Financial Statistics: Time Series, Forecasting, Mean Reversion, and High Frequency Data

FINM 33170 and STAT 33910 Winter 2021

HW 3, due Friday 5 February, 2021

Homework should be scanned and e-mailed to both Ahmed Bou-Rabee, ahmedb@uchicago.edu, and Yi Wang, samwang8899@uchicago.edu

1. **Autocorrelation Plot** Consider the left hand plot on p. 45 in the slides for lecture 2. The code for generating this plot is on the subsequent page.

   (a) Compare to the formula for $\rho(k)$ on p. 44 in the slides for lecture 2. Do you think either the formula or the plot is wrong? [Hint: Do some more simulations of the same AR(1) process.]

   (b) The left hand plot on p. 45 goes below the lower of the two dashed lines. Explain what this line represents?

   (c) There is one explanation for (a) under which you might be worried that that the plot undershoots the dashed line. Explain what you might be worried about, and why, on second thought, you should not worry (too much).

2. **Stock Data from Class** The csv files with stock dada from class are posted on the class home page. Do the R analysis on p. 20 in the slides for lecture 3 (make the four plots), and explain whether you think the series Rpsel[,2]-0.4134798*Rpsel[,3] can be used for pairs trading.

   It is recommended that you do this example from the beginning on p. 16, but there is no need to turn this extra material in.

3. **Currencies**

   (a) (A time series of currencies.) Download the file c4a8681f9469f4a8.csv from the course website, and read it into R. The file is from WRDS's "Federal Reserve Bank Reports"; these daily are exchange rates from 2007 to 2017.

```
curr<-read.csv("c4a8681f9469f4a8.csv") # always check dim
#and also look at the first couple of observations
# to remove NAs:
keep<-c(1:2865)[!is.na(curr[,2])]
```

```
curr2<-curr[keep,]
currnames<-c("Date","CNY","DKK","HKD","SGD","CHF","EUR")
#The data consist of daily exchange rates (for 10 years) of the Chinese, Danish,
Hong Kong, Singapore, and Swiss currencies, and the Euro. All rates are
denominated in US Dollars (USD).
colnames(curr2)<-currnames
#Some inittial preparation
lcurr<-log(curr2[,2:7]) #convert to logs
dlcurr<-apply(lcurr,2,diff) # take diffs
```

(b) To get a sense of the short term dependence between these currencies, construct a correlation matrix and a dendrogram based on the returns (as we did in class).

(c) (Bonus question.) Explain, if possible, the configuration that shows up in the dendrogram, based on your general knowledge.