

Students will be assigned to either an individual or team project. The following outlines the deliverables for which you will be responsible. All submissions should be made to Canvas unless working on a project for a client or otherwise instructed. Submissions should include **Rmd, knitted HTML files, .RData, and journals** when appropriate as well as any other necessary files to meet the objective of the submission.

1 WRITTEN DELIVERABLES

1.1 PROBLEM STATEMENT AND ANALYSIS PLAN

Find a data set of interest (preferred, but confer with your professor before finalizing to ensure suitability) or select one from the list provided. Identify an appropriate audience/client for your research project. Determine a reasonable/appropriate research question that a regression/time series analysis on your data could answer. Submit as an organized Word document in Canvas. (5 pt check point)

Make any revisions to your problem statement necessary based on feedback submitted and add a project plan with deadlines to your document. You will want to select likely tasks using the Table of Contents of your text as a guide to develop a concrete plan. The more specific/concrete your plan is the easier your project will be to implement. The Ch 3-6 Lecture order available on the course website will help you determine which sections are pertinent for the project and which are theoretical in nature. (5 pt check point)

1.2 MATHEMATICAL EVIDENCE OF ANALYSIS

Students will use R/RStudio for their analysis. Create an R project to contain all your work and save your environment/history and an R Markdown file to contain your code and the outputs. You will use the RMarkdown file to run and record the results of your analysis. You will submit an RMarkdown file (.Rmd), a knitted .html file, and a workspace file (.RData). Your files should be organized clearly using sections/headers, including text notes/commentary on results presented above the code/output. It is recommended that you knit your file regularly to debug the knitting process as you go (otherwise you may need to spend extensive time before each submission getting your file to knit properly).

- R code should be organized in such a way that it can be run and easily mapped to the work presented in the reports. Use section labels (`#`, `##`, etc.) and impose structure/hierarchy to make it easier to follow and search through your code (use the Outline feature).
- Code should be clearly commented indicating what is being accomplished. They should document how you go about performing the analysis, how to run things in R, how to interpret the results, what to watch out for to avoid problems/mistakes, etc. The goal is for this document to serve as a model for future analysis and/or to provide understanding/insight for future researchers on your project, so keep good notes for yourself.
- Work on learning to format the text portions so that it knits attractively (Latex is helpful here) and is easy to navigate (include a table of contents in the html files).
- Files in R do not autosave, so save both your R Markdown and R Project files often.

1.3 WRITTEN REPORT

Students will present their solution and analysis as written report for decision makers. Descriptives should be included and used to inform the reader about the data. The average person should be able to read your report

and understand what the data says and what your results are, and the statistician should be able to read your report and be convinced based on the statistics that your conclusions are accurate.

The written report should be organized with the following sections: Executive summary, Introduction, Data exploration/preparation/cleaning/feature selection, Model selection/interpretation and validation, Findings/-summary/conclusion, Appendices. More information on what should go into each section is given in RM Ch 20 as well as an example of a written report. The style is a bit more academic than your paper will be, but it can still be helpful.

Be sure to use a standard reporting style to present your test data. (APA is expected when presenting statistical results but is neither required nor recommended for other formatting choices). While it is possible to do poorly on the written report while have a good analysis, it is very hard to do well on the written report with a weak or incomplete analysis.

1.4 RESEARCH JOURNAL

Best practices in research include a systematic method of *journaling* – keeping a record of research-related activity including observations, conjectures, results (both positive and negative), insights, and reflections.

Individual journals should be kept (even when working on a team), and your progress/contribution to work will be evaluated using the journal. Your journal should be digital, be able to be submitted as a Word document or a PDF, and should clearly demonstrate the following characteristics.

1. **Reflection:** The student will succinctly reflect on research activities including work attempted, insights and results gained, and further paths of inquiry to be pursued. (All three of these should be clearly visible in your journal.)
2. **Organization:** The student will create a single document (useful to self and others) that will serve as a quick reference of their work .
3. **Documentation:** The student will document when (dates) and for how long (approximate elapsed time) course-engagement occurred.

