

# Grassroots benchmarking: introductory programming exams

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<https://shift-magazine.net/2015/11/18/top-10-grassroots-movements-that-are-taking-on-the-world/>

# Grassroots?

- I've been involved in some institution-level benchmarking initiatives, but they were fairly desultory
- We looked at some assessment items from another institution, and vice versa
- So a group of researchers took matters into their own hands

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Judy Sheard, Monash  
Daryl D'Souza, RMIT  
Peter Klemperer, USA  
Leo Porter, USA  
Juha Sorva, Finland  
Martijn Stegeman,  
Netherlands  
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# Benchmarking exam questions

- Purpose: find a way of comparing introductory programming courses
- How: include a set of common questions in final exams at multiple institutions
- Problem: finding a set of questions that many instructors would be happy to use
- Problem: finding a set of instructors who were happy to use the questions

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# The project

- Ten relatively small exam questions
- Used in 13 exams at seven universities in Australia, Canada, Finland, Netherlands, and USA
- They are not the whole exam; they are relatively simple questions that are used alongside questions specific to each exam
- Identical marking scheme used by all
  - not necessarily for their assessment, but for this project

# Example question

**Q2.** What are the values of *girls*, *boys*, and *children* after the following code has been executed?

```
int girls = 0;  
int boys = 0;  
int children = 0;  
children = girls + boys;  
girls = 15;  
boys = 12;
```

- (a) 0, 0, 0
- (b) 0, 0, 27
- (c) 15, 12, 0
- (d) 15, 12, 27

# Example question

Q6. What will be the value of *result* after the following code statements are executed?

```
int[] nums1 = { 1, -5, 2, 0, 4, 2, -3 };
int[] nums2 = { 1, -5, 2, 4, 4, 2, 7 };
int result = 0;
int j = 0;
while (j < nums1.length)
{
    if (nums1[j] != nums2[j])
    {
        result = result + 1;
    }
    j = j + 1;
}
```

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# Example question

Q10. Write a method that will be given an array of integers and will calculate and return (as a double) the mean (average) of all the integers in the array.

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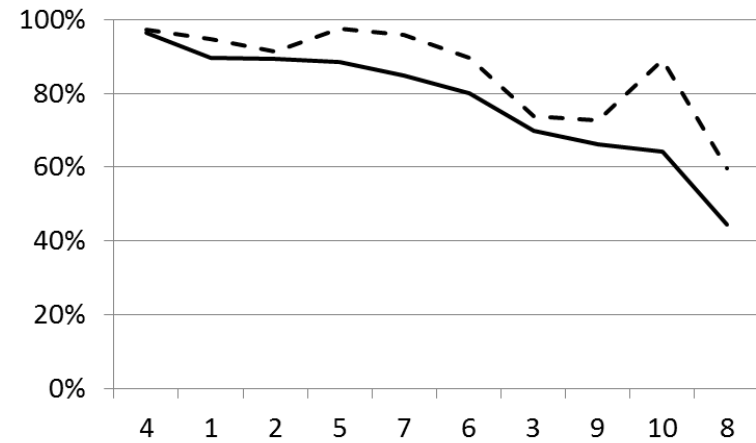
# What can the benchmark do for you?

- You can use the same questions in your final exams
- You can mark them according to the same scheme
- Here are some of the things you can then find out

