

Use of R Markdown in a Graduate Biostatistics Classroom

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Allows students to easily incorporate mathematical symbols and notation into their written comments.

```
31 library(RLRSim)
32 exactLRT(smod, nullmod)
33
34 $H_0S : $\sigma^2 = 0$ v.s. $H_a : $\sigma^2 \neq 0$
35
36 Since the p-value is 0, we would reject the null hypothesis at $\alpha=0.05$
  significance level. In other words, satisfaction differs for different health plans.
```

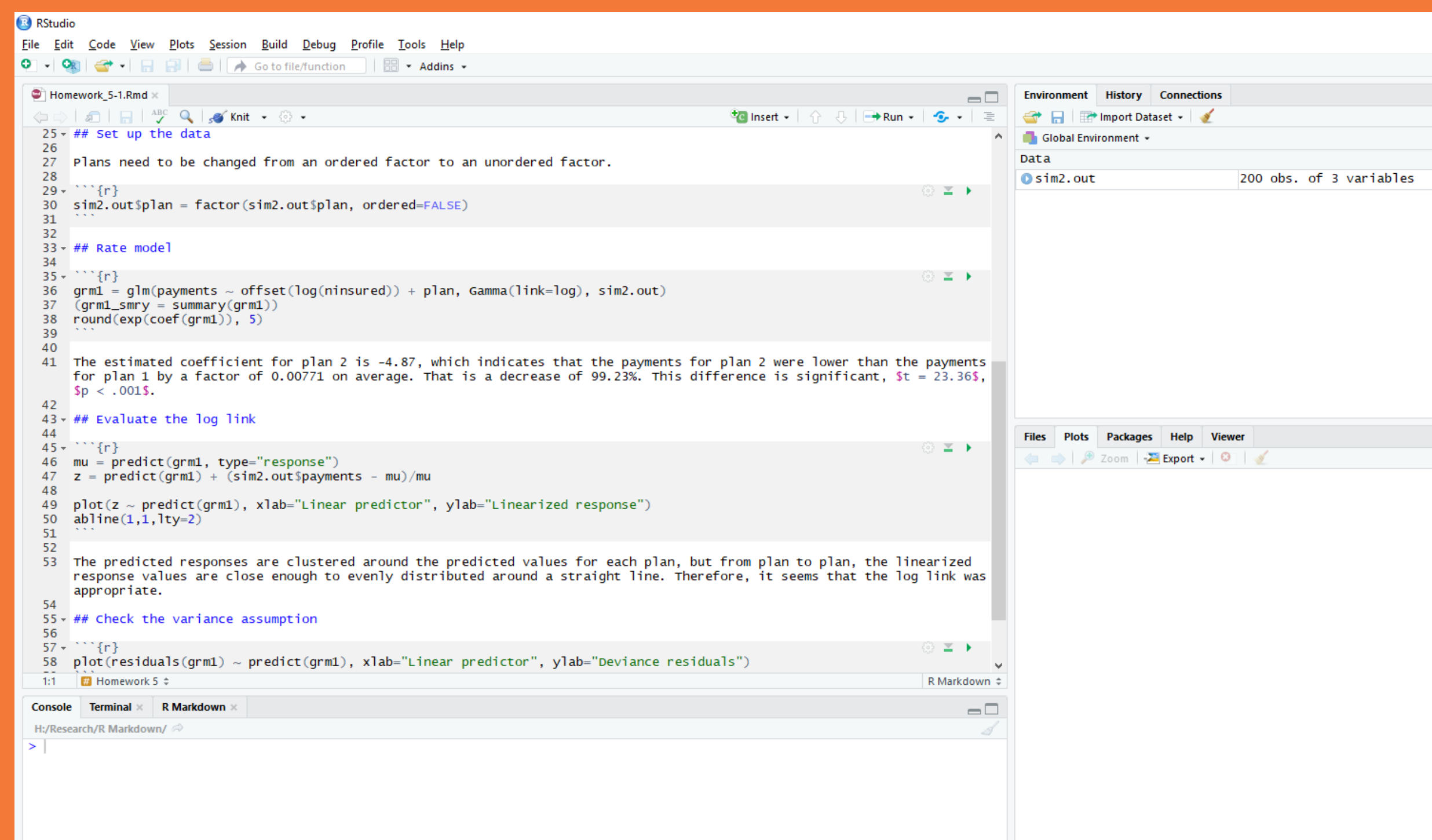
Student Work

```
library(RLRSim)
exactLRT(smod, nullmod)

## No restrictions on fixed effects. REML-based inference preferable.

##
## simulated finite sample distribution of LRT. (p-value based on
## 10000 simulated values)
## data:
## LRT = 0.05, p-value < 2.2e-16
H0: $\sigma^2 = 0$ v.s. $H_a: \sigma^2 \neq 0$
Since the p-value is 0, we would reject the null hypothesis at $\alpha = 0.05$ significance level. In other words, satisfaction differs for different health plans.
```

