

# **Case Study A**

## **How to Pass an Exam**

## Background

- Probability Theory exams at Augsburg University in 2005
- Mixture of multiple-choice questions and a choice of free-form questions (5 of 8)
- Students in different majors
- Includes pre-exam features as well as exam results



## Goals of Study

- Examine how well the exams can capture the knowledge of students (if possible)
- Learn more about the distribution of student attributes
- Check a relationship between preparation (homework assignments) and exam results
- Verify the difficulty level of questions or exam parts
- Analyze effect of the structure of the exam (choice of free-form question vs multi-choice tasks) and possible modifications

## Description of Data

- Gender
- Major Subject
  - Mainly Math or Business Math
- Semester
  - Students should take the test in the third semester, but can also take the test in a later semester, especially if they failed their first attempt or want to improve their mark.
- Homework Group
  - One out of four; student's choice according to their class schedule.
- Pre-Score
  - The average mark on the 12 assignments ranged between 0 and 25 points.

## Description of Data (cont.)

- Multiple Choice
  - Points achieved in the multiple choice part of the exam, 0 – 50.
- Points in Question 1 – 8
  - 0 – 50 points, missing, if question was not selected.
- Question 1 – 8 Selected?
  - Binary variables (Yes/No) indicating whether a question was chosen or not.
- Total Selected
  - Number of questions worked on.
- Sum Points
  - Sum of the multiple choice part and the 5 best questions worked on.
- Mark
  - According to the German educational system, ranging between 1 (best) and 5 (failed) with  $\pm 0.3$  differentiations. (There is no “0.7” or “5.3” and any score lower than 4.0 is a failing grade.)

# Analysis

- Basic properties
  - barcharts for Gender, Subject, Group, Semester
  - fluctuation diagram of Subject × Group
- Focus on results
  - histogram Pre-Score, Multiple Choice, Total Points
  - missing value plot of Q1-Q8 Points to assess choices
  - parallel boxplots of Q1-Q8
- Interactions
  - use Group barchart selection with linear model in Total Points vs Pre-Score scatterplot
  - boxplots Total Points by Semester
- Compare exam parts
  - create Total Points - Multiple Choice, plots vs Total Points
  - select failed students in Total Points