Bayesian Posterior Analysis for Normal-Normal Model

This project performs Bayesian posterior analysis for a normal-normal model using given data and prior distributions. It computes posterior means, standard deviations, and credible intervals based on specified priors.

File Structure

Data

- `data.txt`: Contains the observed data including sample size, sample mean, and population standard deviation.

```
Copy code
sampleSize sampleMean sigma
10         176        3
```

Priors

- `prior1.txt`: Specifies the first prior with:

```
Copy code
theta tau
176   8
```

- `prior2.txt`: Specifies the second prior with:

```
yaml
Copy code
theta tau
176   1000
```

- `prior3.txt`: Specifies the third prior with:

```
yaml
Copy code
theta tau
0     1000
```

Source Code

- `normalNormalPosterior.r`: Implements functions for computing posterior samples and exact posterior summaries:
    - `normalNormalPosterior`: Generates posterior samples using Monte Carlo simulation.

    - `normalNormalPosteriorExact`: Computes the exact posterior mean, standard deviation, and credible intervals.
- `normalNormalPosteriorRun.r`: Main script to run the analysis. It reads data and prior information, sources the core functions, and performs the posterior computations.

How to Use

1. **Run Analysis Script**
    - Navigate to the `run` folder.
    - Execute `normalNormalPosteriorRun.r` in R:

      ```
      R
      Copy code
      source("normalNormalPosteriorRun.r")
      ```

    - The script reads the data from `data.txt` and prior information from `prior1.txt` by default.
2. **Modify Priors**
    - To analyze different priors, update the file path in the script:

      ```
      R
      Copy code
      prior = read.table("../data/prior2.txt", header=T)
      ```

    - Replace `prior2.txt` with `prior3.txt` for the third prior, or back to `prior1.txt` for the first.
3. **Outputs**
    - The script generates:
        - Posterior samples using Monte Carlo simulation.
        - Exact posterior mean, standard deviation, and credible intervals.

Notes

- **Monte Carlo Sample Size**: Set to `1000` by default in `normalNormalPosteriorRun.r`. Modify if needed:

  ```
  R
  Copy code
  monteCarloSampleSize = 1000
  ```

- The prior file (`prior1.txt`, `prior2.txt`, `prior3.txt`) must be explicitly updated in `normalNormalPosteriorRun.r` when switching priors.
- Ensure all paths (data, priors, source) are correctly set relative to the working directory.

Example Results

For `prior1.txt`:

- Posterior Mean: 176
- Posterior Standard Deviation: 0.942
- 95% Credible Interval: [174.15, 177.85]

For `prior2.txt`:

- Posterior Mean: 176
- Posterior Standard Deviation: 0.949
- 95% Credible Interval: [174.14, 177.86]

For `prior3.txt`:

- Posterior Mean: 175.9998
- Posterior Standard Deviation: 0.949
- 95% Credible Interval: [174.14, 177.86]

Dependencies

- R environment with the following libraries (base R suffices):
  - `stats` (for `rnorm` and `qnorm` functions).

Author

Generated based on the provided R scripts and data files. Contact for clarifications or further assistance.