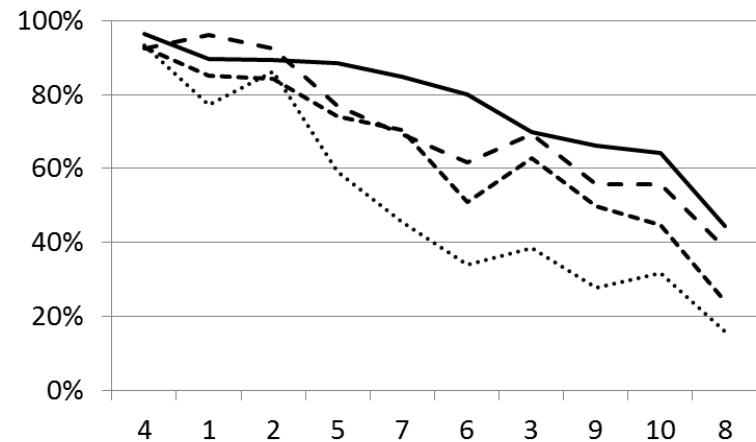


# Performance of students in your course

- As a single course

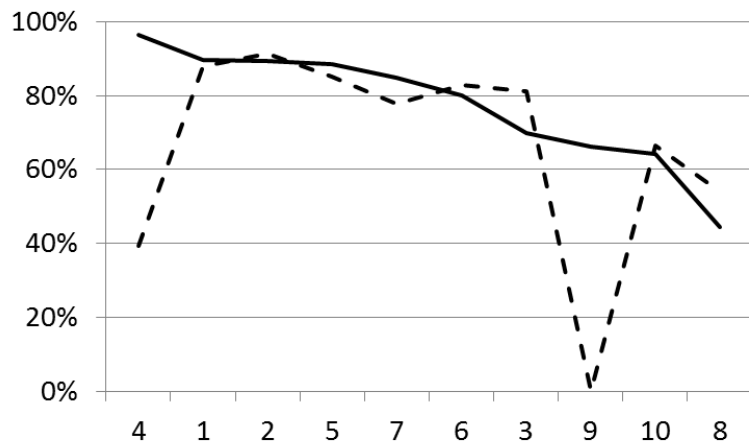
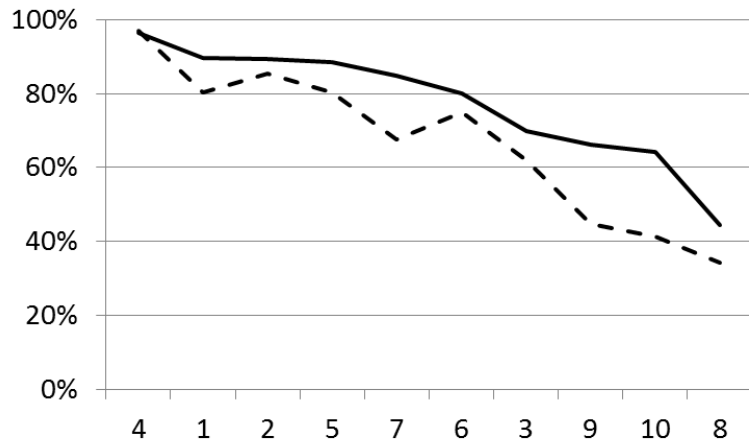


- Or as multiple offerings



# Particular topics that require attention

- Or problems with the questions



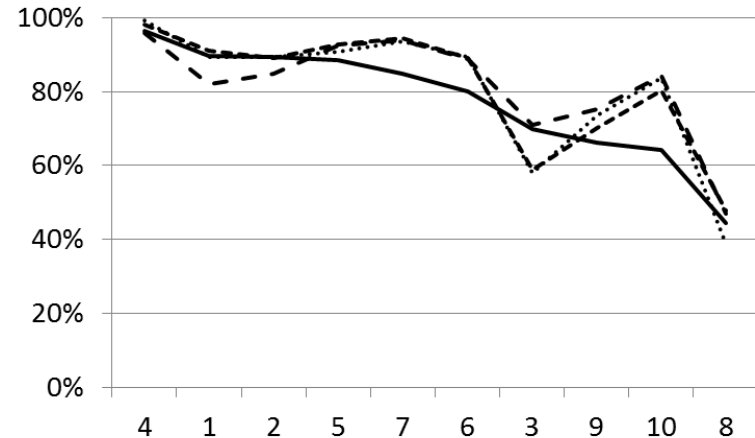
# Example question

**Q4.** What will be the value of the variable z after the following code is executed?

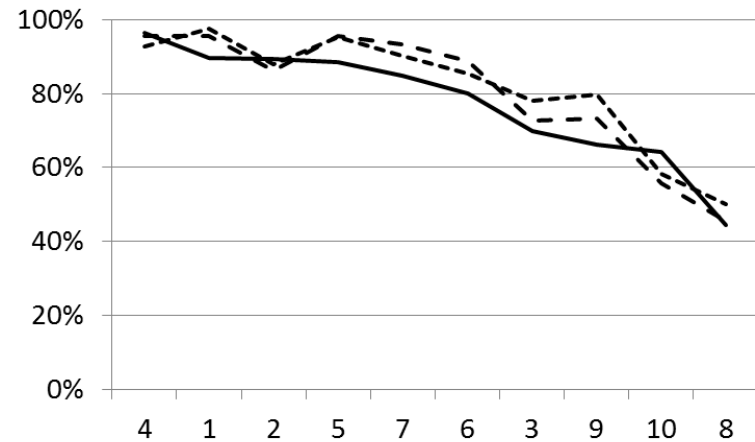
```
int x = 1; int y = 2; int z = 3;
if (x < y) {
    if (y > 4) {
        z = 5;
    } else {
        z = 6;
    }
}
```

# Differences between approaches

- Peer instruction or not



- Course duration and intensity



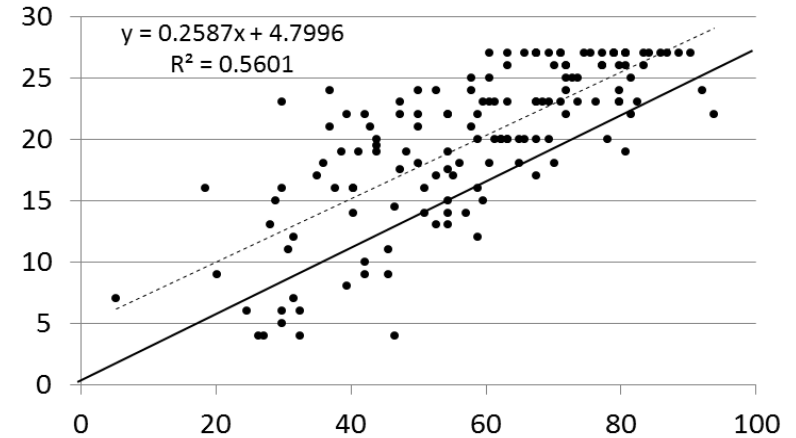
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# Size of exam

