Using Writing to Assess and Improve Student Learning

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Agenda

- Background on using writing in statistics
- Background on assessment
- Why use writing?
- How use writing?
- Case study examples
Background on “Writing”

Early Work:

Background on “Writing” (cont.)

Recent Work:

- Spurrier, J.D. (2001). *A capstone course for undergraduate statistics majors*
Background on “Assessment”

- Hubbard, R. (1997). *Assessment and the process of learning statistics*
- O’Connell, A.A. (2002). *Student perceptions of assessment strategies in a multivariate statistics course*
Highlighted Work on Assessment

Garfield, J. (1994) *Beyond testing and grading: Using assessment to improve student learning*

- Summarized trends in assessment
- Observed “mismatch between traditional assessment and desired student outcomes.”
- Presented framework for “categorizing and developing appropriate assessment instruments and procedures”
Highlighted Work on Assessment (cont.)

Chance, B. (1997) *Experiences with Authentic assessment techniques in an introductory statistics course*

- Presented techniques of assessment used in introductory statistics courses
- Used projects, “technical reports” and journals
- Stressed importance of “communication skills”
- Provided essential features of effective assessment techniques
Highlighted Work on Assessment (cont.)

Garfield, J. et al. (2002) *First courses in statistical science: The status of educational reform efforts*

- Conducted survey of teachers of first statistics course
- Teachers did not mention using “writing,” although at least one reported asking students to keep “journals of both statistical problems and reactions to the course.”
- Authors recommended the need for “high quality assessments to ..determine how well the ‘new’ courses are preparing students to think, reason, and communicate, using statistics.”
Why do we assess students?

- To evaluate:
  - Knowledge of material
  - Independent thinking ability
  - Communication skills
  - Competence (conceptual, computational, and technological)
  - Collaborative skills

Why use writing?

- Communication
- Written Work
- Collaboration
- Competence
Purposes of Assessment?

- To improve student learning and to provide information to students and instructors on:
  - How well students understand topics
  - Students’ perceptions and reactions to material
  - Students’ success in achieving course goals
  - Students’ strengths and weaknesses

Why use writing?

Communication

Collaboration

Written Work

Competence

Reveals student perceptions and understanding of material

Are we achieving course goals? What are weaknesses?
Questions addressed with writing

- What are student perceptions of concepts?
  - (e.g., confidence, variability, normalization?)
- What are student strengths?
  - (e.g., implementation? Selecting appropriate analyses?)
- What are student weaknesses?
  - (e.g., interpretation? Application to real data?)
- Are we achieving course goals?
  - (e.g., conceptual learning? collaborative learning? Appreciation of ethical treatment of data?)
What makes a good writing assignment?

Assignments should be:¹

- Linked to course objectives
- Sequenced from less complex to more complex
- Well-defined (stating topic, purpose, audience, and deliverable)
- Assigned with clear evaluation criteria
- Integrated into context of course
- Structured with progress reports and/or drafts

More thoughts on good assignments…

Assignments should:\(^1\)
- Provide students with timely, constructive, regenerative feedback
- Promote self-reflection and higher-order thinking
- Provide students with guidelines of what is expected
- Be consistent and fair
- Make goals of evaluation clear
- Be well-integrated into the course

Sample Approach

- Set expectations early
  - Emphasize importance of writing on 1st day
- Assign weekly lab/case reports
  - Begin with week 1 or 2 and be consistent
- Provide clear structure
  - Introduction; Methods; Results; Recommendations
- Provide template of exemplary work
- Give clear/specific feedback
- Repeat Process
## Sample Introductory Statistics Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Written Assignments</th>
<th>Suggested Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data collection</td>
<td></td>
<td>Decisions in New Product</td>
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<tr>
<td></td>
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<td>Development (NPD) (A)</td>
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<tr>
<td>2</td>
<td>Data description/presentation</td>
<td>Written Report #1 due</td>
<td>NPD (B) or Space Shuttle Challenger</td>
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<tr>
<td>3</td>
<td>Categorical data</td>
<td>Written Report #2 due</td>
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<tr>
<td>4</td>
<td>Probability</td>
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<td>NPD(B2) or Drug and Disease Testing</td>
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<td>5</td>
<td>Discrete RV's</td>
<td>Written Report #3 due</td>
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<td>6</td>
<td>Normal distribution</td>
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<tr>
<td>7</td>
<td>Sampling dist's</td>
<td></td>
<td>CLT for Census Data</td>
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<tr>
<td>8</td>
<td>Estimation: t-dist; CI's</td>
<td>Written Report #4 due</td>
<td>Risk and Return in World Markets</td>
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<tr>
<td>9</td>
<td>Hypothesis Testing</td>
<td>Written Report #5 due</td>
<td>NPD (C)</td>
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<tr>
<td>10</td>
<td>Chi-Square Test</td>
<td>Written Report #6 due</td>
<td>NPD (D) or Air Bags</td>
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<td>11</td>
<td>Simple Linear Regression</td>
<td>Written Report #7 due</td>
<td>Mutual Fund Flows</td>
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<tr>
<td>12</td>
<td>Review</td>
<td>Written Report #8 due</td>
<td></td>
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</tbody>
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Added information

- Students work in pairs
- Students are required to use technology each week
- Students are given opportunity to rewrite reports
- Students are expected to follow guidelines for figures, tables, graphs, and exhibits
- Written assignments often accompanied by weekly oral presentations (each team presents once)
How to avoid assessment overload\textsuperscript{1}

- Give team assignments
- Design assignments carefully
- Distribute examples of prior work
- Include assessment criteria
- Use peer feedback for revisions
- Use grading standards
- Resist over marking and editing
- Focus comments on main points

Case Study: Using Garfield Framework

**What:** Students’ ability to apply the concepts of confidence intervals and variability to real data and ability to interpret and discuss results accurately.

**Purpose:** To determine if students are able to use the concept of confidence intervals to compare and contrast volatile financial data.

**Method:** A student lab/case, where a prior sample report is made available on the web.

**Who:** Students work in teams of two and instructor evaluates the written report.

**Feedback:** Instructor returns the report the following week with an overall grade and specific comments re: quality of writing (organization, grammar, spelling, etc.) and content (type of graphics used/omitted; treatment of data; conclusions, etc.)
Case Study

Case w/ Sample Student Work

- Risk and Return in World Markets
- Motor Vehicle Fatalities