Bayesian Inference for a Mean (R scripts)

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MATH 347 Bayesian Statistics

Installing the necessary packages

```
install.packages("devtools")
require(devtools)
devtools::install_github("bayesball/ProbBayes")

require(ggplot2)
require(gridExtra)
require(ProbBayes)
require(tidyverse)
crcblue <- "#2905a1"
```

Example: Expenditures in the Consumer Expenditure Surveys

The TOTEXPPQ variable

```
CEsample = read_csv("CEsample1.csv")

summary(CEsample$TotalExpLastQ)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      30    3522    6417    9513   11450 1270598
```

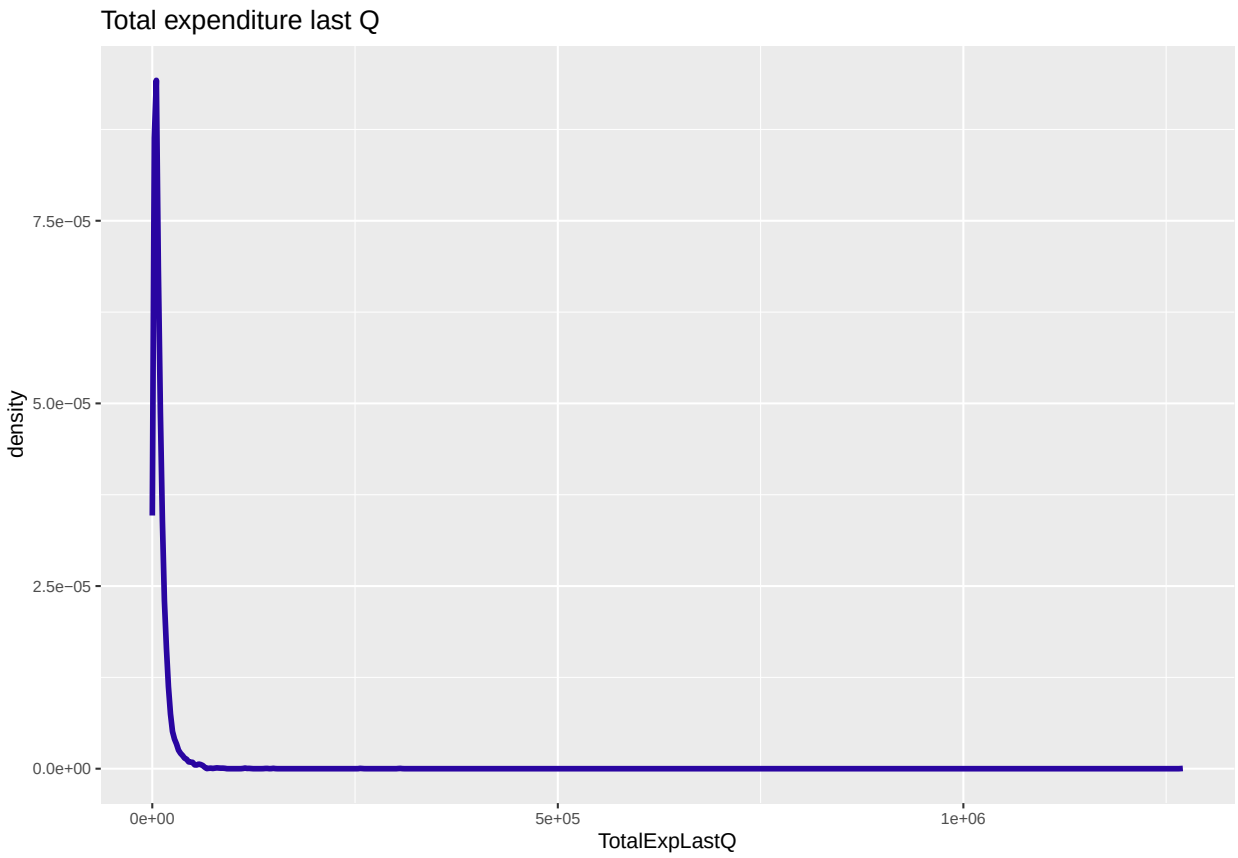
```
sd(CEsample$TotalExpLastQ)
```

```
## [1] 19341.25
```

