

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

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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)

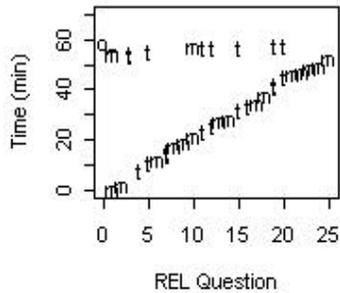
- All 25 (or 50) questions displayed via a single html page
- Students allowed (and encouraged) to answer questions in any order:
 - You have **exactly 60 minutes** to complete the exam. Any items submitted after 60 minutes will not be graded. Try to correctly answer as many questions as possible during 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

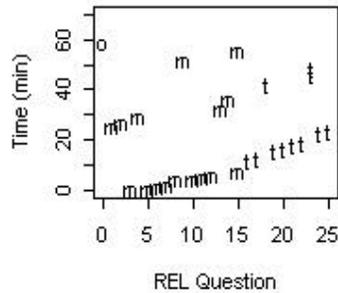
- In which order do students answer the questions?
- Do students speed up towards the end of the exam period?
- Do students have a preference when to answer multiple-choice and text questions?

VA2: Answer Time for each Question

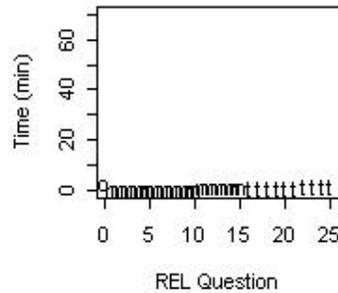
Mid 1: Student 1



