The Econometrics of DSGE models
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Problem Set #2

Bayesian Vector Autoregression

The file Y.csv contains quarterly data on 21 economic variables. The names of variables and their descriptions are given in Table 1. Data is available from the first quarter of 1959 to the last quarter of 2008.

Getting the data into R

To get the data into R, you can use the following lines of code

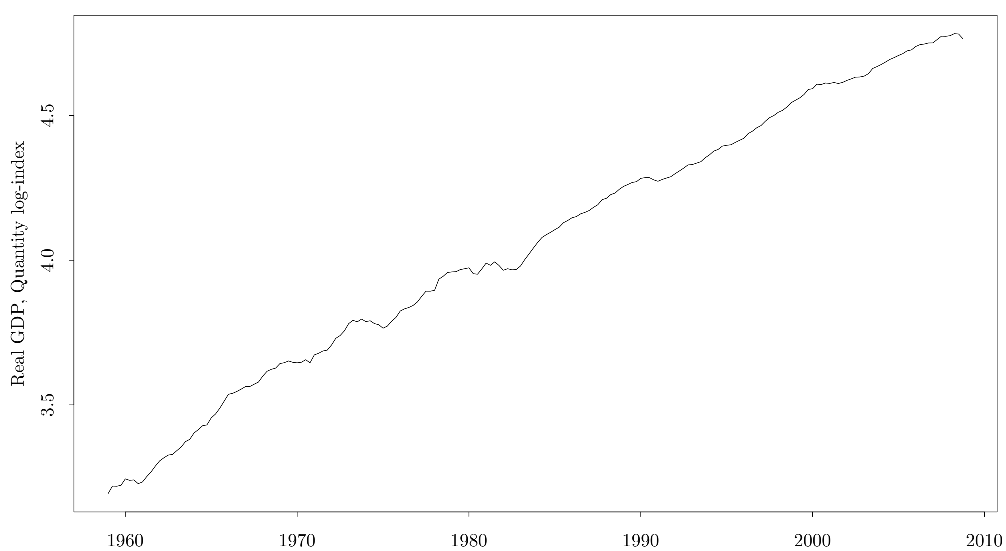
```
Y <- as.matrix(read.csv("Y.csv"))
Yts <- ts(Y, start = c(1959, 1), frequency = 4)
```

The first line of code read the data (`Y.csv`) and coerce it to a matrix of dimension of (200×21). The second line of code coerce the matrix to a time series object. The class of `Y` and its dimension can be obtained by

```
class(Y)

## [1] "matrix"

dim(Y)

## [1] 200  21
```

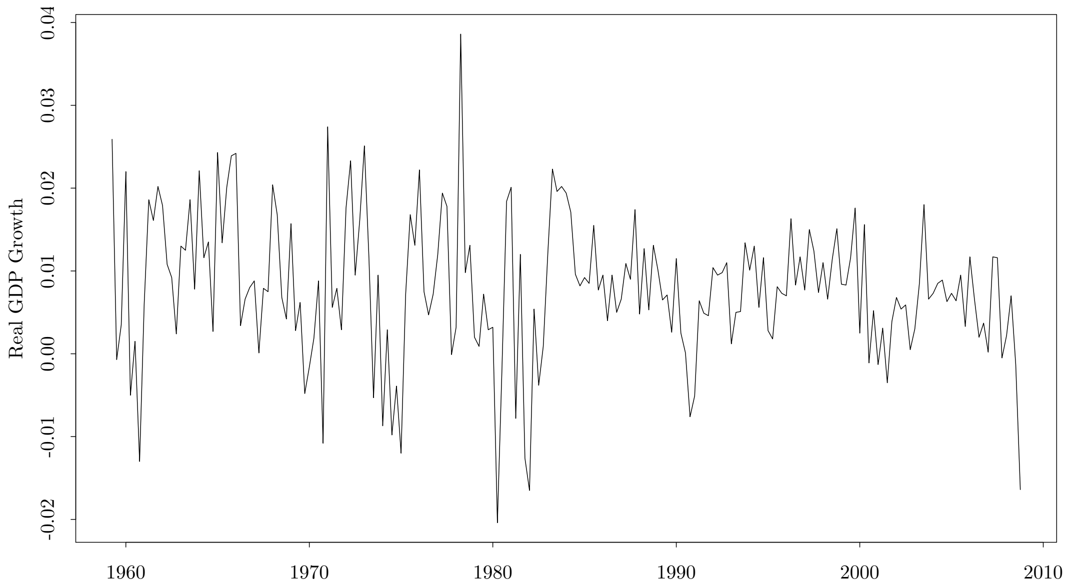
Working with a time series object is very convenient because it allows quickly to plot and to subset the series with built-in R command. For instance, suppose we want to plot the real GDP plot (`GDP251`). Since this variable is sotred in the first column of `Yts`, we simply do as follows

```
plot(Yts[, 1], ylab = "Real GDP, Quantity log-index")
```