The TOTEXPPQ variable cont'd

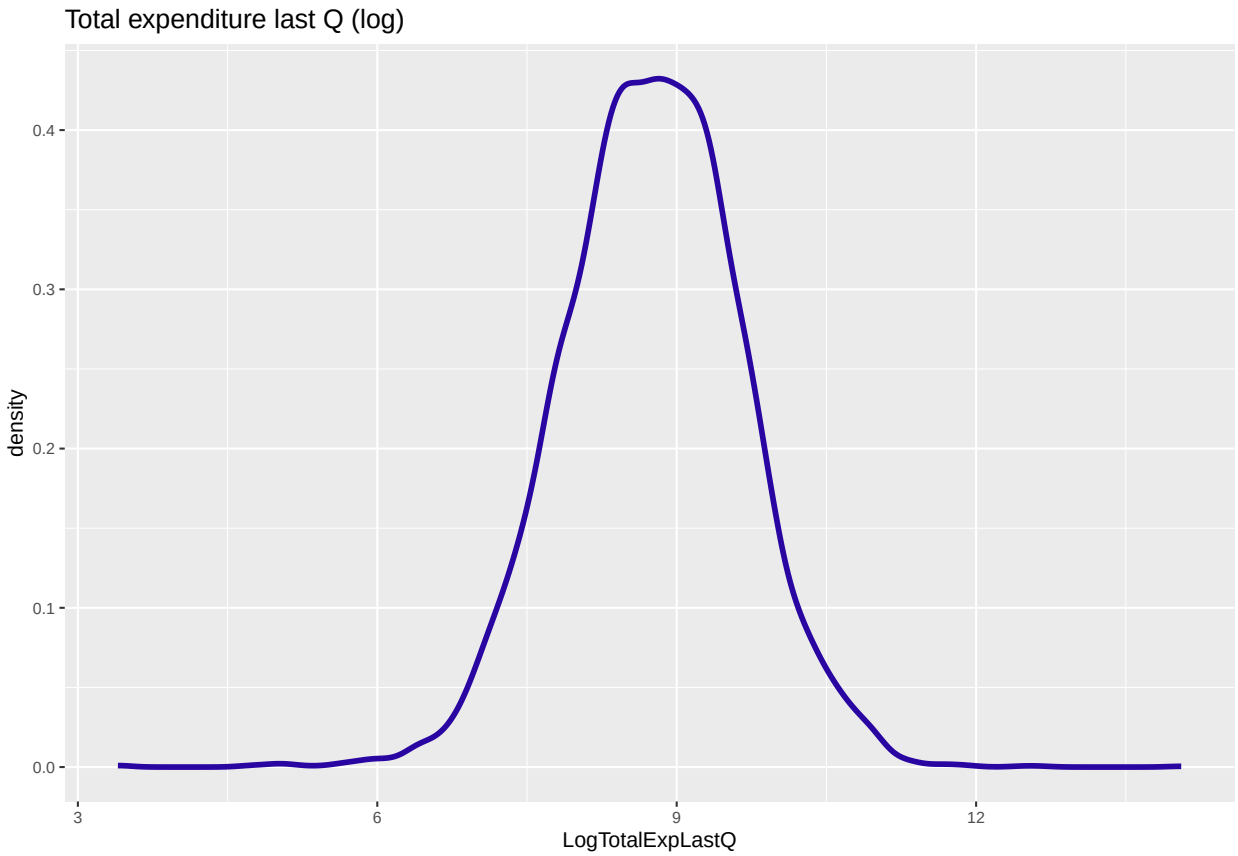
```
ggplot(data = CEsample, aes(TotalExpLastQ)) +
  geom_density(color = crcblue, size = 1) +
  labs(title = "Total expenditure last Q") +
  theme_grey(base_size = 8, base_family = "")
```

```
## Warning: Using ‘size‘ aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use ‘linewidth‘ instead.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```



Log transformation of the TOTEXPPQ variable