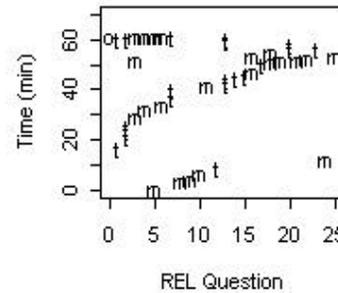
Mid 1: Student 2



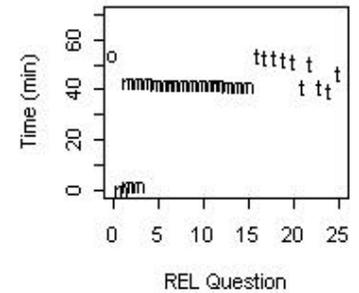
Mid 1: Student 3



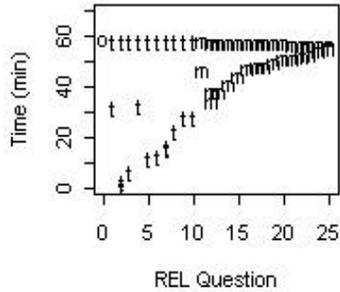
Mid 1: Student 4



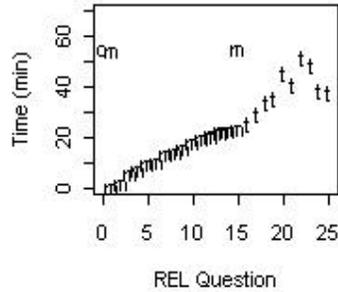
Mid 1: Student 5



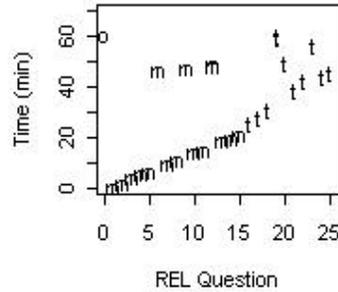
Mid 1: Student 6



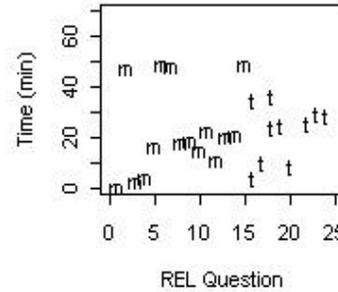
Mid 1: Student 7



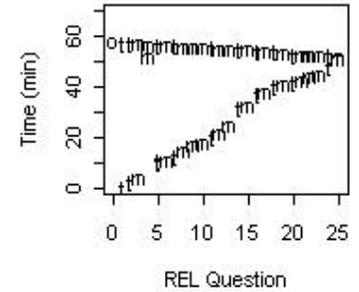
Mid 1: Student 8



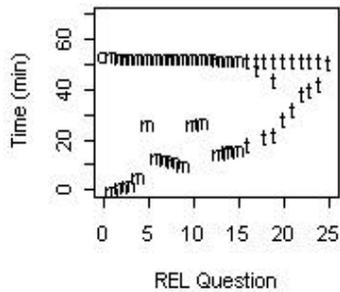
Mid 1: Student 9



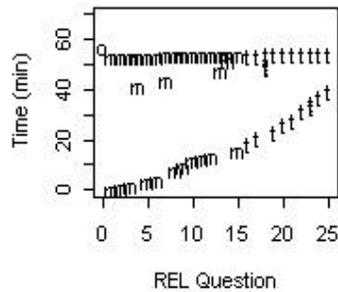
Mid 1: Student 10



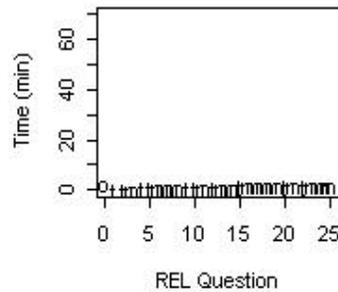
Mid 1: Student 11



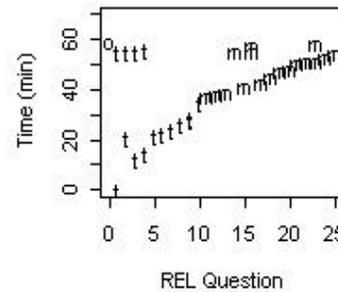
Mid 1: Student 12



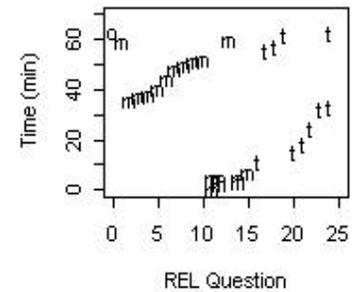
Mid 1: Student 13



Mid 1: Student 14

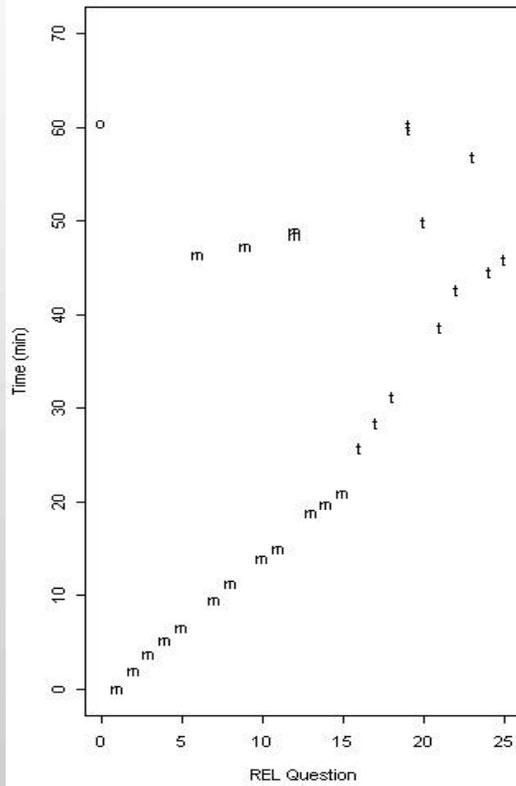


Mid 1: Student 15

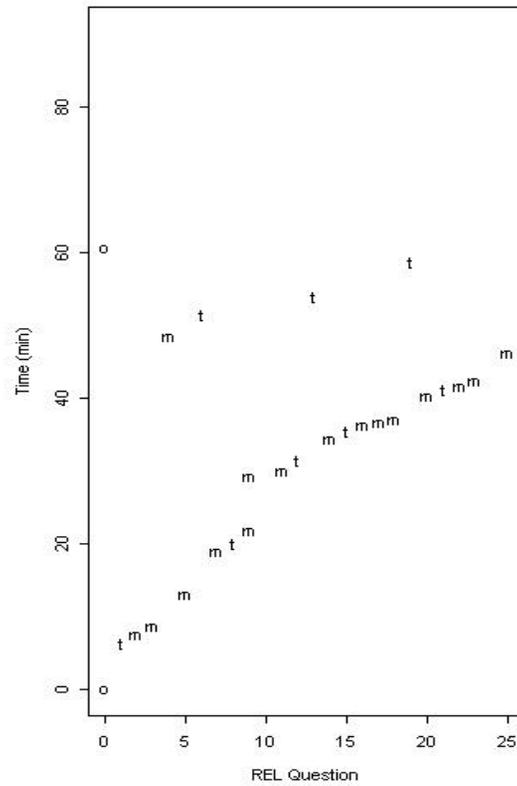


VA3: Sequential Answers (1 Student)

