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Statistical Graphics and Visualization: Course Rubrics

These grading rubrics are from CMU course 36-721, Statistical Graphics and Visualization, Fall 2015. Each rubric targets one of the course learning objectives. The software-agnostic rubrics can be reused with new prompts, making the course updatable and portable. In a variant of "specifications grading," final course grades depend on demonstrating Competent or Sophisticated mastery on enough components. Students may revise and resubmit as needed, which promotes continuous learning. Grading remains simple and consistent.

HW1: Legible Graphics

Component	Competent	Not yet competent
Legible	Image is high-resolution bitmap or vector format. Font is large enough to read easily. Data are not hidden or overwhelmed by ticks, axes, or gridlines. Different colors or symbols are easily distinguishable. Aspect ratio shows data clearly.	Image is low-resolution, grainy, or pixelly. Font is too small to read. Data are hidden by other graph elements. Colors or symbols cannot be distinguished. Aspect ratio causes data to be too bunched up or spread out to see patterns easily.
Comprehensible	Graphic has an informative title, axis labels, and legend (if relevant). Axis ticks are labeled with sensible, round numbers. Graphic axes, legend, colors, etc. are consistent across small multiples (if relevant).	Graphic has no (or unclear) title, axis labels, or legend. Axis ticks are unmarked or are marked at arbitrary, unhelpful numbers. Graphic elements are inconsistent across small multiples.
Informative	Graph clearly highlights any trend or pattern in the data, which is indicated in the title and described in the writeup. Interesting differences or comparisons are plotted directly.	Graph highlights no interesting or useful pattern. Pattern is not indicated in title or not described in writeup. Readers have to mentally compute differences instead of seeing them directly.
Reproducible	Submission includes miminal, clear, standalone code (or written instruction) for reproducing the graphic.	No code or instructions are included; or they are not standalone or do not run/compile; or contain far more than needed to reproduce this graphic.

HW2: Visual Perception

Component	Competent	Not yet competent
Consistency	Meaning of graphical elements is consistent across small multiples. Changes in design are purely data-driven. Visual variables are used only when mapped to data. Semantic associations are used, if possible (e.g. blue = cold, red = hot). More means more (larger size or deeper hue maps to larger value of the variable).	Small multiples are not consistent. Design changes are arbitrary (e.g. new colors for the same categories). Superfluous visual variables are shown (3D, shadow, other variables not mapped to data). Semantic associations are reversed. More (stronger encoding) is mapped to less (lower value of data variable).
Cognition	Differences, proportions, or other important derived variables are plotted directly. Items are ranked by variables on which comparisons are to be made.	User must compute differences, etc. mentally. Ranking is arbitrary or unhelpful for analysis (e.g. alphabetical).
Quantitative Comparisons	Quantitative variables use visual encodings high on the Cleveland-McGill ordering. Encodings are used sensibly (bars start at 0; hues are ordered intuitively; etc.). Elements to be compared are as near each other as possible.	Quantitative variables use visual encodings low on the ordering. Encodings are implemented poorly (bars not anchored at 0; arbitrary hues assigned to quantitative/ordinal variable). Elements to be compared are distant.
Grouping and Search	Gestalt and preattentive processing features are chosen to ease task (find important groups, follow lines, etc.) Elements to be compared are aligned, as much as possible. Distinct variables are mapped to separable dimensions. Choice of colors, shapes, etc. is easy to discriminate.	Difficult to find groups, follow lines, etc. Elements to be compared are not aligned. Distinct variables are mapped to integral dimensions (e.g. point width and height). Distinct elements cannot be discriminated.

HW3: Grammar of Graphics

Component	Competent	Not yet competent
Description	The given graphic is correctly modeled/described in the `ggplot2` framework: `data`, `aes`, `stat`, `geom`, `scale`, `coord`, & `facet`. ('Roughly correct' is OK: this is for a human reader and needn't run/compile.)	The given graphic is not described correctly according to this framework.
Creation	Your graphic is created in `ggplot2` or another GoG-based tool. Demonstrates understanding of the framework and explicitly specifies all or most of its components.	Your graphic is not created in a GoG-based tool. Demonstrates understanding of few or none of the framework components.