```
CEsample$LogTotalExpLastQ <- log(CEsample$TotalExpLastQ)
ggplot(data = CEsample, aes(LogTotalExpLastQ)) +
  geom_density(color = crcblue, size = 1) +
  labs(title = "Total expenditure last Q (log)") +
  theme_grey(base_size = 8, base_family = "")
```



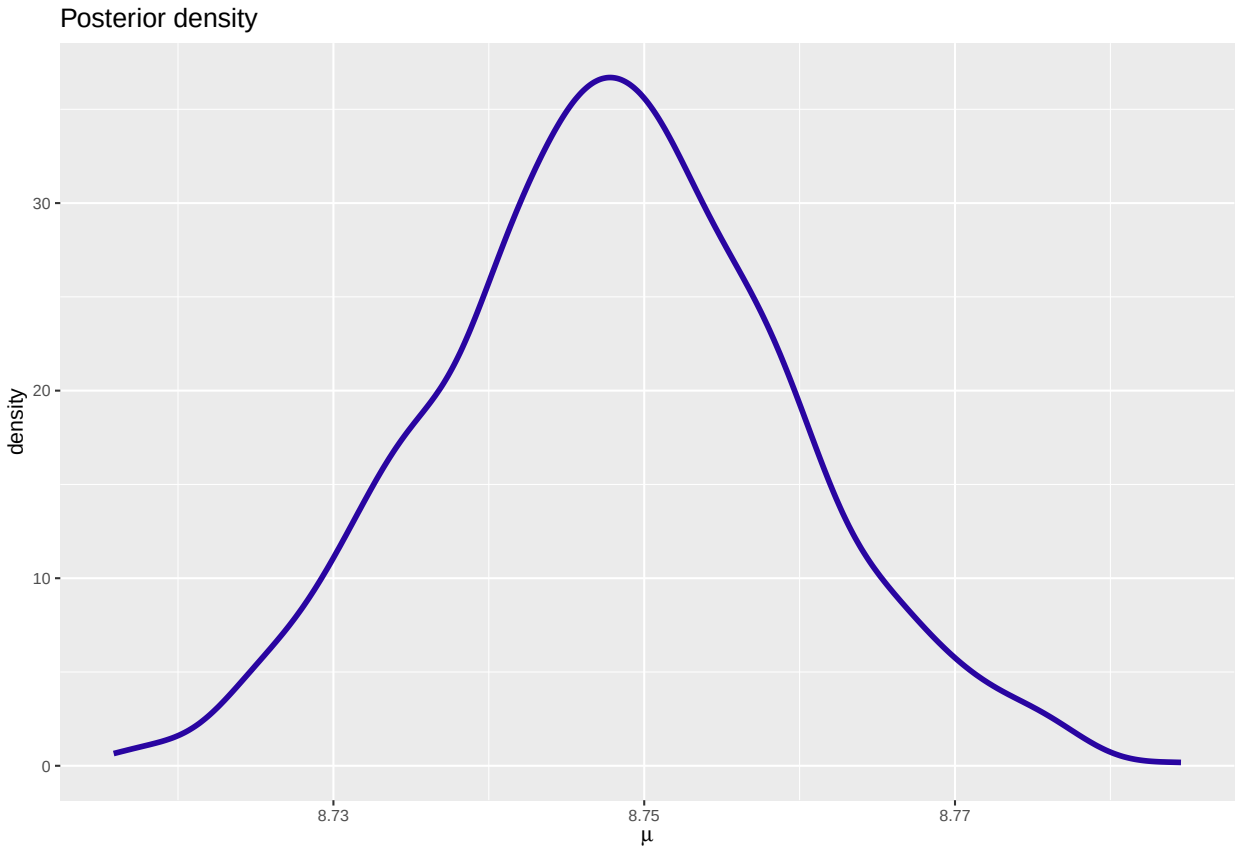
Simulate posterior draws of μ

```
mu_0 <- 5
sigma_0 <- 1
phi_0 <- 1/sigma_0^2
ybar <- mean(CEsample$LogTotalExpLastQ)
phi <- 1.25
n <- dim(CEsample)[1]
mu_n <- (phi_0*mu_0+n*ybar*phi)/(phi_0+n*phi)
sd_n <- sqrt(1/(phi_0+n*phi))

set.seed(123)
S <- 1000
mu_post <- rnorm(S, mean = mu_n, sd = sd_n)
df <- as.data.frame(mu_post)
```

Simulate posterior draws of μ cont'd