If you want instead plot GDP growth, you can simply plot the time difference of `Yts[,1]`:

```
plot(diff(Yts[, 1]), ylab = "Real GDP Growth")
```

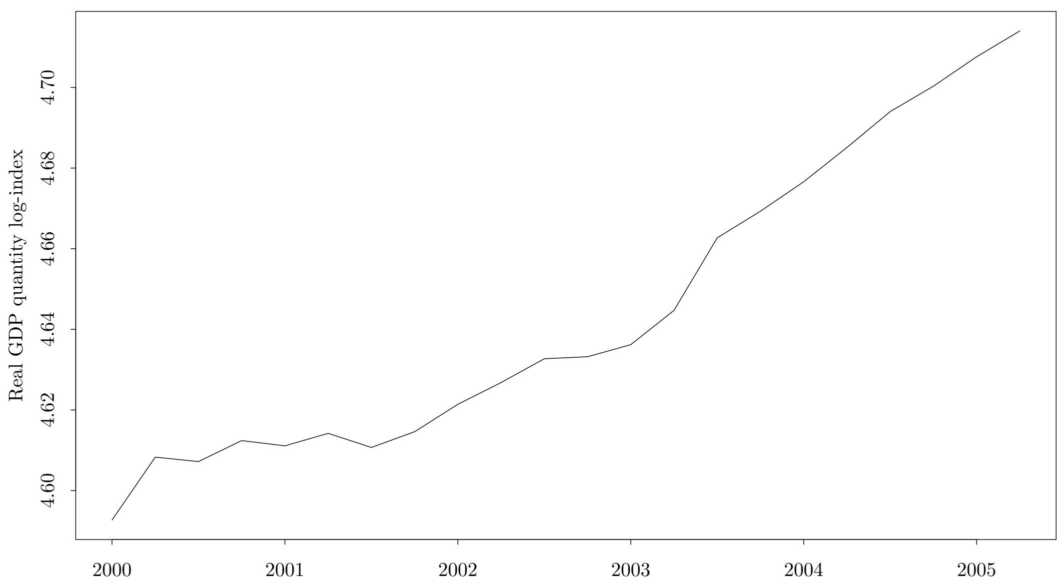


To subset a time series we use the following command:

```
Y00 <- window(Yts, start = c(2000, 1), end = c(2005, 2))
```

The variable `Y00` will contain the real GDP index from 2000:1 to 2005:2.

```
plot(Y00[, 1], ylab = "Real GDP quantity log-index")
```



The `bvar.R` code is sourced using the following command

```r
source("bvar.R")
```

Now the functionBVARBGR is ready to be used. As an example consider the BVAR(5) that uses only the first six variable of the dataset. The shrinking parameter λ is set to 0.01.

```r
Ys <- Y[, 1:6]
bvar_small <- BVARBGR(Ys, p = 5, lambda = 0.01, predictive = FALSE)
```

The function returns an object with the following components

```r
names(bvar_small)

## [1] "fcast"      "fitted"     "residuals"  "predictive"
```

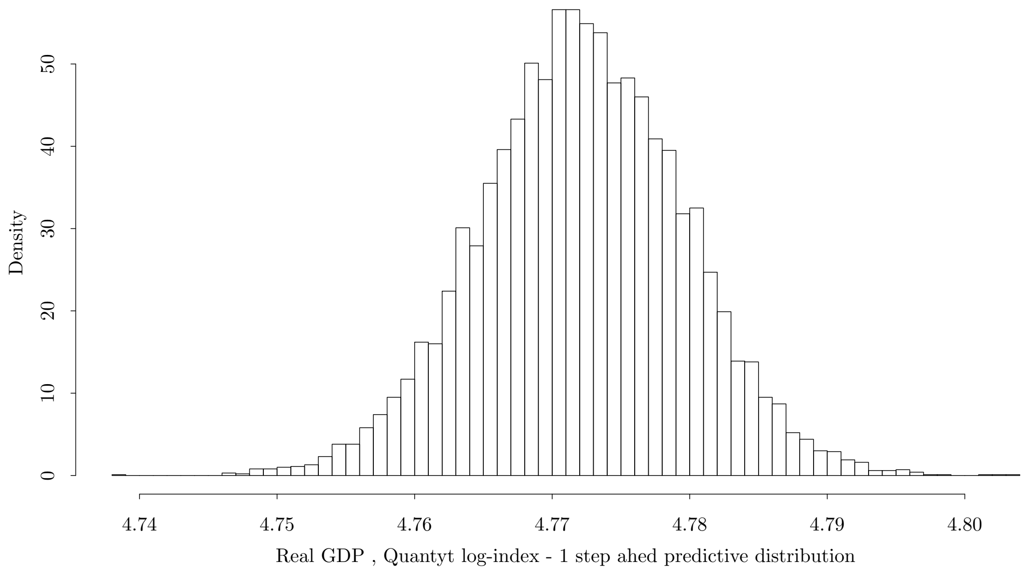
The component `fcast` is the out-of-sample forecast up to twelve periods ahead

```r
bvar_small$fcast

##       GDP251   FYFF PCEPI  FYGM3 RPCNDSV CPIAUCSL
## h=1    4.772 0.4919 4.715 0.2750   4.614    5.371
## h=2    4.779 0.4945 4.721 0.2638   4.617    5.377
## h=3    4.786 0.5092 4.728 0.2612   4.620    5.383
## h=4    4.793 0.5330 4.734 0.2657   4.624    5.388
## h=5    4.800 0.5619 4.741 0.2745   4.627    5.394
## h=6    4.807 0.5923 4.747 0.2842   4.630    5.400
## h=7    4.814 0.6239 4.754 0.2944   4.633    5.407
## h=8    4.821 0.6566 4.761 0.3052   4.637    5.413
## h=9    4.828 0.6903 4.767 0.3164   4.640    5.419
## h=10   4.834 0.7249 4.774 0.3280   4.643    5.425
## h=11   4.841 0.7604 4.781 0.3399   4.646    5.431
## h=12   4.848 0.7966 4.788 0.3520   4.649    5.437
```