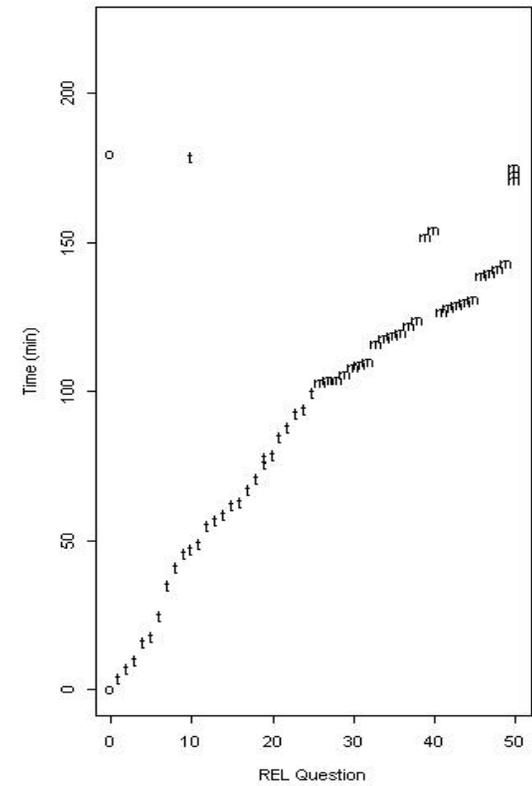
Mid 1: Student 8



Mid 2: Student 8

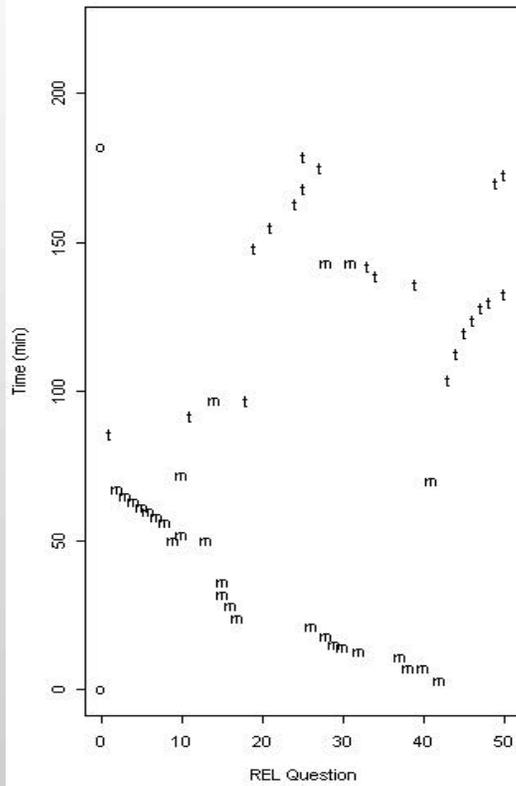


Final: Student 8

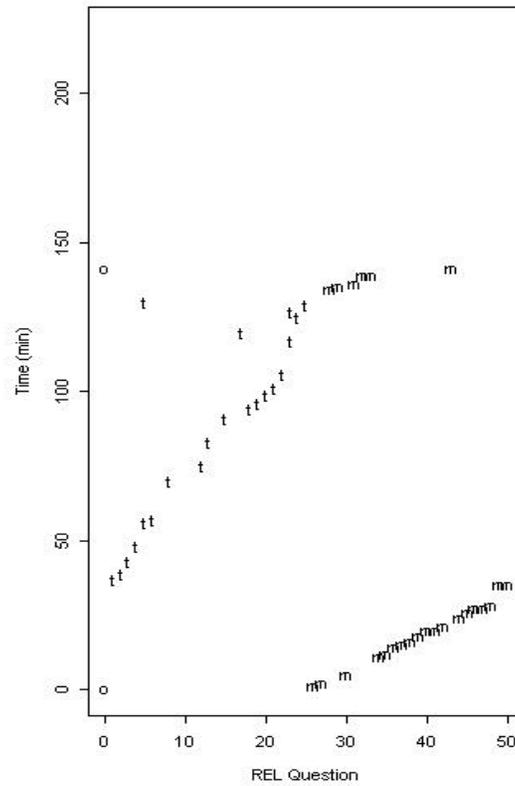


VA4: M-first Answers (3 Students)