GUIDELINES FOR JOURNALING

1. **Style:** As long as all other elements are addressed, the student may use personal style in developing their research journal, although your professor reserves the right to direct changes to improve effectiveness. Journal entries are not meant to be formal pieces of research. Entries are to be useful rather than polished. Informal writing, abbreviation, and bulleted phrases are all acceptable/preferred as long as they can be easily deciphered by another mathematician. Daily entries should take less than five minutes, but based on prior experience students typically don't invest enough time/include enough detail.
 2. **Frequency:** The student should journal on each day that they engage in research activities.
 3. **Date/Time:** Each entry should start with the date, an approximation of total elapsed time for that day, and a running total of time spent on research for that project.
 4. **Entry:** The entry for a day should be a brief synopsis of and reflection on the research activity. Some prompts that could be addressed are ... (Tragically students do not seem to use these prompts.)
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- (a) What was the question you focused on?
- (b) What attempts were made? with what outcomes?
- (c) What challenges appear to be hampering progress? How might these difficulties be resolved?
- (d) What impact might these outcomes have on other avenues of inquiry?
- (e) What questions arose? Do they need immediate attention, future attention, or setting aside?
- (f) What should you work on next time?

5. **Submission:** The Research Journal is to be included with each project submission. Submissions should include your name in the file name as well as on the first page of the file. Failure to submit the journal will result in a 0 on that portion of the submission (your professor will not go searching for it).

1.5 REFLECTION

Reflection is an important part of your learning and professional development. It gives you the opportunity to consider your personal growth and evaluate how a current project fits into your career path. This reflection will ask you to address the four questions listed below.

1. **Course Connections:** How has your experience in the Ma 441, 442 (if applicable), and 444 projects connected to learning (ideas/theory, facts, skills, applications) you have done in courses (or work-experience) in your chosen field?
2. **Career Competencies:** How did your career competencies grow as a result of your project experience this year? (Specifically reference the NACE Career Competencies listed.)

NACE Career Competencies:

- Critical thinking/problem-solving
- Oral/written communication
- Teamwork/collaboration
- Digital technology
- Leadership/initiative
- Professionalism/work ethic
- Career management
- Global intercultural fluency

3. **Critical Thinking:** What problems did you solve related to your project experience this year? How did you solve the problems? (Include a one-sentence definition of critical thinking in your reflection. Problem-solving is NOT the same as critical thinking and should not be the topic of discussion in this section.)
4. **Creation-Fall-Redemption (CFR) Worldview:** How has your project experience helped you develop an understanding of data analysis that is consistent with the biblical arc of creation-fall-redemption? Consider the three distinct elements involved: the mathematical tools in and of themselves, the decisions the analyst has to make, and the use of the results.

This paper is an essay style paper. Each question should comprise its own section (word count per section: 150 - 600 - more is not necessarily better) with each section clearly labeled. This reflection will be collected in five parts, an initial draft for each question based on all your analysis experiences (incorporating the work from both the 441, 442 (if you've already taken it) and 444 projects) and a final draft of all four questions. Your final draft should be revised appropriately based on the feedback provided on your initial drafts.

2 ORAL DELIVERABLES

2.1 MEETINGS

Weekly group meetings will be scheduled. During the weeks of February 10, 24, March 10, April 7, and 21, the meeting will be graded individually.

Come prepared to give an update on your progress and have at least two questions you have about the project, your project planning, or problems you are or anticipate having. This meeting will be a graded activity and your grade will be based on your journal status, your preparation for the meeting, your completion of work, and your participation in the discussion (the more ownership of this meeting you take, the better your grade will be).

You will be assessed on your meetings using the rubric available in Canvas. You should review this in advance and prepare for the meeting.

2.2 ORAL PRESENTATION

You will be assigned to present one (not both) of your projects to the class at the end of the semester. The presentation should be 10-12 minutes in length, summarizing your research question and your analysis with appropriate justification of your findings/solution.