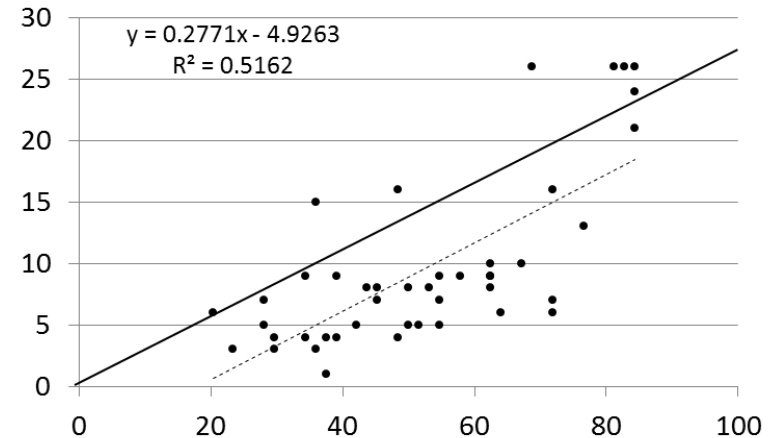
- What proportion of the exam do the benchmarking questions make up?
- 20% – that's a big exam
- 50% – that's a small exam

# Difficulty of your exam cf benchmark

■ Harder

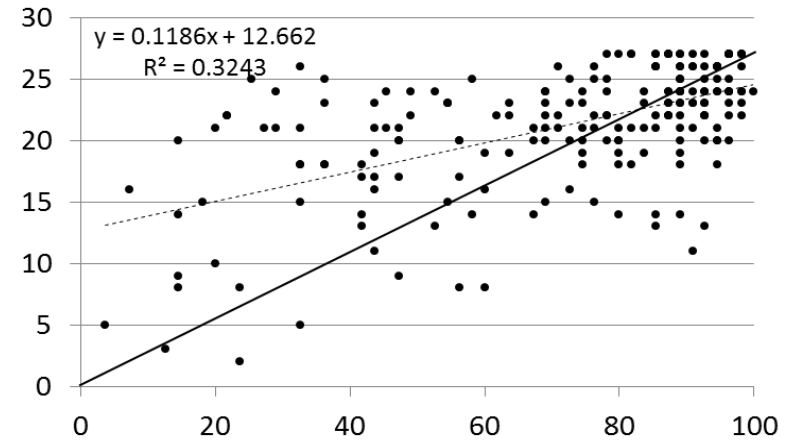


■ Easier

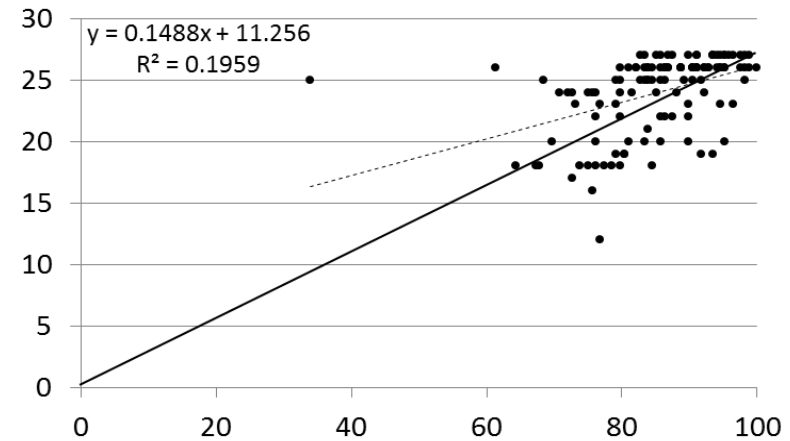


# Difficulty of your exam for your students

- Moderately challenging



- Too easy?



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# Some issues

- Uniformity of coverage
- Uniformity of marking
- Bonus marks
- Language dependence
- Prior exposure to question types
- Understanding and interpreting the results



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# Summary

- Ten small questions to form part of a final exam
- A uniform 'marking' scheme
- Can tell you
  - performance of your class against the benchmark
  - topics that might require attention
  - relative performance of different offerings or approaches
  - size of your exam
  - difficulty of your exam compared with benchmark questions
  - difficulty of your exam for your students

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# Curious about your course?

- The Java versions of the questions have appeared in two published papers
- We have versions available in five programming languages
- We would love other people to use them
- We would love other people to share their results with us, but that's not mandatory
- The questions and marking guides are available from Simon

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