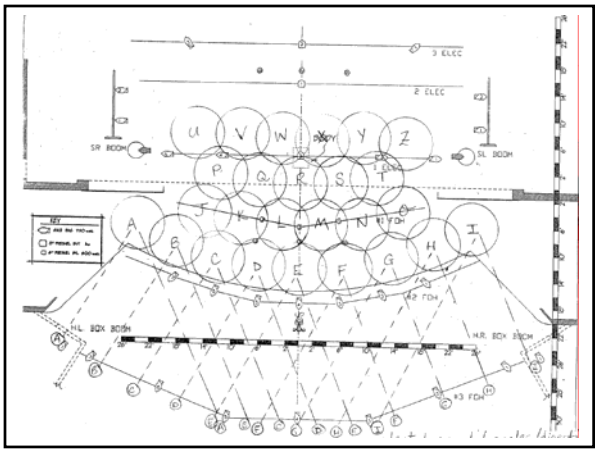
Potentials and problems of theatrical lighting through lab exploration with standard industry equipment

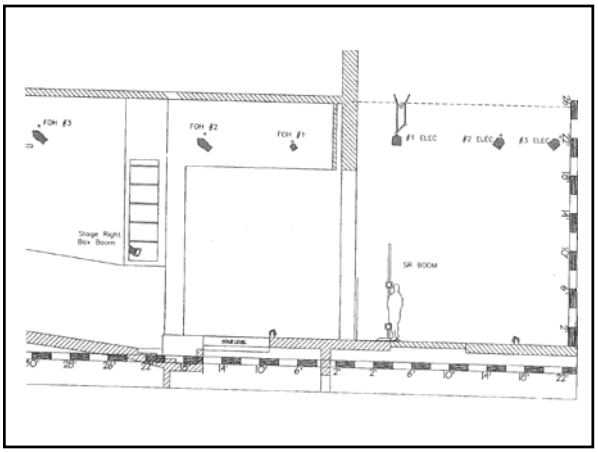
Script based design projects

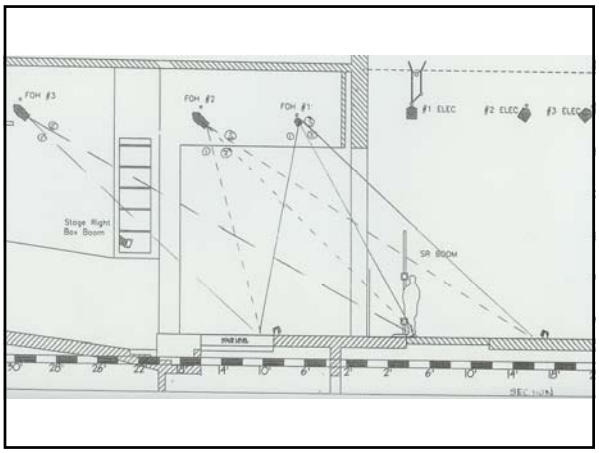
Quantitative concepts – angle, beam spread, intensity, wattage, control board timing

Execution of design allows students to see their schematics "in action"






**American Social History**
**Professor Ruth Doan**

Family in Colonial New England

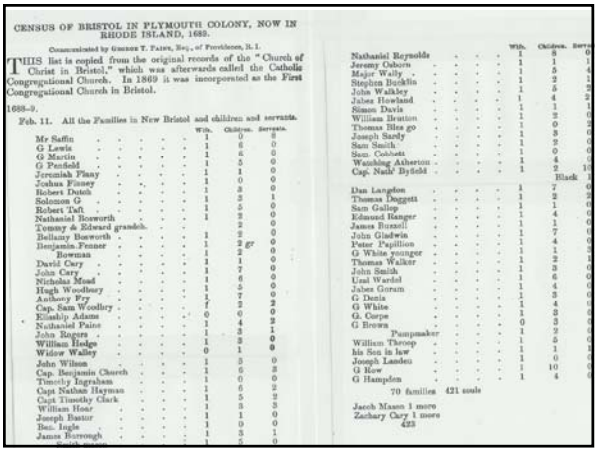
Analysis of family data from Bristol census of 1689

Mean, median and mode
-household size, number of children, number of servants

Family
- extended, blended, nuclear, female-headed

Feb. 11. All the Families in New Bristol and children and servants.