- Slides or visual aids of some kind are required (and should be uploaded to Canvas prior to your presentation).
 - They should be used effectively to enhance your presentation (DO NOT READ THEM to us).
 - Slides are neat, easy to follow, created using good choices regarding coloring/formatting/spacing to promote your message.
 - Your interaction with the slides is comfortable and effective.
- Your presentation should focus on your final model and include the justification of your model over alternatives and the consideration of other important aspects of the analysis (as time allows).
- Personal presentation should be appropriate, professional, and compelling.
- The tone of your presentation is comfortable and conversational (not tense/awkward); interactions (non-verbal possibly also verbal) with the audience should exist throughout the presentation and are comfortable. This means that you understand well and are comfortable with the material that you are presenting and how you present it (it requires practice). Your presentation should engage the audience and generate questions, and you should be able to respond comfortably to any questions posed.
- You need to make efficient, effective, and appropriate use of your time to communicate clearly and effectively.

Your oral presentation grade will be based on the quality/clarity of the presentation you give (not the quality of your data analysis; however presenting poor/unsubstantial content well is nearly impossible).

GRADING RUBRIC FOR RMARKDOWN PROCESS/ANALYSIS _____ % = _____ / 220/135 POINTS

- _____/ 5% Well organized - easily mapped to the work presented in the reports; use of section labels (#, ##, etc.) with easy to follow structure/hierarchy; code is easy for the professor to navigate
- _____/75% Contains all elements needed to perform a thorough analysis/validation and interpret results, which includes the following when appropriate:
- _____/15% Well commented - including text notes/commentary on what is being accomplished and results presented above the code/output; includes notes tasks needed to perform the analysis, how to run things in R, how to interpret the results, what to watch out for to avoid problems/mistakes, etc. (a good model for future analysis); provides understanding/insight for future researchers
- _____/ 5% Professionalism - text portions knits attractively; includes TOC in html; easy to follow
- _____/ 0% Penalty: Overall presentation - solution files are professionally presented/knitted properly; Failure to follow directions, submission did not include all required files (.Rmd, .html, .RData), submitted late (15%, 25%, 35%, 45%), etc.

GRADING RUBRIC FOR FINAL JOURNAL _____ % = _____ / 40/25 POINTS

- _____/85% Effective synopsis/reflection of research: including work attempted, insights and results gained, and further paths of inquiry to be pursued
- _____ Work attempted
- * What was the question you focused on?
 - * What attempts were made? with what outcomes?
- _____ Insights and results gained
- * What attempts were made? with what outcomes?
 - * What challenges appear to be hampering progress? How might these difficulties be resolved?
- _____ Further paths of inquiry
- * What challenges appear to be hampering progress? How might these difficulties be resolved?
 - * What impact might the outcomes have on other avenues of inquiry?
 - * What questions arose? Do they need immediate attention, future attention, or setting aside?
 - * What should you work on next time?
- _____/15% Well organized/easy to read
- _____/ 0% Penalty: Overall presentation - digital (Word/PDF), little/no organization; Failure to follow directions - dates, time, running total time, properly named (file name/first page); Submitted late (15%, 25%, 35%, 45%), etc.

GRADING RUBRIC FOR WRITTEN REPORT _____ % = _____ / 110/65 POINTS

_____/35% Communication

- Clarity/cohesiveness - easy to follow logic, contains all info needed to follow the arguments
- Executive summary – clear/concise written summary, appropriate for someone who reads nothing else
- Intro/problem statement – clearly defines the problem and business context
- Use of tables and graphs – clearly constructed, labeled, and referenced; appropriate usage for clear comm
- Interpretation of model – relates the results of the modeling process to the problem statement
- Findings/conclusions - clearly presented
- Audience – appropriate sections tailored to both decision-maker and statistician; content organized effectively

_____/10% Data Exploration and Feature Selection

- Description of the data – summary statistics and graphs with interpretation
- Selection of features/variables for use in the model – includes creating new features through transformations, discussion of variables available

_____/55% Model Selection and Construction

- Selection and justification of model type – relates model choice to the business problem and the available data
- Identification of issues and corrective steps – includes handling missing data, possible transformations, and potential outliers/influential points
- Estimation of model parameters, with explanation – calibrates the selected model, including selecting features (including variables) from the list previously established, addresses differencing, etc.
- Validation of the selected model – documents that an appropriate validation method was used and provides an estimate of model accuracy using previously unseen data
- Description of selected model – describes the model in appropriate terms for the stated audience
- Appendices - include appropriate statistical results appropriately formatted