The components `fitted` and `residuals` are the fitted value based when the parameters of the BVAR are set to the posterior mean and the difference between the actual value of the variables and the fitted values, respectively. `predictive` contains draws from the predictive distribution of Y_{T+h}. Since calculate the predictive draws is time consuming, calculation of the draws must be explicitly requested. If not requested, that is if `predictive==FALSE` the predictive will be NA. The following call to `BVARGBR` calculates the predictive distribution

```r
bvar_small <- BVARBGR(Ys, p = 5, lambda = 0.01, predictive = TRUE, h.max = 12)
## Show dimension of the predicitive component
dim(bvar_small$predictive)

## [1] 10000     6    12
```

```r
## Histogram of [,1,1] - Real GDP - One step ahead
hist(bvar_small$predictive[, 1, 1], main = "", freq = FALSE, breaks = 50,
    xlab = "Real GDP , Quantyt log-index - 1 step ahed predictive distribution")
```



Question

1. Estimate a BVAR(5) for the following values of the shrinking parameter:

$$\lambda = (0.01, 0.02, 0.1, 0.5, 1)$$

. Use the small dataset with 6 variables, but consider only data from 1959:1 to 2005:4.

(a) Which of the 5 models give you the lowest in sample mean sqare errors:

$$MSE = \frac{1}{T}\sum_{t=1}^{T}(Y_t - \hat{Y}_t)^2$$

(b) Can you give a reason why the model with largest λ is the better model?

(c) Now compare the out of sample forecasts from the 5 model with the actual data, that is, data from 2006 : 1 to 2008 : 4. Which of the models was more accurate in predicting GDP in these quarters. [The evaluation can be based on the following measure

$$\frac{1}{12}\sum_{s=1}^{12}(Y_{i,T+s} - \hat{Y}_{i,T+s})^2$$

(d) Repeat points (a)-(c) using the larger models that includes all 21 variables. How does you answers change?

Table 1: List of variables in the dataset

	Mnemonic	Description
1	GDP251	Real GDP, quantity index (2000 = 100)
2	FYFF	Interest rate: federal funds (pct per annum)
3	PCEPI	Consumption Price Index Non Durable and Service
4	FYGM3	Interest rate: US T-bills, sec mkt, 3-month
5	RPCNDSV	Real Consumption Non Durable and Service
6	CPIAUCSL	Consumer Price Index All Items
7	LBMNU	Employees, nonfarm: total private
8	PCEPILFE	Real spot market price index: all commodities
9	FMRRA	Depository inst reserves: nonborrowed (mil USD)
10	FMFBA	Depository inst reserves: total (mil USD)
11	MZMSL	Money stock: M2 (bil USD)
12	IPS10	Industrial production index: total
13	LBOUT	Capacity utilization: manufacturing (SIC)
14	LHNAG	Unemp. rate: All workers, 16 and over (%)
15	HSBR	Housing starts: Total (thousands)
16	GDP288A	Real avg hrly earnings, non-farm prod. workers
17	FSDJ	Money stock: M1 (bil USD)
18	FSPCOM	S&P 500 Composite Stock Index
19	FYGT5	Interest rate: US treasury const. mat., 5-yr
20	FYGT10	Interest rate: US treasury const. mat., 10-yr
21	sFYBAAC	US effective exchange rate: index number