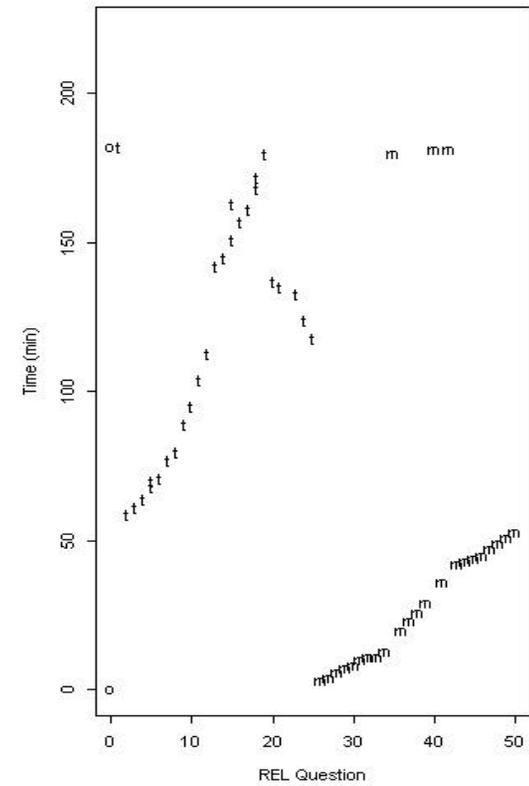
Final: Student 5



Final: Student 16

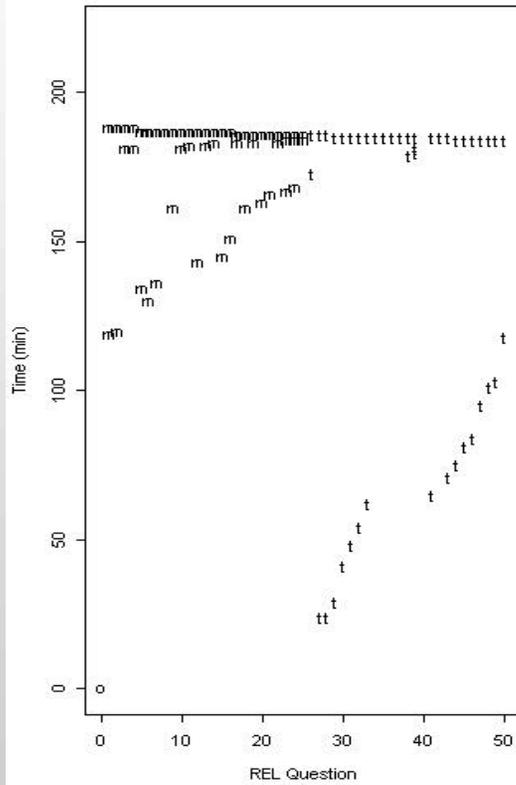


Final: Student 25

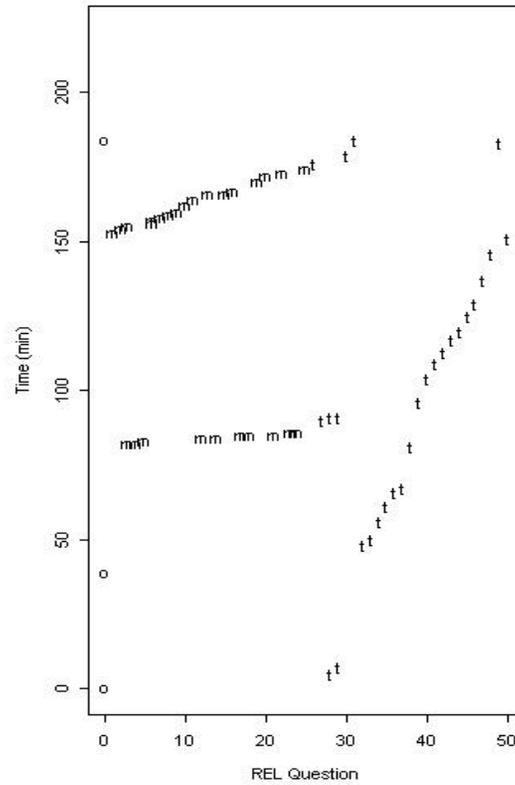


VA5: T-first Answers (3 Students)

