Specifications Grading for Success in Statistics Education

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# Why Do We 'Grade' Students?

I have four questions for you to consider.

- What is the **purpose** of assessing students' work?

- Where did grades **come from**?

- How do we grade, and **cui bono**?

- How do we **resolve the conflict** between grade stakeholders?

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An overly hyperbolic statement

I do not know one (statistics) colleague who genuinely enjoys the act of grading undergraduate student work. It is drudgery at best; hellish at worst.

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What is Specifications Grading?
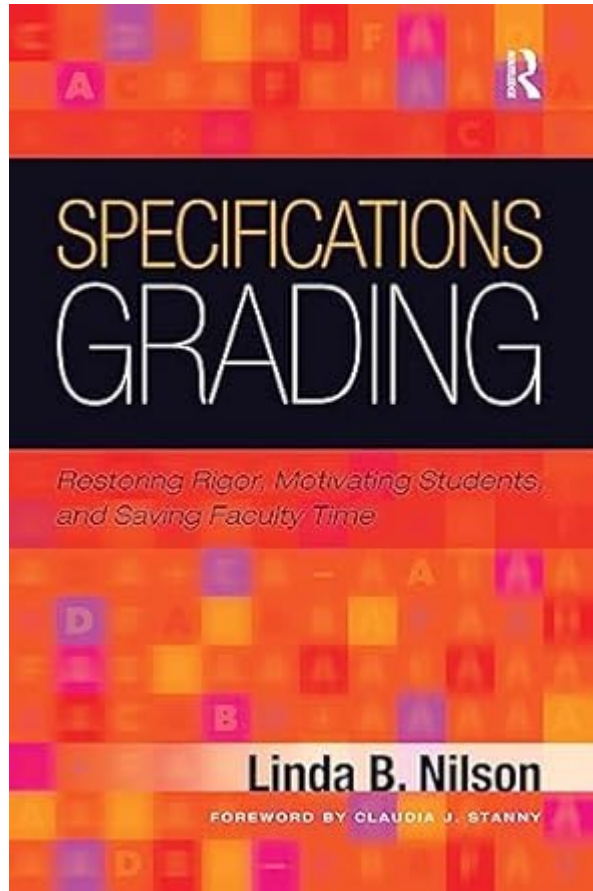
- book released in 2014
- I became aware of it via a colleague (K. Kinnaird, at ICOTS10 in Kyoto!) in 2018
- tried it the following semester
- immediate convert to the **concept**
- (courtesy of dinner with Helen) a modern version of the **Keller Plan** (1965-68)

SPECIFICATIONS GRADING

Restoring Rigor, Motivating Students, and Saving Faculty Time

Linda B. Nilson

FOREWORD BY CLAUDIA J. STANNY

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How Far Has This Spread?

- numerous converts in the mathematical, statistical and computational sciences

- some publicity in 2016, then a surge of interest after 2020

- some links for those interested

- Inside Higher Ed (2016)

- university example 1

- university example 2

- university example 3

- Grading for Equity book

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My Experience

I teach a broad cross-section of 2nd through 4th year undergraduate courses, and occasional graduate specialist courses. I have implemented variations of specifications grading in:

- 5 iterations of Mathematical Statistics (2nd year)
- 2 iterations of Stochastic Processes (4th year)
- 3 iterations of Linear Models (3rd year)
- 2 iterations of Experimental Design (4th year)
- 1 iteration of Statistical Learning (3rd year)

All from 2018 Fall through 2023 Winter - 5 years.

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How does it work: Mathematical Statistics

- broke course down into the most atomic learning outcomes feasible

- in its latest iteration:
    - a total of 30 target concepts, with 15 accompanying challenge areas (45 modular pieces)
    - students work independently, submitting work weekly
    - any item can be redone: all are graded on successful/unsuccessful (S/U)
    - maximum number of **submissions** per week

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Mathematical Statistics: Example Topics

- Target Concept 13: Sampling Distributions I
- Target Concept 21: Bootstrap-t CIs for Means
- Challenge Problem 9: Parametric CI Simulation

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How does it Work: Linear Models

- second major course, Linear Models, is a 3rd-year course on linear models for statistics majors

- students largely **choose** to be in the class,

- more mathematically and academically mature than the students in Mathematical Statistics

- the course is broken into modules, each of which is fairly broad

- each module has a bank of problems

- students complete a set number of problems from each module (e.g., best 6 count)

- they may do as few or as many problems as they wish

- each problem is graded on a NA/Bronze/Silver/Gold scale

- problems may not be redone, but additional problems from the module may

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Advantages to Both

- grading is very simple - specifications make for extremely easy and rapid assessment of student performance

- students have full control over their final grades, based entirely on their performance on the assessments

- significantly reduced grade and test anxiety

- feedback feels meaningful but not punitive

- most students really like the system

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Disadvantages to Both

- both systems are more complicated to implement

- preparing larger banks of problems, and refreshing them, is higher workload

- students can fall behind, and have no effective way of 'catching up'

- depends heavily on student engagement and academic integrity

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Is It Worth It?

I can't imagine going back. Students are happier, I'm happier, and the students' overall comprehension is either higher, or at least comparable at worst.

I don't hate grading when it's done in this framework.

If you are interested in trying a variation, reach out: I'd be happy to share my materials and details of my implementations.

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Contact Details

- Contact me: Email or Twitter

- Slides created via the R package xaringan by Yihui Xie

- Slides and source at http://bit.ly/ozcots2023_wsb

- there's a paper in the proceedings with more detail and musings