P1: Graphic Design

Component	Sophisticated	Competent	Not yet competent
Message	Clear, multifaceted message. Text, graphs, and annotations are used to support the message strongly.	Simplistic but clear message. Text and graphs support the message adequately.	No message, or message is not at all supported by text and graphs.
Graphs	Three or more graphs that complement each other well. Visual style is consistent across graphs, and each demonstrates skills from the Legible and Visual Perception homeworks.	Two or more graphs. Each stands alone well, though may not complement each other and style may not be consistent across graphs.	No graph, or only one graph. Any graphs are unhelpful or unclear.
Color & Font	Shows strong use of principles of **Contrast** and **Repetition**: limited color palette and font choices convey structure and unity.	Effective use of either Contrast or Repetition, though not both.	Poor Contrast (colors or fonts are not clearly distinguished, or are not used to provide structure) and poor Repetition (too many different colors or fonts, and do not convey unity).
Layout	Shows strong use of principles of **Alignment** and **Proximity**: bold alignment guides reader through the graphic; proximity groups related elements together and separates distinct groups.	Effective use of either Alignment or Proximity, though not both. Alignment is adequate within sections of graphic, but not across them.	Poor Alignment (elements are placed haphazardly) and poor Proximity (no obvious grouping of elements or separation of groups; unclear which captions match which text/graphs).
Other	Shows good craftsmanship and use of computer layout. Cites all data sources.	Shows decent craftsmanship on computer layout, with minor imperfections. Cites data sources.	Poor craftsmanship with many imperfections. Does not cite data sources.

P2: Interaction Design

Component	Sophisticated	Competent	Not yet competent
Message	Clear, multifaceted message or purpose, supported strongly by text, graphs, and annotations. Starting view is global overview (Shneiderman's mantra).	Simplistic but clear message or purpose. Text and graphs support the message adequately. Starting view opens with reasonable default settings.	No message or purpose, or not supported by text and graphs.
Consistency	Consistent navigation across the graphic (actions, tabs, screens, etc.) Controls are consistent with similar websites/software. All graphs show consistent visual design (as in HW 2 rubric).	Navigation is consistent through most of the graphic, even if controls may be unlike standards in other similar software. Graphs may not all have consistent visual design.	Navigation changes erratically or unhelpfully after different interactions. Graphs have no consistent visual design.
Constraints	Limited number of interactions keeps the interface manageable. Each interaction is constrained to prevent user errors before they happen.	Number of interactions is not overwhelming. If interactions allow user errors, error messages are human-interpretable and helpful.	An overwhelming number of interactions to choose from. Interactions allow bad inputs that lead to unintelligible errors.
Visibility	Each interaction has obvious meaning and predictable consequences. Controls and context-giving annotations do hide as you interact.	Most interactions have clear meaning and consequences. Controls don't hide as you interact, but critical annotations may sometimes hide.	Interactions have no predictable meaning or consequences. Controls and critical annotations get hidden by interactions.
Feedback	Graphic is clear in how it reacts to user's actions. Feedback complements, not interrupts, user's actions. Graph titles, annotations, etc. always reflect user's selections.	Graphic responds to user's actions. Feedback exists but interrupts user (e.g. pop-up box). Graph titles, etc. reflect at least some of user's selections.	Elements that look interactive do not respond. No clear user feedback is given. Graph titles, etc. do not change with user selections.
Other	Three or more interactions. Shows good craftsmanship, with no obvious imperfections. Cites all data sources.	One or two interactions. Shows decent craftsmanship, with minor imperfections. Cites data sources.	No interactions. Poor craftsmanship with many imperfections. Does not cite data sources.

P3: Research

Component	Sophisticated	Competent	Not yet competent
Literature Review	Clear review of two or more related papers on this topic. Shows strong understanding of the problem and proposed solutions.	Clear review of one paper. Adequate understanding of the problem and possible solutions.	No papers reviewed, or review is unclear, or shows no understanding of the problem or solutions.
Guidelines	Report shows strong understanding of the paper's justifications for the proposed solution, as well as guidelines for when it is / is not applicable.	Report covers paper's justifications for their solution, but may not give useful guidelines for its use.	Report shows no understanding of justifications or guidelines for use of the proposed solution.
Application	Proposed solution is implemented and demonstrated on several contrasting examples (either against other related methods, or on several datasets). Code for implementation is clear and reusable (e.g. a well-documented R function).	Proposed solution is implemented and demonstrated on at least one example. Code is functional, though may be hard to reuse on new data.	Proposed solution is not implemented or no demonstration is shown. Code is not given or does not work.
Other	Writing shows good craftsmanship, with no obvious spelling or grammar errors. Gives full citations for mentioned papers/presentations and data sources.	Writing shows decent craftsmanship, with minor errors or typos. Cites papers/presentations and data sources.	Poor craftsmanship with many errors or typos. Does not cite papers or data sources.