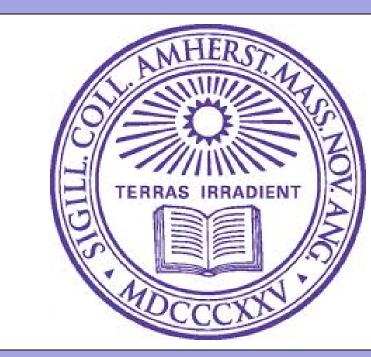# Writing Assignments in a Second Statistics Course

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Introduction

We focus on assessing and improving writing assignments in a second statistics course. Capped at 24 students (recent class sizes 25 and 30), this course covers simple linear regression (as a transition topic), multiple regression, ANOVA, experimental design, and logistic regression methods. Students use the statistical software R (with RStudio and RMarkdown) in weekly hands-on activities to practice the techniques they are learning about. Writing assignments are paired with more traditional homework assignments to solidify conceptual understanding.

Motivation

We examined our curriculum in light of the revised curriculum guidelines[1] and wanted to put more focus on communication skills. Recently, we found that some of our senior majors were having trouble with the writing aspect of their comprehensive evaluation project (required for graduation), in which they research and explain a statistical topic new to them. We decided to integrate more writing throughout our curriculum to help address this issue. In particular, writing assignments were added to this second course to enhance the written communication skills of our students (and in particular, our majors), as they transitioned from introductory to upper-level coursework.

Writing Assignments

Assignment	Length	Paired with…
Meaningful Paragraphs	1-2 paragraphs	Homework; due before homework assignment
Reflections	1 page	Ethics and p-value modules
Design Critique	2-4 pages	Design unit; due after homework
Abstract (practice)	1 paragraph	Due 2 weeks before project report
Course Project Report	10-12 pages	Oral presentation and technical appendix

Recent versions of the course had different numbers of reflections, and one omitted the design critique in an attempt to balance the writing out over the course of the semester.

References:
[1] American Statistical Association Undergraduate Guidelines Workgroup, 2014 Curriculum Guidelines for Undergraduate Programs in Statistical Science, American Statistical Association, 2014.
[2] Jordan, J. (2008), "Writing Assignments in an Introductory Statistics Course," in *CAUSE Teaching and Learning Webinar Series; May 13, 2008*. Available at: https://www.causeweb.org/webinar/teaching/2008-05/
[3] J.L. Green and E.E. Blankenship (2015), "Fostering Conceptual Understanding in Mathematical Statistics", *The American Statistician*, Vol 69 (4), 315-325.

Meaningful Paragraphs

A "meaningful paragraph" (MP) is a continuous piece of writing that uses all the listed terms and demonstrates that you understand the terms and can use them meaningfully in context[2]. In [2], Jordan credits Elaine Backus with creating the assignment.

For this course, the "meaningful paragraph" was introduced to students early on, with multiple paragraphs due in the first half of the semester. The prompt listed the criteria (adapted from [3]) for evaluation as:
• Knowledge of and incorporation of all listed terms
• Quality of writing (includes proofreading and organization)
• Creativity and originality

Based on the submissions, the instructor noted that some students were having trouble with the assignment. Given her limited experience in teaching writing, she reached out to the Writing Center for help and was matched with a writing consultant. Together, they embarked on a quest to help students succeed at these assignments – examining the assignment itself and the instructor's feedback for ways to improve both.

Revision Process

Writing Troubles

• Some students' paragraphs failed to show the relationship among the set of terms or to develop a scenario in which all of the terms could be used in a meaningful way.

• The scenarios were often not written for an audience outside of the student's head; they were not explained fully and clearly enough for the instructor to understand, leaving her with many questions.

Revising the Prompt

Have we actually asked for what we want?

We talked about the purpose of the assignment and revised the criteria to address the "writing troubles." We added "cohesion" and "appropriateness of scenario" and took out "creativity and originality," which, while important, are less crucial than whether the context the student creates actually works.

How can we offer students the tools to succeed?