R Markdown allows students to combine code, output, and formatted text in the same file.



Student Work

“Knit” the document to create your output file.

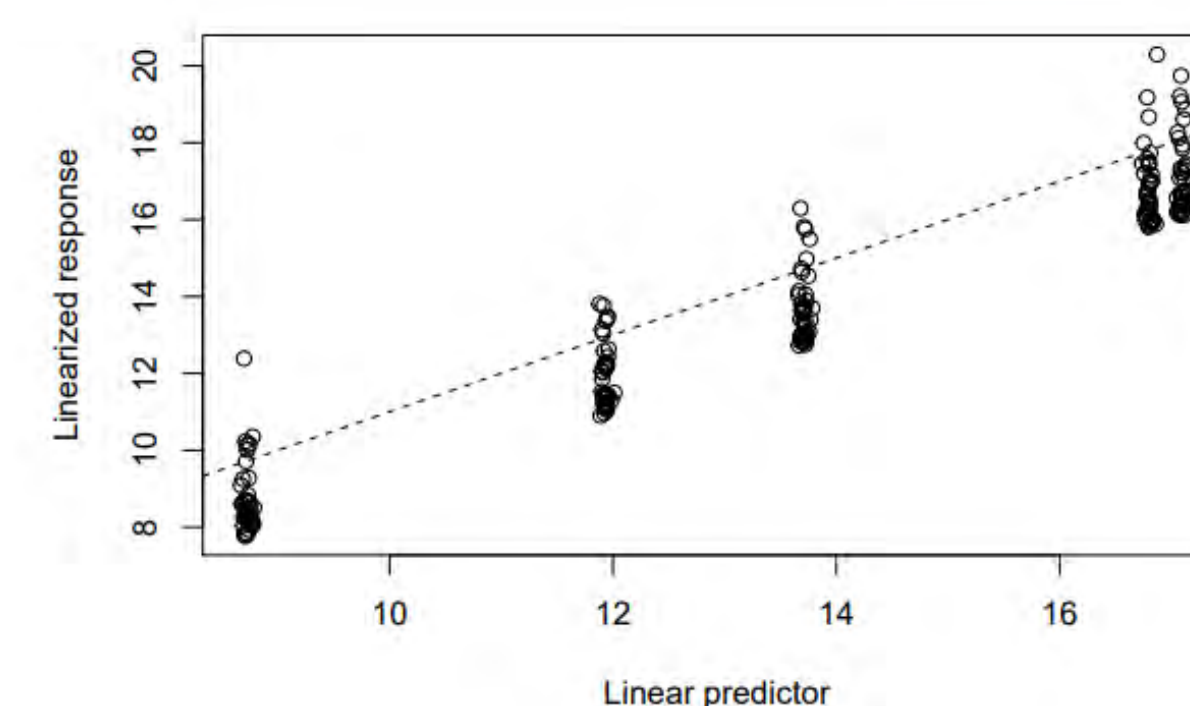
Output will contain your code, code output, and formatted text.

