Lab 7/8 – MATH 240 – Computational Statistics

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Abstract

In labs 7 and 8, I did a thorough analysis of the beta distribution. This includes an analysis of its parameters, properties, what it looks like, and what it's used for. This information is helpful for the same reason it would be helpful for any probability distribution. They are a way for us to estimate various properties of data that approximately follows a certain probability distribution.

Keywords: Probability, moments, summarize, sample size.

1 Introduction

In this lab, there is not one specific question we want to answer. We more so want to analyze the beta distribution by looking at its use, meaning, parameters, properties, and what it looks like.

We analyze the distribution and its parameters by using multiple sets of parameters, and comparing their plots as well as their numerical summaries. To analyze the properties of the beta distribution, we first see how the mean, variance, skew, and kurtosis vary based on the sample size, and whether or not they converge to the true population values. If you want to see the distribution of these statistics, called sampling distributions, we can do what's called resampling, and store each statistic for every sample we take.

Another question we aim to answer at the end of the lab is which estimators we should use for the beta distribution, method of moments, or maximum likelihood estimates? We can do this through the use of sampling distributions again, but now for the MOM and MLE for each new sample. I used data on country death rates from 2022 as an example. Calculating properties like bias, precision, and mean squared error can tell us which estimator is more optimal.

2 Methods

Describe the data you are working with, if applicable. Describe the specific process you will follow to answer the question at hand. This does not mean you should write something like this.

> *I did this and then I did that and then I did this other thing and then..., and then..., and then...*

Instead, it should provide a clear and concise narrative that flows from the problem specification in the Introduction to how you will approach answering it. This is where I would expect to see some citations for `R` packages you will use to conduct the statistical analysis reported in the Results section.

2.1 Methods Subsection

Much like the Introduction, subsections can be helpful for the Methods section. For example, you might describe data collection and the statistical analyses of the collected data in different subsections. Or, you may have different questions that require distinct methods.

3 Results

Tie together the Introduction – where you introduce the problem at hand – and the methods – what you propose to do to answer the question. Present your data, the results of your analyses, and how each reported aspect contributes to answering the question. This section should include table(s), statistic(s), and graphical displays. Make sure to put the results in a sensible order and that each result contributes a logical and developed solution. It should not just be a list. Avoid being repetitive.

3.1 Results Subsection

Subsections can be helpful for the Results section, too. This can be particularly helpful if you have different questions to answer.

4 Discussion

You should objectively evaluate the evidence you found in the data. Do not embellish or wish-terpet (my made-up phase for making an interpretation you, or the researcher, wants to be true without the data *actually* supporting it). Connect your findings to the existing information you provided in the Introduction.

Finally, provide some concluding remarks that tie together the entire paper. Think of the last part of the results as

abstract-like. Tell the reader what they just consumed – what's the takeaway message?

Bibliography: Note that when you add citations to your bib.bib file *and* you cite them in your document, the bibliography section will automatically populate here.

5 Appendix

If you have anything extra, you can add it here in the appendix. This can include images or tables that don't work well in the two-page setup, code snippets you might want to share, etc.