Math/ISyE 6783 Homework 1; Regression in R

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1. Submit your report and software in a single file in T-square.
2. The file names should be

   submission_Last Name_First Name.pdf (or .zip or .docx, etc).

   (5% penalty for not following this instruction.)
3. Due time: Tuesday, February 2, 1:35PM; For online students, the due time will be a week after.
4. Later submission has a penalty that is described in the syllabus.
5. Report writing advisories are attached at the end.
6. Start earlier, to avoid last minute technical difficulty.
7. For handwritten (acceptable however not encouraged) solutions, scan into PDF file for submission.

Problem Description.

The attached data set (w_logret_3automanu.txt) includes weekly log returns of three auto manufacturers: Toyota Motor Corp., Ford Motor Corp., and GM. Treat the log returns of GM as response and log returns of Toyota and Ford as predictors. Fit a linear regression model in R. Perform necessary model diagnostics. Is linear regression a useful tool for this data set? Do you need to do any model selection?

Write a report to a banker who thinks that linear regression can be utilized, so that he can use the log returns of Toyota and Ford to interpret the log returns of GM. Your conclusion can go either way. Your justification should be convincing.

Report Writing. Given the lecture materials, the implementation part should not be that hard. The style of writing of your report will play an important role in grading. Below are some suggestions:

- One thing to keep in mind is: "Explain it to your roommate!" Pretend that individuals who will read this report does *not* understand statistics like you do, and it is your job to digest your findings and report them in a user-friendly format. Each paragraph and each section should transition smoothly. The report can be broken into sections. Each section could also be broken into sub-sections. Apart from a few graphs and tables that complement your writing, please put ALL other materials (such as R and SAS scripts) into the Appendix.

  You may imagine that you are actually writing a short conference paper.

  You suppose to write this report in Word or Latex.

- *Write a Summary.* This section should be considered the "snap shot" of your report. It should provide a brief background of the problem you are studying and a succinct summary of your findings. The Summary should be a stand-alone piece. The reader should be able to get the gist of your report from reading it. A good summary can coax the reader to read further. Novel findings and results should be shared so that the reader gets excited about the subject matter. See last page on more professional advices of writing a summary.
- *Introduction.* Many find that the Summary and the Introduction are extremely similar, and they are, but the Introduction goes into greater detail about the contents of your report. In this section, the writer can elaborate more on the following: methods used, major findings and an overview of the report. The writer can go as far as providing brief descriptions of the contents of each section. Please remember, when outlining the methods and findings, do not mention all methods used or findings that are insignificant. Highlight the key methods used and findings that impact the study the most.
- *Main Body.* You describe here your work in details. Pay attention to the organization and transition of your writing.
- *Conclusion.* You briefly summarize what you have achieved. You can also discussion what you have done and future works.
- *Appendix.* R and SAS scripts and other figures and tables that are not needed to be part of the main text can be put here.
- *Reference.* List useful references here. If someone wants to find literature points for your work or for further study, they should find them here. If you are using the Latex, you are welcome to use the Bibtex in building the Reference.

In the end, you want to have the banker think that you are hirable.

Hewitt, J. (Winter 2004). First Impressions: Writing a Good Abstract. *The Communication Factor* (Newsletter of the Cain Project in Engineering and Professional Communication at Rice University), p. 2.

First Impressions: Writing a Good Abstract

Because an abstract often determines if a published paper or dissertation will be read or ignored, a writer needs to pack persuasive information into a few words.

If an abstract answers the Seven Key Questions in the box to the right, it is likely to be complete and enticing.

A single sentence may answer or signal the answer to more than one of the seven questions. For example, Importance, Contribution, and Application may well be covered in the same few words, and a clear elucidation of the problem may well include other aspects.

Seven Key Questions

1. **Clear Focus**. Does the abstract make clear what work needed to be done, what problem needed to be solved?
2. **Method(s)**. What method(s) were applied to address the problem? Why these particular methods?
3. **Importance**. Why should we care about this research?
4. **Context**. How does this work fit in with other work in the field?
5. **Results**. What, specifically, are the results? What evidence is given to convince us of those results?
6. **Unique Contribution**. What does this work report that is new?
7. **Possible Applications**. In what ways might this work be useful, either theoretically or practically?

Annotated Sample Abstract

This abstract is from "Directional Hypercomplex Wavelets for Multidimensional Signal Analysis and Processing" by Wai Lam Chan, Hyeokho Choi, and Richard G. Baraniuk, all in the ECE Department at Rice. The sentences are numbered for easier reference in the comments below.

Abstract	***Comments on Each Sentence in the Abstract***
1. We extend the wavelet transform to handle multidimensional signals that are smooth save for singularities along lower-dimensional manifolds. 2. We first generalize the complex wavelet transform to higher dimensions using a multidimensional Hilbert transform. 3. Then, using the resulting hypercomplex wavelet transform (HWT) as a building block, we construct new classes of nearly shift-invariant wavelet frames that are oriented along lower-dimensional subspaces. 4. The HWT can be computed efficiently using a 1-D dual-tree complex wavelet transform along each signal axis. 5. We demonstrate how the HWT can be used for fast line detection in 3-D.	1. Instead of writing the all-too-common passive construction, "The wavelet transform is extended to handle…," these authors take possession of and responsibility for the work with the opening word, "We." (Those authors who cannot bring themselves to use "we" even in a multiple-author paper could use "This paper extends" as an alternative.) The verb "extend" not only precisely says what the work does, but also signals context. Clearly, this paper is based on specific prior work on "the wavelet transform" and expands possible applications of the earlier work to specific multidimensional signals. The problem is defined; applications are signaled. As one student said, "There's a lot riding on that word extend," and he's right. Consider what would be lost if the word were the more common (and imprecise) "study" or "discuss." 2. "First" clearly signals to the reader that there will be more than one step in the method. The rest of the sentence gives details about what was done and links the sentence with the "multidimensional" in the title and in the first sentence. 3. This second step in the sequence is clearly signaled and then precisely defined. Though the details are left for the body of the paper, enough is given here to illustrate the actual process. 4. The shift to passive voice works here because it includes the reader as a possible user of this new any computer-driven research project, in which saving time translates to "saving money." 5. "Demonstrate" clearly signals results, evidence, and applications, as well as suggesting importance of the work. Repetition of "HWT" reinforces what has newly been added to the field, and "for fast line detection in 3-D" illustrates the promise of the title or a "multidimensional " application of the wavelet transform.

*V*erb choice in the five sentences illustrates a powerful writing technique. *Extend, generalize, construct, computed*, and *demonstrate* are precise and varied. Each verb signals an exact action necessary for the persuasive progression of the argument.

In summary, this brief abstract defines the focus of the paper, suggests its context, identifies and applies the methods used, shows why those methods work, gives specific results that echo the promise of the title, indicates what is new, and in the final sentence signals evidence for possible applications of this new technique. Impressive and persuasive in only 95 words!