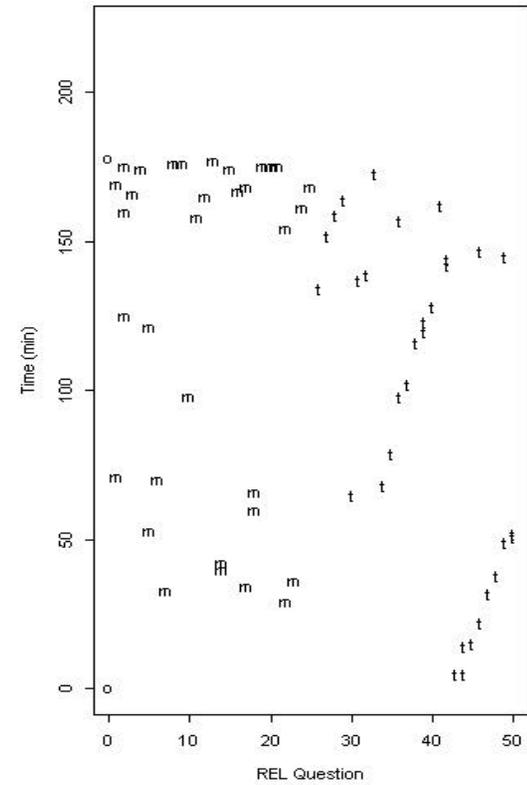
Final: Student 46



Final: Student 56

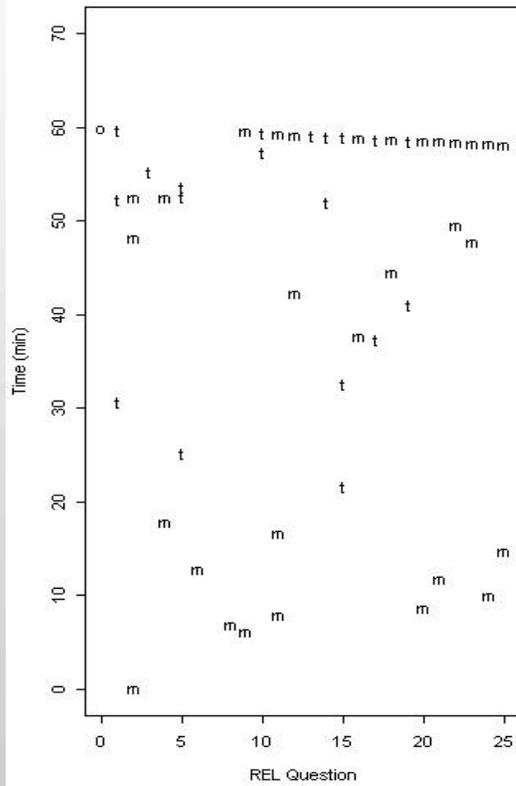


Final: Student 43

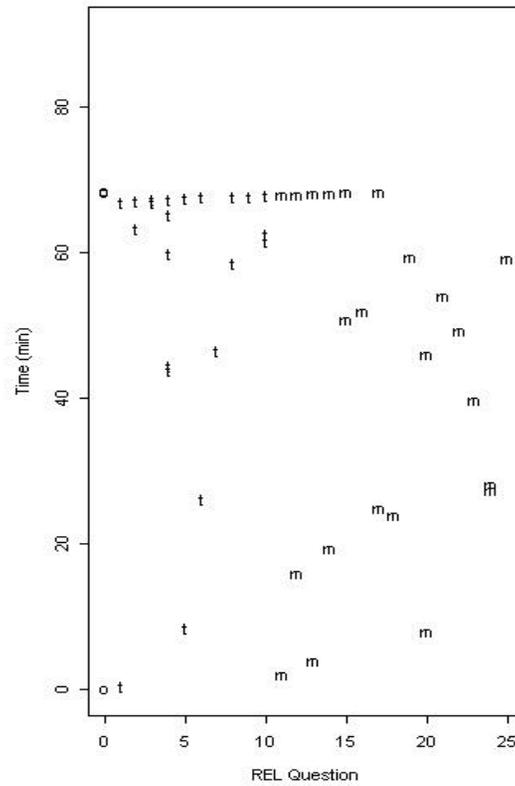


VA6: Random Answers (1 Student)