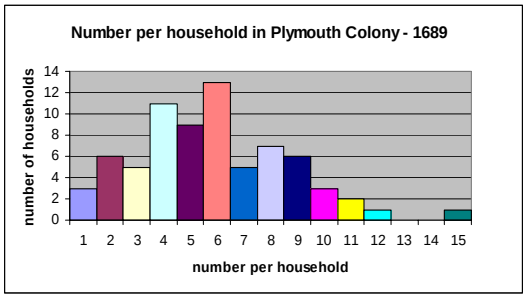
| | Wife. | Children. | Servants. |
|---|---|---|---|
| Mr Saffin | 1 | 0 | 8 |
| G Lewis | 1 | 6 | 0 |
| G Martin | 1 | 6 | 0 |
| G Penfield | 1 | 5 | 0 |
| Jeremiah Finny | 1 | 1 | 0 |
| Joshua Finney | 1 | 0 | 0 |
| Robert Dutch | 1 | 3 | 0 |
| Solomon G | 1 | 3 | 1 |
| Robert Taft | 1 | 5 | 0 |
| Nathaniel Bosworth | 1 | 2 | 0 |
| Tommy & Edward grandch. | | 2 | 0 |
| Bellamy Bosworth | 1 | 2 | 0 |
| Benjamin Fenner | 1 | 2 gr | 0 |
| Bowman | 1 | 2 | 0 |


CENSUS OF BRISTOL IN PLYMOUTH COLONY, NOW IN RHODE ISLAND, 1689.

THIS list is copied from the original records of the "Church of Christ in Bristol," which was afterwards called the Catholic Congregational Church. In 1809 it was incorporated as the First Congregational Church in Bristol.

1688-9.

Feb. 11. All the Families in New Bristol and children and servants.




**Symbolic Logic**
**Professor Michael Gettings**

Project One

- identify categorical syllogisms
- determine validity/invalidity of the syllogisms

Project Two

- identify conclusion of a given passage
- symbolize the argument of given passage using propositional logic
- use truth tables to determine validity
- construct proof (valid) or show counterexample (invalid)

## *Reason*, August 2003

"Think for a moment what it would mean if the world were not barely half free. What if every nation in the world were a prosperous commercial republic? What would international relations look like? They would look a lot like what is happening within Europe today – growing peaceful integration of economies, increasingly open borders, and shrinking military forces. By aggressively expanding the scope of free institutions worldwide, we ultimately guarantee our own liberties at home."

1. The world is only half-free, and our liberties are endangered.
2. If we aggressively expand the scope of free institutions worldwide, the world will not be only half-free.
3. If the world is not only half-free, then the peaceful integration of economics will grow, borders will increasingly open and military forces will shrink.
4. If the peaceful integration of economics grows, borders increasingly open and military forces shrink, our liberties will not be endangered.

C: If we aggressively expand the scope of free institutions worldwide, our liberties will not be endangered.

## Scheme of Abbreviation

- F: The world is only half-free.
- D: Our liberties are endangered.
- E: Peaceful integration of economies grows
- B: Borders are increasingly open.
- S: Military forces shrink.
- A: We aggressively expand the scope of free institutions worldwide.

## Symbolized Argument & Proof

| | | |
|---|---|---|
| 1. | $F \bullet D$ | |
| 2. | $A \supset \sim F$ | |
| 3. | $\sim F \supset [E \bullet (B \bullet S)]$ | |
| 4. | $[E \bullet (B \bullet S)] \supset \sim D$ | $/ \therefore A \supset \sim D$ |
| 5. | $A \supset [E \bullet (B \bullet S)]$ | 2, 3 HS |
| 6. | $A \supset \sim D$ | 5, 4 HS |

**Basic Quantitative Reasoning Requirement (q)**

Began in Fall 98

QR Assessment

q proficiency — Enroll in Intro to QR; q proficiency upon completion

- Pilot QR Tutoring (Fall 99)
- Director of QR and "virtual" QR Center (Fall 03)
  - additional tutoring
  - QR Tutor, Theory and Practice Course
- Center for Learning Excellence
  - Writing and QR (Fall 04)

**Applied Quantitative Reasoning Requirement (Q)**

Hollins Funded Faculty Development Efforts

- Workshop to develop preliminary Q modules (98-99)
- Faculty Reading Group (99-00)

CCLI/A&I NSF Faculty Development Grant (00-01)

