

Implementation of DGE Workflow using R Shiny

Figure 1: DGE Workflow

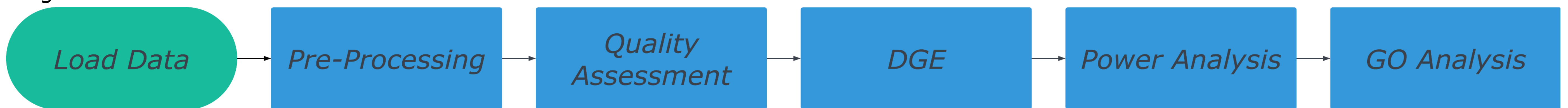


Figure 2: User Interface to define the Study Design

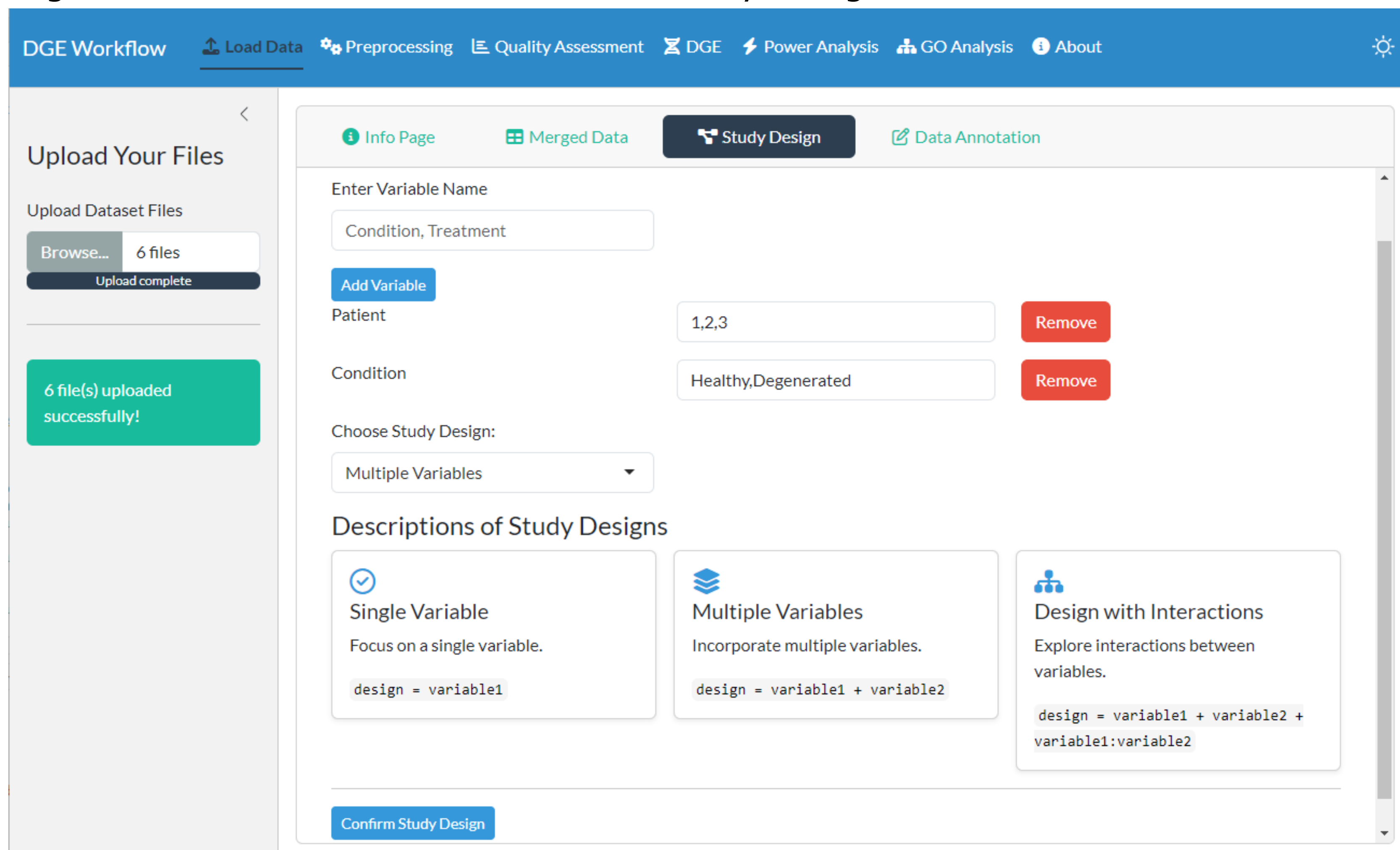


Figure 3: Volcano Plot

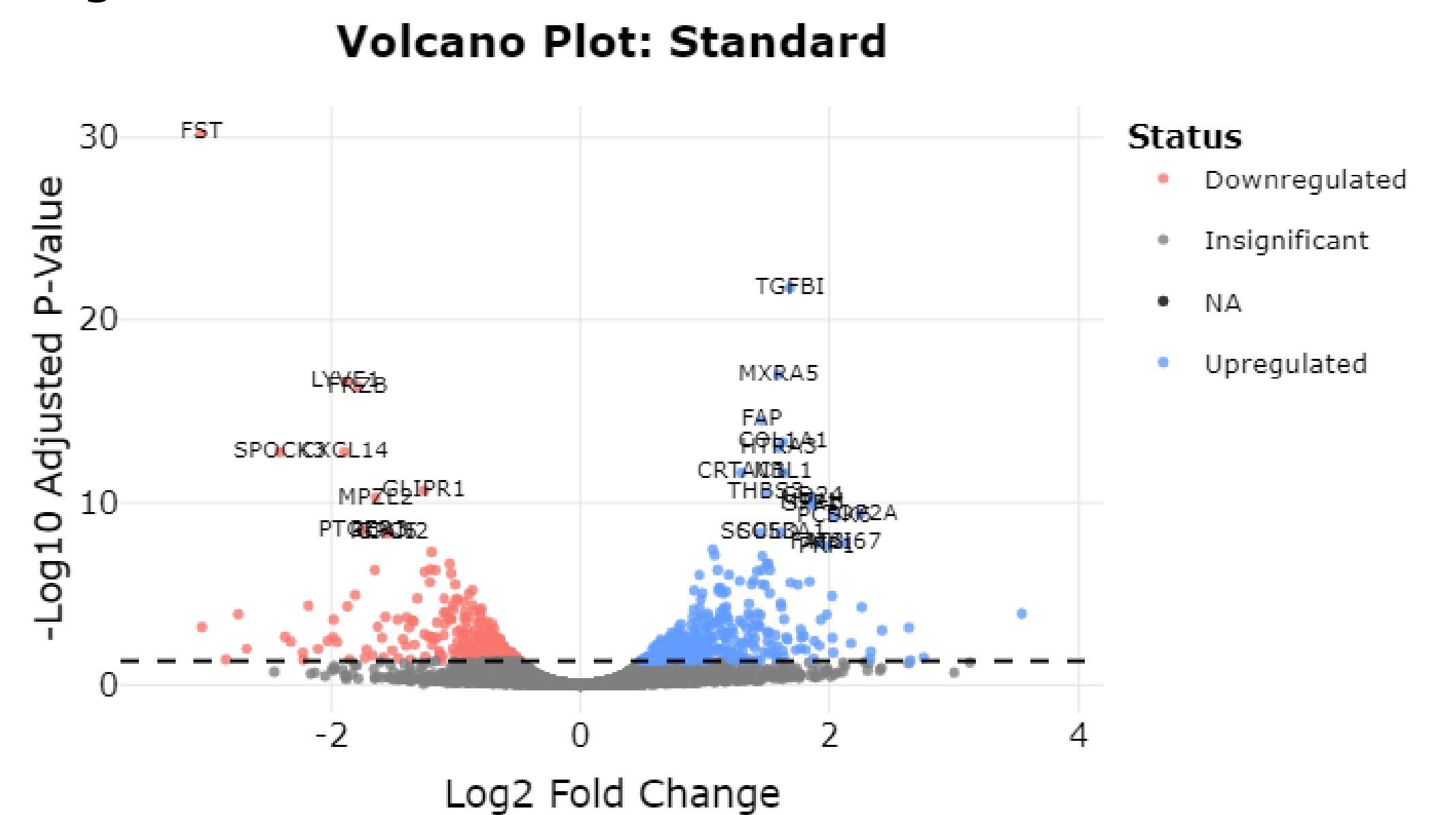
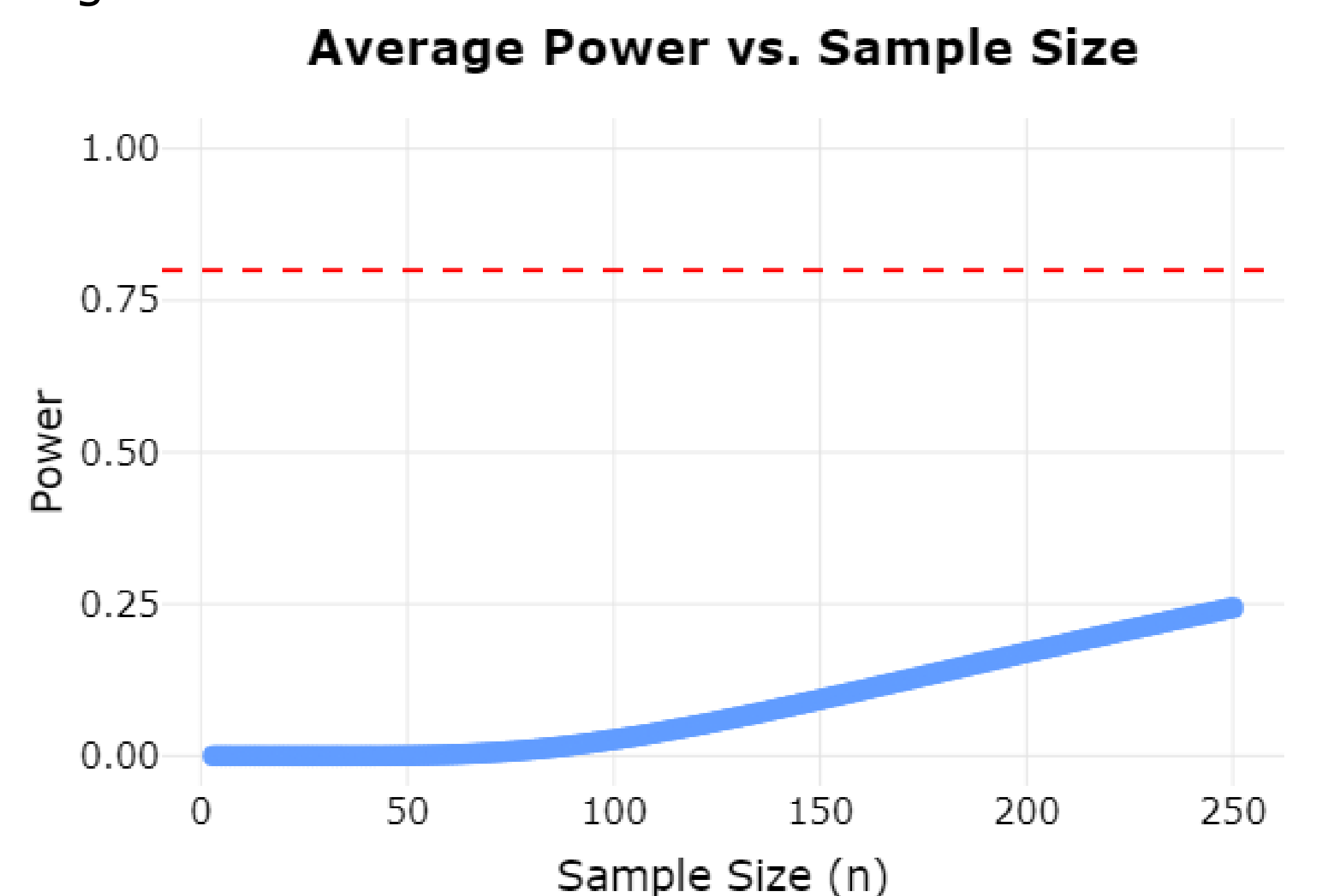