The instructor thought through the steps she would take in order to write a meaningful paragraph herself, so that she could suggest a process the students could follow. She wanted to make sure students grasped the terms and their relationships and then identified the features the scenario would need before brainstorming an original, creative context in which to present the terms.

Writing for an Audience

• In order to encourage students to write for an audience, we directed them to "be sure [to] provide enough detail … for a reader to follow it."

• We also provided an example of a vague scenario and a specific one and explained what is missing from the first that "might be an important detail for a reader to know."

Improving Feedback

Following a coaching model, rather than a corrective one, the instructor could use the language of the prompt to indicate both what needs work and what steps the student might take to improve, rather than simply pointing to problems specific to the set of terms at hand.

Feedback: *Hi, Michael. I am concerned that you might have mixed up 2 sample t-tests (or ANOVA) and regression situations. The setup you describe would make me think of comparing means (of some variable) between groups of ants, but I'm not sure what variables you'd be comparing here. Is it time to response? Amount of sugar picked up? Most of your fellow students identified the situation as regression, and then picked two quantitative variables to brainstorm a situation for. It looks like you have some of the concepts down, but you might want to talk with me about the mix-up in setting (or maybe just very unclear setting).*

Proposed Feedback: *Michael, your paragraph shows a good grasp of some of the concepts and is suitably original. However, it seems as if your creativity with the ant scenario got in the way of showing your understanding of some of the terms and how they relate to one another. I'm not sure at what point in the process you got off track, but I would suggest you revise this, going back to the beginning of the process outlined by the prompt. You'll want to be sure not to confuse 2 sample t-tests (or ANOVA) and regression situations and to be clear what kind of variables the concepts call for and what variables you are comparing. After you take a stab at revising, I suggest you see me and/or someone at the Writing Center. I look forward to seeing you improve on this, which I'm certain you will.*

Additionally, as a coach, the instructor could, particularly for the first assignment or two, reinforce what students has done well, rather than simply indicating a lack of error. This would help them understand what they have done well and also be more rewarding and encouraging.

Feedback: *Elizabeth, this was fun to read and I saw no issues with your grasp of the statistical concepts. Nice job!*

Proposed feedback: *Great job, Elizabeth! Not only was your scenario compelling and fun to read, but it also worked extremely well as a context in which to show the relationships among all of the terms. I look forward to reading your next paragraph.*

Improved Version of MP Prompt

Revised Criteria

Meaningful paragraphs will be assessed based on the following criteria (highest priority first):
• Knowledge of and incorporation of all listed terms
• Cohesion (how well the terms are used together)
• Appropriateness of scenario/context (Is the scenario developed appropriate for use of all terms?)
• Quality of writing (includes proofreading, organization, clarity)

Suggested Process

• Read and review the list of terms
• Identify the relationships among terms
• Determine what features your scenario/context needs to have to include all terms (for example, do you need one or more variables? do you need quantitative or categorical variables?)
• Brainstorm scenarios/contexts with the appropriate features

Note: This process might iterate. You might have a context in mind that you have to adapt once you realize it needs a particular feature in order to include all terms.

Next Steps

The process used to improve the meaningful paragraph assignment can be applied to the other course assignments. Here are some suggestions if you'd like to apply the process to your own assignments:

Assignment Design Questions

• What is the purpose of this assignment?
• Have I made the purpose and evaluative criteria clear?
• Have I prepared my students for this task?
• How would one go about executing this task?
• Have I offered my students strategies to succeed?

Feedback Suggestions

• Use coaching feedback rather than only corrective feedback.
• Reinforce what students have done well.
• Use criteria and suggested process from prompt to help students improve.

Conclusions

Our statisticians had not used the Writing Center as a resource as we infused more writing in our curriculum. Once we asked for help, we learned a lot of useful information. Collaborations continue, including workshops for faculty on improving assignments. Check out what writing resources are available to you if you are adding more writing to your courses!

For the MP assignment, the improved prompt and provided process seemed to help students in the second semester of the course. Since this evidence is anecdotal, work ahead includes a study examining the impact of writing assignments on student attitudes and conceptual understanding.