New Gen Ed program and two QR requirements started with students entering in Fall 2001

Pilot Site for Bookman/Ganter SGER NSF Grant (03-04)

**QR Faculty Development Activities 2000-2001 (supported by NSF)**

Four Visiting QR Scholars

Public Lecture
Faculty Workshop

Two QR Workshops for Hollins Faculty

**Visiting QR Scholars**

Jerry Johnson, University of Nevada at Reno (9/2000) Lecture (100): "The Mathematics Across the Curriculum Project at UNR"
Workshop(15): Applications of QR in the Social Sciences

Dorothy Wallace, Dartmouth College (10/2000) Lecture(70): "The Mathematics Across the Curriculum Project at Dartmouth"
Workshop(14): A Study of Symmetry Using Block Art

Helen Lang, Trinity College in Connecticut (2/2001)
Lecture(70): "The Role of Science/Math Laboratories in Humanities Courses"
Workshop(14): Discussion of the Importance of QR in the Humanities

Lou Gross, UT at Knoxville (4/2001)
Lecture(70): "Everglades Restoration: Computing, Ecology, Mathematics, and Public Policy"
Workshop(9): QR in Ecology (Using Ecobeaker and Populus)

**Q Faculty Development Workshops at Hollins 2000-2001**

2 NSF funded 4 day workshops - emphasis on development of QR projects for Q courses

Workshop Sessions
Math 100 topics (lecture and Excel labs)
Definition of QR
Discussion of teaching strategies
Sample QR projects and guidelines
Presentation of QR projects by faculty

Workshop Participants
Humanities: Classics(1), Philosophy(1)

Social Sciences: Communications(1), Economics(1), History(2), Political Science(1), Sociology(1)

Fine Arts: Theatre(1)

Natural and Mathematical Sciences: Biology(3), Chemistry(2), Computer Science(2), Mathematics and Statistics(2), Physics(1), Psychology(1)

**2004 NSF Grant – QL Assessment – Ganter, Bookman**

Pilot Sites: Hollins University, Trinity College, Washington Center

Hollins' Responsibilities

Pre-test/Post-test/Post-post-test analysis

Designing Q projects

Assessing Q projects

**2004 NSF Grant – QL Assessment – Ganter, Bookman**

Pilot Sites: Hollins University, Trinity College, Washington Center

NSF/Hollins funded 2 day workshop - create a design plan for projects and guidelines for assessing student work

Content of workshop sessions
Background information on QL
Presentation of projects by faculty teaching Q courses
Discussion of important elements in good/successful projects
Presentation of revised/new projects
Discussion of guidelines for assessing student work

Workshop participants
Humanities: English (1), French (2), Philosophy(1)
Social Sciences: Economics(1), History(1)
Natural and Mathematical Sciences: Mathematics and Statistics(2)
Fine Arts: Dance(1)

**Design Plan for Q Projects**

Project Idea

Central topic, natural fit, application of QR

Process

Use class time to develop necessary background material

Handout with specifics -sequence of assignments

Group work/activities to foster student discovery and confidence

Analysis in language of the discipline

Include open-ended questions to encourage multiple approaches

Drawing Conclusions

Reality check, revisions, limitations, future improvements, reflection

## Guidelines for Assessing Q Projects

Understanding the Problem

Problem well defined?

Firm grasp on the necessary quantitative methods?

Completing the Process

Appropriate quantity and quality of data?

Implementation and integration of quantitative methods?

Appropriate problem solving techniques?

Drawing Conclusions

Interesting, creative, original? Reasonable?

Self-assessment?

## Resources

Achieving Quantitative Literacy, An Urgent Challenge for Higher Education, Lynn Steen, MAA, 2004.

Quantitative Literacy – Why Numeracy Matters for Schools and Colleges, edited by Bernard L. Madison and Lynn Arthur Steen, NCED, 2003.

Mathematics and Democracy – The Case for Quantitative Literacy, edited by Lynn Arthur Steen, NCED, 2001

Why Numbers Count – Quantitative Literacy for Tomorrow's America, The College Board, edited by Lynn Arthur Steen, 1997

Quantitative Reasoning for College Literacy, edited by Linda Sons, MAA, 1996

Mathematical Association of America (MAA)

Quantitative Literacy Special Interest Group of the MAA (QL SIGMAA)

National Numeracy Network (NNN)