Figure 4: Power Plot



Problem Statement

Differential Gene Expression (DGE) analysis is a key bioinformatics technique for unravelling biological processes. At the CC-BME, a project is dedicated to investigating gene expression differences in human knee cartilage tissue. As part of this effort, a workflow for bulk RNA-seq analysis in R was developed.

However, the current workflow is static and restricted to processing a single dataset. This limitation necessitates a more dynamic solution that empowers researchers and clinicians to analyse multiple datasets and adjust outputs interactively based on user inputs.

Although several open-source applications for dynamic DGE analysis exist, they often enforce rigid workflows incompatible with the one already established. Additionally, integrating a newly developed app into the Clinical Data Cockpit at the CC-BME would enhance its utility for future research applications.

Solution Design

An R Shiny app was developed to address the outlined problem by offering a dynamic solution. To implement this application, the existing workflow was modularized, dividing the functionality into distinct UI and server components. The core concept of reactivity was integrated, allowing for dynamic adjustments based on user inputs. Finally, the app was tested with several datasets to ensure its robustness and functionality in real-world scenarios.

Results

The developed R Shiny application is divided into six modules, guiding users through the entire DGE analysis process. The app enables users to upload their own datasets, annotate them, and apply tailored settings to perform analyses.

The application is designed to be user-friendly, requiring no programming skills. All visualizations and outputs update dynamically in real-time as options are modified.

Verification confirmed that the app produces accurate and reliable results across different datasets, although currently limited to human data. Moreover, it matches the performance of other similar applications while providing an added feature: a built-in power analysis tool.

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