_____/ 0% Penalty: Overall presentation - the report is professionally presented/organized/formatted; Inappropriate usage of English, missing required sections, failure to follow directions, submitted late (15%, 25%, 35%, 45%), etc.; Use of figures/tables/equations – clearly constructed, labeled (use table/figure captions and just numbering for equations), and discussed/referenced

No figure/table/equation should be presented without commentary focusing the reader on how they can understand/interpret what they will see in the figure/table/equation (so commentary should start before the figure/etc. is presented and explicitly reference it).

GRADING RUBRIC FOR ORAL PRESENTATION

_____ % = _____ / 75 POINTS

_____/40% Slides/visual aids are used effectively

- Slides are used to complement the presentation (they are NOT read)
- Neat, easy to follow, good choices regarding coloring/formatting/spacing to promote message
- Interaction with the slides is comfortable and effective

_____/20% Sufficient and appropriate content: research question/context, final model, justification of model, consideration of other important aspects of the analysis, etc.

_____/30% Effective oral communication

- Efficient/effective/appropriate use of time to communicate clearly and effectively
- Tone of presentation is comfortable and conversational (not tense/awkward)
- Interactions (nonverbal/verbal) with audience exist throughout the presentation and are comfortable
- Clearly evidence that you understand what you are talking about; inspired confidence in results
- Generate audience response and respond comfortably to any questions

_____/10% Professional/appropriate/compelling personal presentation

_____/ 0% Penalty: Overall presentation - slides not uploaded prior to presentation; Failed to meet time requirements (~ 10-12 minutes) Not presented when scheduled (100%); Failure to follow directions

FINAL REFLECTION

_____ % = _____ / 40 POINTS

	Exemplary (9-10)	Acceptable (7-8)	Developing (0-6)	Score
Course Connections: student will be able to connect the project to other learning	Word-count \geq 150; Draws conclusions between the project and coursework by combining relevant specific examples, facts, or theories from both inside and outside your field of study or perspective.	Word-count \geq 150; Draws conclusions between the project and other courses by combining relevant examples, facts, or theories from either your field of study or another discipline.	Word-count < 150; Draws general conclusions between the project and other courses in your discipline, or attempts to make connections that are not relevant.	Initial: _____ / 5 Final: _____ / 10
Career Competencies: student will be able to grow career competencies through the project.	Word-count \geq 150; Assesses how the project furthered your career skill set by giving specific evidence for growth in four or more career competencies in light of the project.	Word-count \geq 150; Assesses how the project furthered your career skill set by giving specific evidence for growth in only two or three career competencies in light of the project.	Word-count < 150; Assesses how the project furthered your career skill sets by giving specific evidence for growth in only one career competency in light of the project.	Initial: _____ / 5 Final: _____ / 10
Critical Thinking: student will be able to solve problems related to the project.	Word-count \geq 150; Defines critical thinking. Clearly defines a complex problem encountered in the project. Demonstrates how you applied skills, abilities, theories, or methodologies to solve the problem.	Word-count \geq 150; Defines critical thinking. Defines a problem encountered in the project. Applies general learning to solve the problem encountered.	Word-count < 150; Adapts and applies general learning to the work encountered in the project.	Initial: _____ / 5 Final: _____ / 10
CFR Worldview: student will be able to connect the project to biblical worldview.	Word-count \geq 150; Uses specific examples to connect the project with each part of CFR model and relates them to major ideas in Scripture. Explains clear and detailed strategies to counter distortions or fallenness.	Word-count \geq 150; In general terms, connects the project with each part of the CFR model and relates them to general ideas in Scripture. Mentions strategies to counter distortions or fallenness.	Word-count < 150; Deals with some parts of the CFR model. Does not adequately connect the project with the CFR model or to ideas in Scripture. Omits or only mentions strategies to counter distortions.	Initial: _____ / 5 Final: _____ / 10