```
ggplot(data = df, aes(mu_post)) +
  geom_density(color = crcblue, size = 1) +
  labs(title = "Posterior density") +
  xlab(expression(mu)) +
  theme_grey(base_size = 8, base_family = "")
```



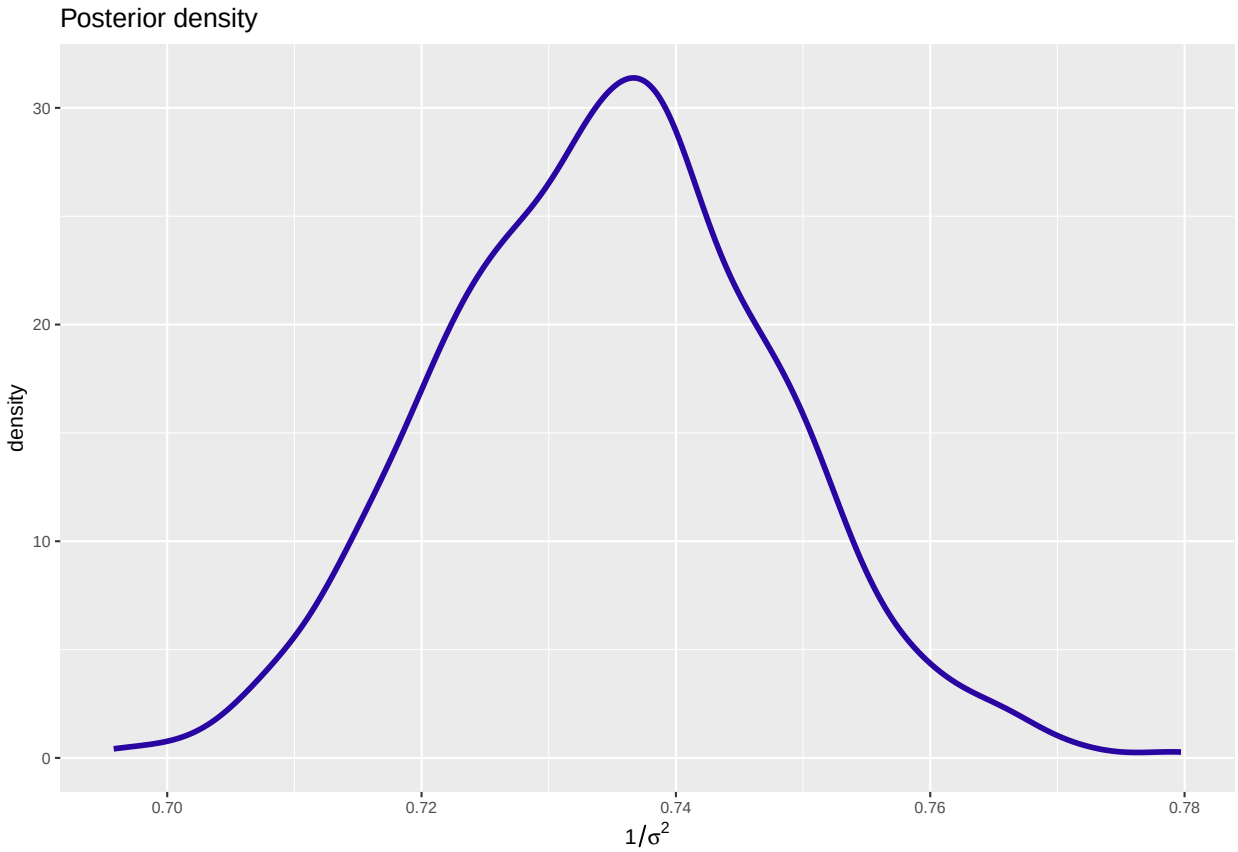
Simulate posterior draws of σ

```
alpha <- 1
beta <- 1
mu <- 8
n <- dim(CEsample)[1]
alpha_n <- alpha+n/2
beta_n <- beta+1/2*sum((CEsample$LogTotalExpLastQ-mu)^2)

set.seed(123)
S <- 1000
invsigma2_post <- rgamma(S, shape=alpha_n, rate=beta_n) # 1/sigma^2
df <- as.data.frame(invsigma2_post)
```

Simulate posterior draws of σ cont'd

```
ggplot(data = df, aes(invsigma2_post)) +
  geom_density(color = crcblue, size = 1) +
  labs(title = "Posterior density") +
  xlab(expression(1/sigma^2)) +
  theme_grey(base_size = 8, base_family = "")
```



Bayesian inference for unknown mean μ (Lab 2)

Recap