Take-home Midterm - Statistics 158, Fall 2023

Due Saturday October 14, 12:00 PM PDT

1 Overall Guidelines

You are allowed to use textbooks, R documentation, notes, scientific papers, and other written materials in print or online to help you complete this assignment (note that you must give written attribution when using information from such a source). However, **you must not consult any other person** about any aspect of your project. If you have clarification or logistical questions about the assignment instructions below or about submission, you may contact Prof. Pimentel and the course staff by private bCourses message. The course staff will not answer content-related questions.

You will have 72 hours to complete the assignment. However, the assignment itself should require only a very small fraction of that time to complete. As a result, we do not plan to give extensions, and you should budget your time carefully in accordance with this policy, especially if you have other assignments or other unavoidable conflicts during the period of the midterm.

2 Experimental context

Employers wish to design workplace environments and employee interactions in such a way that employees are motivated to excel in work-related tasks. One approach is to encourage employees to consciously set and pursue goals for their own productivity. However, there is also substantial evidence from past studies in psychology that subtle "priming" factors can substantially influence human behavior even when the human subject is not consciously aware of the change. For example, in one study people who were shown a picture of a library on a computer screen subsequently spoke more softly than those who did not see the picture. There is debate within psychology about the relative importance of conscious and unconscious factors in determining a person's motivation to complete a task.

We now consider a study[1] that aims to quantify and compare the effects of conscious and non-conscious goals in a workplace. In the study, which uses a balanced and completely randomized factorial design, 96 workers in a call center were tasked with making phone calls to solicit donations for a university. At the beginnning of the shift, employees were given an information packet containing the same written information about the university. However, to investigate unconscious motivation arising from priming, one third of employees received packets containing a clearly printed color photo of a woman winning a race on the backdrop of the page, another third of employees instead received packets with a collage of achievement-related photos printed near the top of the page, and the final third received packets printed with no accompanying images (an example page from the first type of packet is shown at the end of this document). In addition, to investigate conscious goal-setting, half of employees were given a specific goal of $1200 to raise during their shift, while the other half were simply urged to do their best to raise as much money as possible. At the end of the three-hour shift, the number of dollars raised by each employee was recorded. The data is provided in the file `motivation.csv` available under Data on bCourses.

[1] Based on Shantz (2008), "An Exploratory Field Experiment of the Effect of Non-conscious and Conscious Goals on Employee Performance," University of Toronto, Toronto, Canada.

3 Tasks

1. (15 points) Describe in detail the units, conditions, and response for this experiment. Describe the form of the potential outcomes and report how many potential outcomes there are (as a function of the total number of subjects in the study N). Comment on the reliability and validity of the response.
2. (7 points) Imagine you were tasked with carrying out this experiment or training others to do so. Provide a detailed step-by-step procedure for how you would randomize units to treatments, and comment on any other steps you would take to eliminate possible confounding factors.
3. (15 points) Conduct an exploratory/informal analysis of the data. Comment on any major patterns you observe in the data and on the potential presence or absence of interactions.
4. (35 points) Conduct and report inferences for all the structural factors in the experiment using randomization inference. In addition, describe three contrasts that you judge to be potentially interesting (explain why), estimate them, and conduct inference for them. At least one of these contrasts should not be a pairwise contrast. Address multiple testing for the contrasts and explain why the approach you chose is appropriate.
5. (5 points) Summarize your findings and explain the strengths and weaknesses of the study's design. In particular, articulate in what way these finding are more trustworthy than similar findings from a purely observational study.
6. (18 points) Imagine a second version of this same study is being planned. Describe how you could use blocking to improve the design and how exactly the resulting design might be better. Be specific about the blocking factor(s) you would recommend using and why. Provide a detailed step-by-step procedure for how you would randomize units to treatments in the proposed block design.

In addition, your work will be evaluated overall for quality of writing (5 points). This includes clarity, concision, level of detail, and observance of the submission requirements below.

4 Submission

Please submit a report summarizing your work on the given tasks on Gradescope.Your full R code should be included as an appendix at the end of the report (although it's fine to include concise code snippets in the body of the report as well if you want). Please comment your code so it is easy to understand and tag it on Gradescope to each corresponding task. Figures should be carefully chosen, labeled, and referred to in the text. You should also include a cover page with your name and your student ID; **you should not include your name in the body of the report itself**. The maximum number of pages allowed in the report is **ten** (excluding the cover page and any appendices).

Information Sheet

UofT now offers one of the best athletic and recreational experiences the world has to offer. The new field, located on St. George campus, recently received a 2-star rating from the Federation Internationale de Football Association (FIFA), the soccer governing body's GOLD standard for performance. This signals UofT's commitment to providing the best to its students. A dome covers the field in the winter months, and will be taken down in April for the summer.

Scientists at UofT have isolated another gene responsible for Alzheimer's disease in January 2007. This isn't the first Alzheimer's gene to be identified at UofT's Centre for Research in Neurogenerative Diseases – in 1995, they found 2 others that cause aggressive early onset of Alzheimer's.

A student from UofT Scarb was chosen to represent Canada as a goodwill youth ambassador to the UN. Matthew Cimone will spend a 2-year term with the UN, focusing on issues that affect the world's youth.

Three undergraduate students from UofT won first prize in the Chartered Accountant Campus Challenge, a competition sponsored by the Institute of Chartered Accountants of Ontario (ICAO).

Margart MacMillan from Trinity College is a finalist for the Lionel Gelber Prize for the 'world's best books on international affairs.' Her book is called, 'Nixon in China: The Week that Changed the World.'

Alumni may save up to 40% on seats to the Toronto Raptors games from now until April, 2007. www.alumni.utoronto.ca

In late December, 2006, the UofT Art Centre Lounge at University College was opened. Jazz musicians from the Faculty of Music play there. This promotes UofT's goal of creating more student spaces to relax and study.

Great North Run 5 10 02 SONIA O'SULLIVAN (Ireland) wins in 67 mins 19 secs

photograph by Mark Shearman