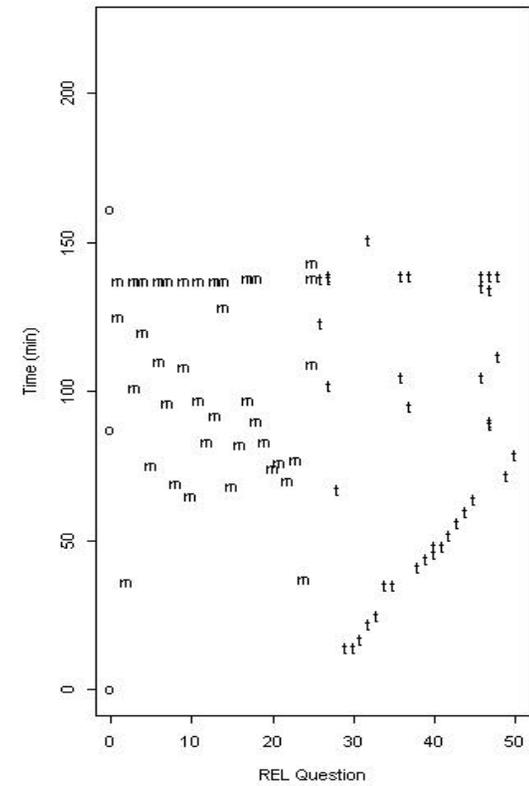
Mid 1: Student 27



Mid 2: Student 27

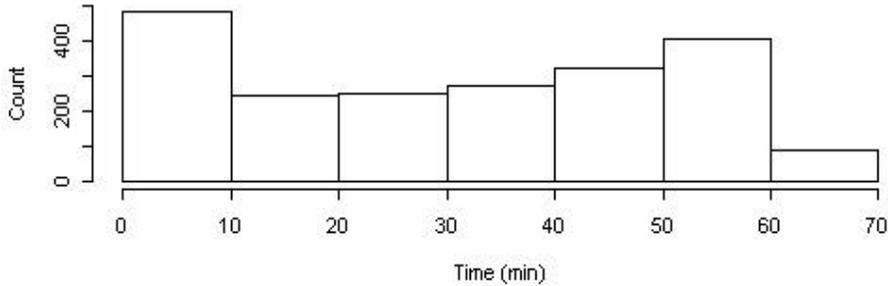


Final: Student 27

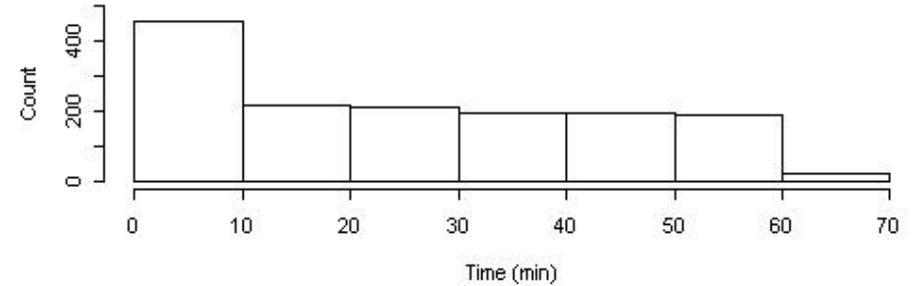


VA7: Answers per Time Interval

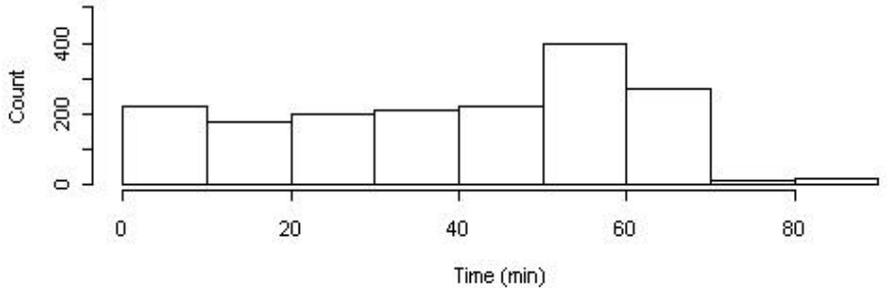
Mid 1: All Students - All Answers



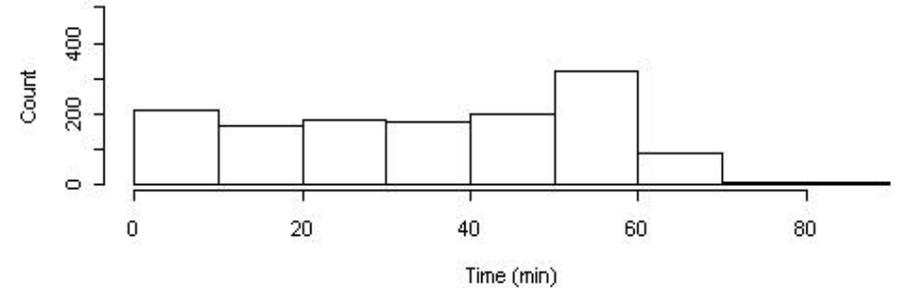
Mid 1: All Students - First Answer



