— Problem Set 3 —
Y1: Macroeconometrics
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In this problem set you will adjust the data. The output gap will be defined as the difference between actual output and the Hodrick-Prescott trend. You will then compute various moments of the data.

These exercises will be easy to do with Iris (see, for example, my code in http://teaching.ripatti.net/meconom/) and, according what I have seen, also easy to do with R-program. Hence, if you are familiar with `R`, use it.

—Exercise 1. (preparing the data)—

The Matlab binary data file `mdata.mat` is downloadable in the course website. The file contains the following variables for time span 1970q1 – 2005q4:

`Y` Euroarea GDP in bill. 1995 euros

`P` Private consumption deflator, 1995=1

`I` 3 months nominal interest rate

Make the following transformations: $\pi_t \equiv 4[\log(P_t) - \log(P_{t-1}]$, $i_t \equiv I_t/100$. Now they both are *annual* and measured in fractions.

Compute the output gap using the Hodrick-Prescott filter (with parameter $\lambda = 1600$) with the following steps: To avoid the end-point problem you should first build a forecasting model: I suggest that you estimate an AR(4) (with a constant term) model for the log-difference of the GDP and use this model to generate 2-years (i.e. 8 quarters) forecast of the GDP. Hence, specify AR(4) model of $\Delta \log(Y)$, estimate the parameters for the data $t = 1970q1 - 2005q4$, and compute the forecast of periods 2006q1–2007q4. Extend the original series with the forecast and apply the HP-filter to the extended $\log(Y)$. The time series without the trend will be your measure of output gap.

Plot these variables together. It would be nice to get the years correctly to the time axis, eg with command `plot(1970:0.25:2005.75,pie);`

—Exercise 2. (simple moments of data)—

Compute the following moments of your empirical inflation, interest rate and output gap measures:

- mean
- variance
- skewness
- kurtosis
- autocorrelation up to 4th order
- partial autocorrelation up to 4th order
- cross-correlation up to 4th lag and lead

Characterize (=write a short, 1-2 paragraphs, story) the comovement of the variables of interest using the above data moments.

—Exercise 3. (spectral analysis)—

Compute the spectral density function of the inflation, interest rate and output gap measures (that you made in exercise 1). Compute also the coherence of all pairs of variables. Since these are estimates, it would be nice to obtain confidence bounds too (if available in your software).

—Exercise 4. (calibration of the theoretical model to data)—

Consider the theoretical model of the exercise 3 in the second problem set. The dynare command

```
stoch_simul(order=1);
```

reports some moments (eg variances and autocorrelations). Try to calibrate the theoretical model such that you are able to match *at least some of them*[1] to the estimated data moments you computed in the exercise 3. Matching does not mean that you produce exactly the same numbers but, rather, the many moments of the theoretical model are within the confidence bounds of data moments.

[1] Not only variances!