Formats include docx, pdf, html, and many others.

Write R code in designated code chunks.

Outside of the code chunks, write the accompanying text (titles, comments, interpretations, conclusions, etc.).

Use markup annotations (e.g. *, **, `[]`, etc.) to format your text and create professional looking output.



The predicted responses are clustered around the predicted values for each plan, but from plan to plan, the linearized response values are close enough to evenly distributed around a straight line. Therefore, it seems that the log link was appropriate.

GAISE College Report

- Use tools that offer “support for reproducible analysis and integration with word-processing and presentation software”

Carver et al., 2016

R Markdown

- Seamlessly integrates interpretations of statistical methods with R code
- Allows for direct reproducibility of code by replacing the copy-and-paste workflow.

Allaire et al., 2013

Application

- Biostatistics Methods II with both online and face-to-face sections.
- R Markdown encouraged for use with homework assignments and classroom activities (face-to-face only).

14 students in face-to-face section (10 biostat MS, 4 other)

9 students in online section (all biostat MS)

Students

Intervention

Homework submissions using R Markdown

Classroom activities using R Markdown

Likert scale survey on attitudes toward R Markdown

Evaluation

Background Questions

How often had you used R prior to taking this course?

Face-to-Face (14/14)

A few times (7)

Did you watch the R/R Markdown tutorial provided in the Canvas page?

No (8)

R Markdown Statements

0 no opinion, 1 strongly disagree, 2 disagree, 3 indifferent, 4 agree, 5 strongly agree

Mean Score

I find the R Markdown syntax to be simple and understandable.

4.24

When my Markdown document does not compile, I know how to go about fixing it.

4.00

I am frequently frustrated by R Markdown when doing my homework.

2.00

I am frequently frustrated by R when doing my homework.

1.86

R Markdown makes my homework easier to read and understand.

4.50

I would rather copy and paste my results (plots, tables, and numbers) into a word processing program.

1.71

I resent being forced to use R Markdown. It should be my choice how I prepare my homework.

1.71

I found R Markdown to be frustrating at first, but now I've got the hang of it.

3.43

R Markdown makes it easier for me to complete my homework.

4.36

R Markdown makes it more difficult for me to complete my homework.

1.86

R Markdown makes it easier for me to work on in-class activities.

4.15

R Markdown makes it more difficult for me to work on in-class activities.

1.88

I wish I had received a more thorough introduction to the logic and features of R Markdown.

3.36

Baumer et al., 2014

Discussion

- Responses from the face-to-face section suggest a positive overall attitude toward the use of R Markdown (all positive statements > 3.00, most negative statements < 3.00).
- Only 2 out of 9 online students responded to the survey.
- These two students expressed higher levels of frustration with R and R Markdown, possibly indicating that these tools are easier to incorporate in face-to-face settings.
- Both would rather *not* copy and paste results into a word processing program.
- Some evidence of students desiring more introduction/tutorials to R Markdown, especially in the beginning of the course. These may further reduce frustration attributed to R/R Markdown while completing homework assignments.
- Easier to grade than with a copy-paste workflow since instructor can easily view/re-run code when needed.
- Student interviews would be useful to more deeply explore student attitudes toward R Markdown.

References

Allaire, J., Horner, J., Marti, V., & Porte, N. (2013). markdown: Markdown rendering for R.

Baumer, B., Cetinkaya-Rundel, M., Bray, A., Loi, L., Horton, N.J. (2014). R markdown: integrating a reproducible analysis tool into introductory statistics. *Technology Innovations in Statistics Education*.

Carver, R., Everson, M., Gabrosek, J., Horton, N., Lock, R., Mocko, M., ... & Wood, B. (2016). Guidelines for assessment and instruction in statistics education (GAISE) college report 2016.

