

# Automated Individualized Student Assessment

Stas Kolenikov

Department of Statistics  
University of Missouri-Columbia

Stata DC conference 2009

# Context

- **Stat 3500:** Intro to Probability and Statistics II, 14 sections
- **Audience:** sophomore/junior business students
- **Prerequisite:** Stat 2500, from basic probability to  $t$ -tests
- **Topics:** ANOVA, regression, rank statistics
- **Tools:** formula packet + tables, calculator, software package (at instructor's discretion)

- Automated Individualized Student Assessment system
- Goals:
  - help students learn statistics at their fingertips
  - practice theoretical concepts with data
  - familiarize students with **STATA** statistical software
- Main idea: a simulated data set for each student  $\times$  assignment
- Advantages:
  - interweaves learning statistical software and statistical methods
  - equips students with modern computing tools
  - forces students to work with and interpret statistical concepts
  - simplifies academic honesty issues

# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment



# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

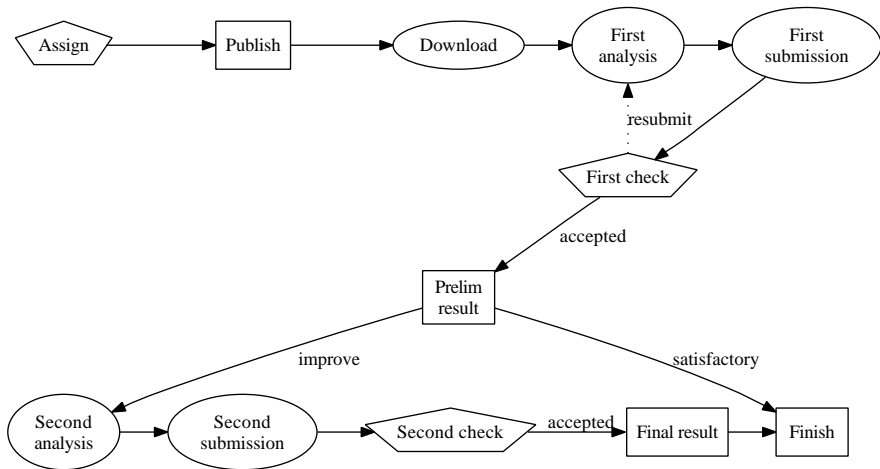
# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

# Principles for good practices in education

- **Interaction with faculty:** it is easier for students to ask for help in the form of “This thing does not work here” than “I don’t understand this concept”
- **Interaction of students with one another:** slower learners can look over the shoulder of faster ones and get peer explanations of both the content and the software
- **Active learning:** students need to do their own work and interact with statistical software
- **Prompt feedback:** it takes an instructor 3 minutes to grade an assignment and post the results
- **Time on task:** there are make-up opportunities for early submissions
- **High expectations:** learn both the content and the software
- **Diversity of the ways of learning:** students can work on assignments on their own pace and in their preferred environment

# Work flow



# Components

- Data processing: **stata** package (ado file, 800 lines of code + help file)
- Project/class files: roster, grade book
- Assignment level files
  - Do files: data generation, key generation
  - Automated data files: results
  - Documentation files: HTML text of the assignment
- Assignment  $\times$  student level files
  - Automated data files: raw data, answer key data
  - Student: answers (data or do-files)

# Creating an assignment

- Assignment on  $t$ -tests and confidence intervals:
  - 1 What is the mean of variable  $x$ ?
  - 2 Test hypothesis that the mean of  $x$  is equal to 2.7 against a two-sided alternative. Report the  $p$ -value.
  - 3 Should the null hypothesis be retained or rejected at 5% level? Enter 1 if the null is rejected, and 0 if the null is retained.
  - 4 Identify the confidence interval in the test output. Report the 90% confidence interval, with the Answer to Question 4 being the lower limit. . .
  - 5 . . . and the Answer to Question 5 being the upper limit.
- The text of the assignment is provided as an HTML or PDF file
- John Doe: an exemplary student with ID 99999

# Student data files

Raw data to be used by the student: made available from the course website

```
set seed StudentID
set obs 20+floor( uniform()*16 )
gen x = uniform() + uniform() + uniform() +
uniform() + uniform() + uniform()
```

Answer keys: the analysis to be performed, results stored for later matching

In **STATA**, run:

```
aisa assign test2, replace
```

# Student work

Student's task: create and submit a data file with numeric answers in the format

Question	Answer
1	2.9988
2	0.0086
3	1
4	2.8177
5	3.1799

In **STATA**, show:

```
johndoe-test2-post.do
```



# Grading an assignment

In `STATA`, show:

```
aisa check test2
aisa check test2 99999, replace verbose
aisa check test2 537909, replace verbose
aisa gradebook test2, nomissing
```

HTML file with the results is automatically generated:

- Student ID
- Score on the assignment
- Problems missed

# Experience and challenges

- Interface with blackboard: a total mess
- Instructor time expense:  $\sim 10$  min/question for development,  $\sim 2$ – $5$  min/student if something is wrong
- Learning curve: students have to learn basics of **STATA** first, then move on to statistics, then to work flow management in **STATA** with do-files
- Students' technical problems: empty, incomplete, or raw data files submitted; interim files stored locally in the lab and lost
- Deeper concepts (such as interpretation of tests and graphics) still need to be assessed via written tests
- Graders become obsolete

# Student reactions

- John Doe is everybody's hero
- Office hours in computer lab are extremely helpful
- **STATA** assignments are closer to real life than paper-and-pencil homeworks
- **STATA** assignments are helpful for both learning the software and the content
- Flexibility and make-up opportunities are great
- Easy to get 100%