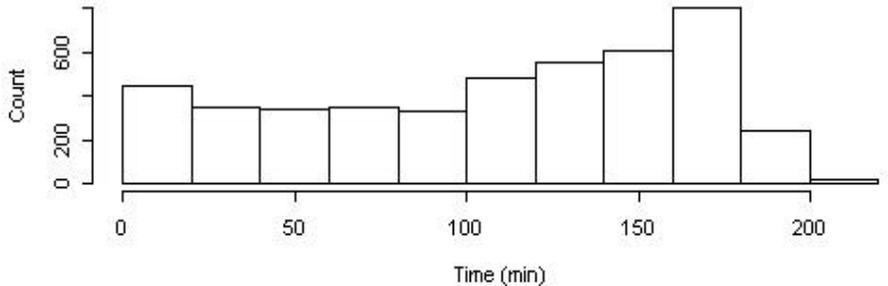
Mid 2: All Students - All Answers



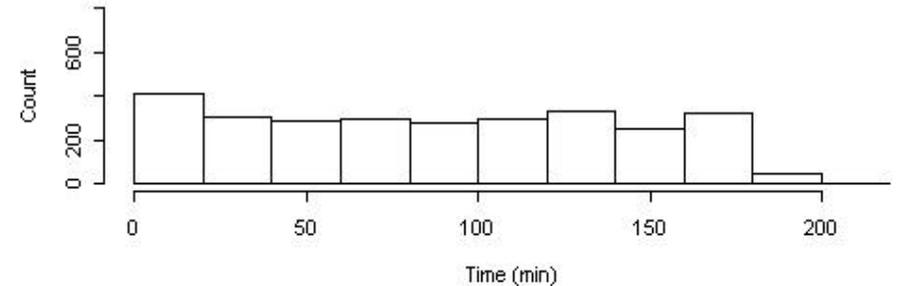
Mid 2: All Students - First Answer



Final: All Students - All Answers

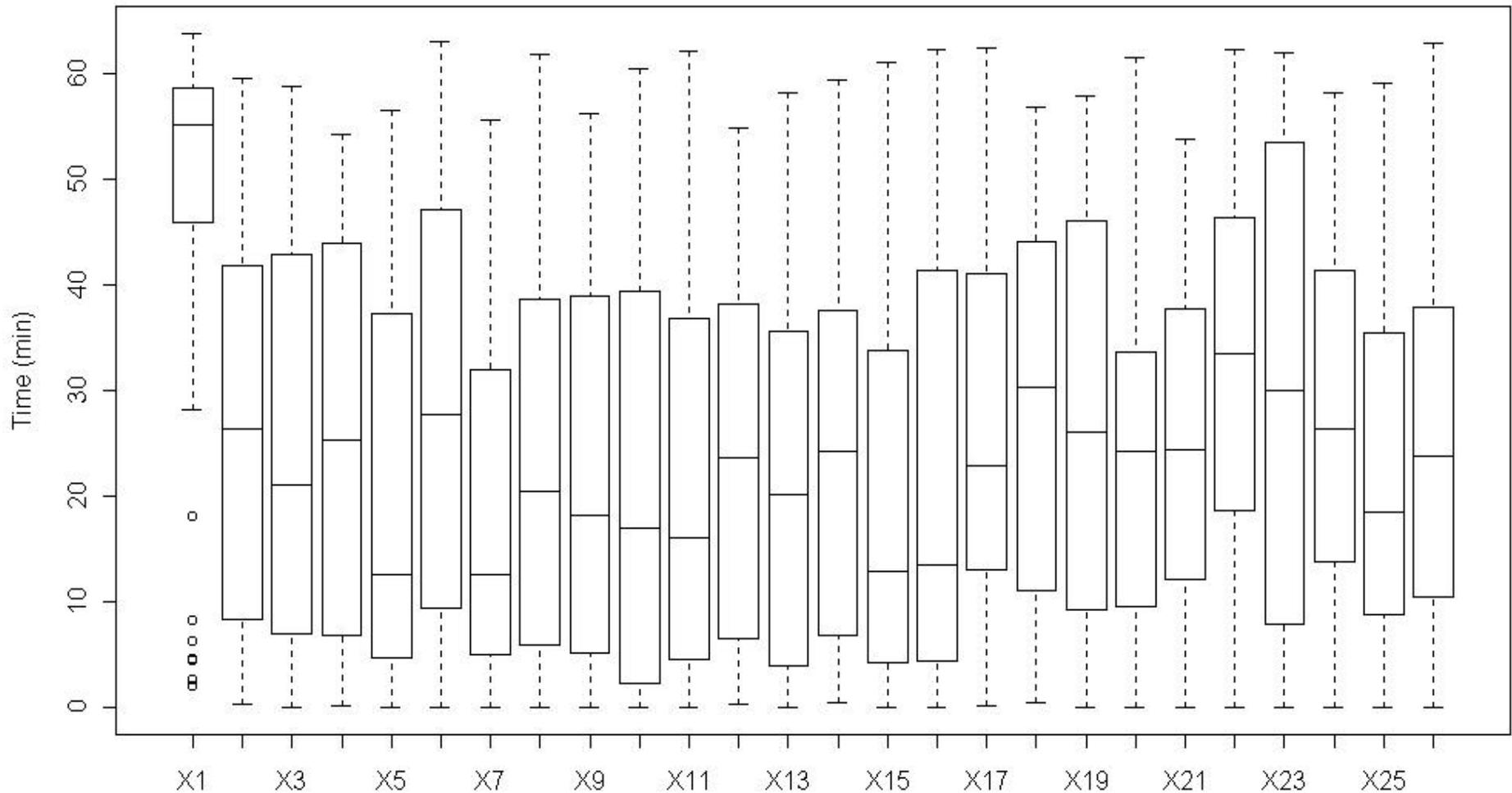


Final: All Students - First Answer



VA8: Answers per Time Interval

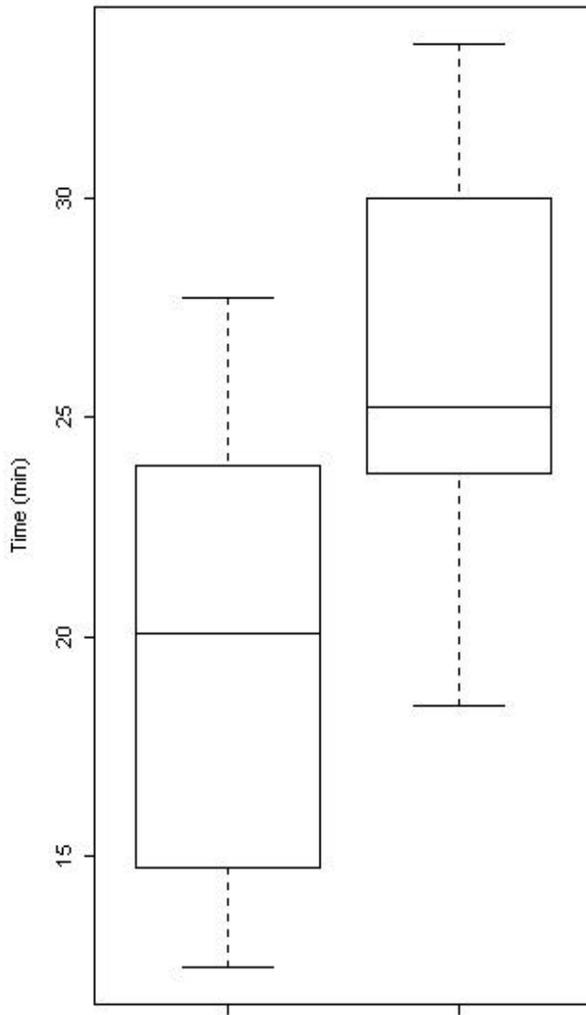
Mid 1: Boxplot of First Answer Times by Question



