On the Effect of the Ordering of Questions in Exams - A Visual Analysis

Jürgen Symanzik
Utah State University, Logan, UT
*e-mail: symanzik@math.usu.edu*
WWW: http://www.math.usu.edu/~symanzik

Palyne Gaenir, CyberGnostics, Inc.
Robert Erbacher, Utah State University
Natascha Vukasinovic, Monsanto Company
Contents

- Introduction
- Exam Structure
- Visual Analysis
- Conclusions
- Future Work
Introduction

- Stat 2000: Introduction to Statistical Methods
- Utah State long-distance course
- 59 students in Spring 2004 in Hong Kong
- Use of electronic textbook CyberStats

- Fact: Question Order Effect well known for Sample Surveys
Exam Structure (1)

- 3 electronic exams through CyberStats
- 2 question types:
  - multiple-choice (m)
  - text-based (t)
- Midterm 1: 60 min - 15 m, 10 t - 59 students
- Midterm 2: 60 min - 15 m, 10 t - 57 students
- Final: 180 min - 25 m, 25 t - 58 students
Exam Structure (2)

- For each student, for each exam, question order randomized as:
  - [1] first multiple-choice, then text
  - [2] first text, then multiple-choice
  - [3] multiple-choice & text fully randomized

- Each student had each order type once, e.g., [2] in Mid 1, [3] in Mid 2, [1] in Final

- About 10 students for each of the 6 permutations of question order type

- Record each answer and time of submission
Exam Structure (3)

- All 25 (or 50) questions displayed via a single html page
- Students allowed (and encouraged) to answer questions in any order:
  - You have exactly 60 minutes to complete the exam. Any items submitted after 60 minutes will not be graded. Try to correctly answer as many questions as possible during this time period. **You are allowed to answer questions in any order.** Start with a question that seems the easiest for you. If you cannot answer a question within a short time, move to another question, and come back to the previously unanswered questions toward the end of the exam. [Introduction for Midterm 1]
Research Questions

■ In which order do students answer the questions?
■ Do students speed up towards the end of the exam period?
■ Do students have a preference when to answer multiple-choice and text questions?
VA1: # Answers per 10 min

Mid 1: Student 1  
Mid 1: Student 2  
Mid 1: Student 3  
Mid 1: Student 4  
Mid 1: Student 5  
Mid 1: Student 6  
Mid 1: Student 7  
Mid 1: Student 8  
Mid 1: Student 9  
Mid 1: Student 10  
Mid 1: Student 11  
Mid 1: Student 12  
Mid 1: Student 13  
Mid 1: Student 14  
Mid 1: Student 15
VA2: Answer Time for each Question
VA3: Sequential Answers (1 Student)
VA4: M-first Answers (3 Students)
VA5: T-first Answers (3 Students)
VA6: Random Answers (1 Student)
VA7: Answers per Time Interval

Mid 1: All Students - All Answers

Mid 1: All Students - First Answer

Mid 2: All Students - All Answers

Mid 2: All Students - First Answer

Final: All Students - All Answers

Final: All Students - First Answer
VA8: Answers per Time Interval

Mid 1: Boxplot of First Answer Times by Question

Questions: X1 = Intro, X2 = Q1, ..., X26 = Q25
VA9: Answers per Time Interval

Mid 1: Boxplot of Median First Answer Times

Mid 2: Boxplot of Median First Answer Times

Final: Boxplot of Median First Answer Times

Question Type: left = Multiple Choice, right = Text
Q: In which order do students answer the questions?

A: There are different student “types”:
  – mostly sequential
  – multiple-choice first
  – text first
  – random
Conclusions (2)

Q: Do students speed up towards the end of the exam period?

A: Student frequently change (or resubmit) answers towards the end. No noticeable increase in Midterm 1 & Final, but some increase in Midterm 2.
Q: Do students have a preference when to answer multiple-choice and text questions?

A: The medians of the times multiple-choice questions get answered are smaller than the medians of the times text questions get answered.
Future Work

- Continue visual analysis to generate further hypotheses:
  - associate scores with question order type
  - associate scores with student “type” (e.g., does random answering order result in more/less points?)

- Use additional data (Summer 2004/1: 29 students, Summer 2004/2: 87 students) for statistical inference
Questions ?