Questions: X1 = Intro, X2 = Q1, ..., X26 = Q25

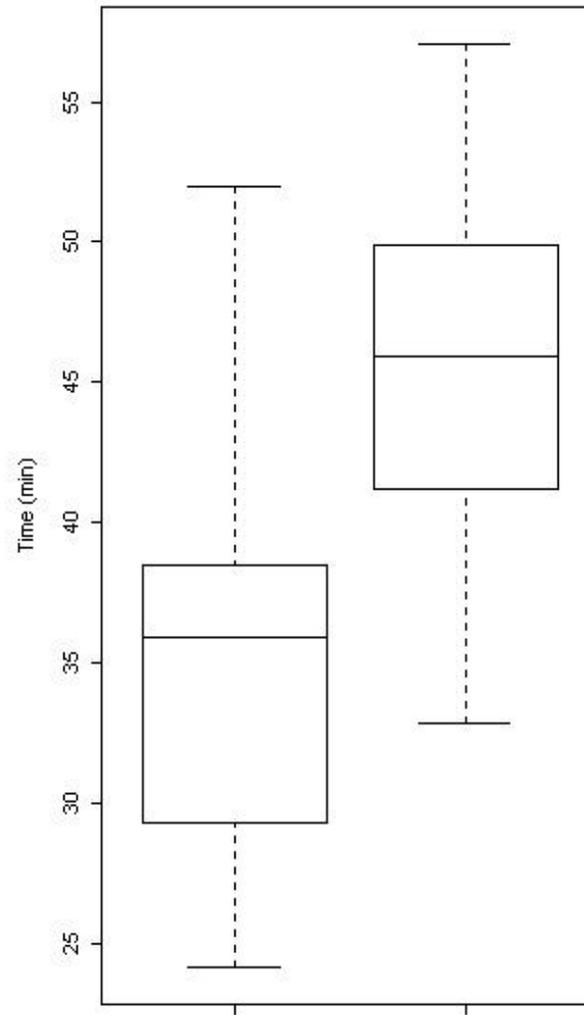
VA9: Answers per Time Interval

Mid 1: Boxplot of Median First Answer Times



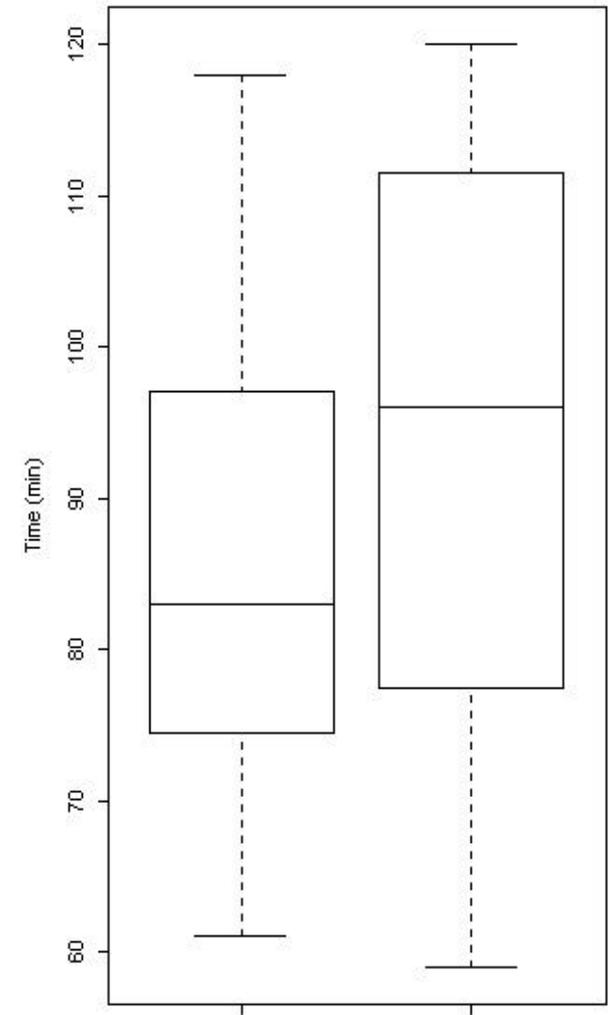
Question Type: left = Multiple Choice, right = Text

Mid 2: Boxplot of Median First Answer Times



Question Type: left = Multiple Choice, right = Text

Final: Boxplot of Median First Answer Times



Question Type: left = Multiple Choice, right = Text

Conclusions (1)

- 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.

Conclusions (3)

- 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

The background is a blue gradient, transitioning from a lighter blue at the top to a darker blue at the bottom. Overlaid on this gradient are several parallel diagonal stripes of a slightly lighter shade of blue, running from the top-left towards the bottom-right.

Questions ?