Problem Set 1
Econ 40357 Financial Econometrics
University of Notre Dame
Professor Nelson Mark
Fall 2019

Problem sets should be typed to the maximum extent possible and and presentable. Don't restate the questions in your write-ups. One main document per work group plus an appendix showing each person's Eviews work. Give each person a section heading. No explanations needed in the appendix.

1. Write out all the terms in the following and evaluate them
   (a) $\sum_{j=1}^{3} j$
   $1 + 2 + 3 = 6$
   (b) $\sum_{i=1}^{n} x$ with $n = 4$ and $x = 3$
   $3 + 3 + 3 + 3 = 12$
   (c) $\Pi_{j=1}^{3} x$ with $x = 2$
   $2 \times 2 \times 2 = 8$

2. Consider the following matrices,

$$A = \begin{pmatrix} 1 & 6 \\ -2 & 4 \end{pmatrix}, B = \begin{pmatrix} -3 & -8 \\ 6 & 4 \end{pmatrix}, C = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, D = \begin{pmatrix} 6 & -2 \\ 0 & -1 \\ 3 & 0 \end{pmatrix}$$

   (a) Which pairs of matrices can be multiplied together?
   AB, BA, CD, DC
   (b) For those pairs that can be multiplied, perform the multiplications.

$$AB = \begin{pmatrix} 1 & 6 \\ -2 & 4 \end{pmatrix} \begin{pmatrix} -3 & -8 \\ 6 & 4 \end{pmatrix} = \begin{pmatrix} 33 & 16 \\ 30 & 32 \end{pmatrix}$$

$$BA = \begin{pmatrix} -3 & -8 \\ 6 & 4 \end{pmatrix} \begin{pmatrix} 1 & 6 \\ -2 & 4 \end{pmatrix} = \begin{pmatrix} 13 & -50 \\ -2 & 52 \end{pmatrix}$$

$$CD = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} \begin{pmatrix} 6 & -2 \\ 0 & -1 \\ 3 & 0 \end{pmatrix} = \begin{pmatrix} 15 & -4 \\ 42 & -13 \end{pmatrix}$$

$$DC = \begin{pmatrix} 6 & -2 \\ 0 & -1 \\ 3 & 0 \end{pmatrix} \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} = \begin{pmatrix} -2 & 2 & 6 \\ -4 & -5 & -6 \\ 3 & 6 & 9 \end{pmatrix}$$

   (c) Calculate 2A

$$2A = 2\begin{pmatrix} 1 & 6 \\ -2 & 4 \end{pmatrix} = \begin{pmatrix} 2 & 12 \\ -4 & 8 \end{pmatrix}$$

(d) Calculate Tr(A)

$1 + 4 = 5$

(e) Calculate $A + B$

$$A + B = \begin{pmatrix} 1 & 6 \\ -2 & 4 \end{pmatrix} + \begin{pmatrix} -3 & -8 \\ 6 & 4 \end{pmatrix} = \begin{pmatrix} -2 & -2 \\ 4 & 8 \end{pmatrix}$$

(f) Calculte $B - A$

$$\begin{pmatrix} -3 & -8 \\ 6 & 4 \end{pmatrix} - \begin{pmatrix} 1 & 6 \\ -2 & 4 \end{pmatrix} = \begin{pmatrix} -4 & -14 \\ 8 & 0 \end{pmatrix}$$

3. If $A = \begin{pmatrix} 3 & -1 \\ -4 & 2 \end{pmatrix}$, find A^{-1}. $\begin{pmatrix} 3 & -1 \\ -4 & 2 \end{pmatrix}^{-1}$

$$A^{-1} = \begin{pmatrix} 1 & \frac{1}{2} \\ 2 & \frac{3}{2} \end{pmatrix}$$

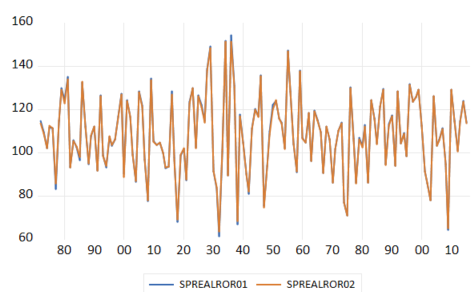
Download the Excel file PS01_2020.xlsx from the course website. These are annual historical prices and dividends for the S&P index, the CPI, one-year and ten-year treasury yields. Load the data into an Eviews workfile and name it PS01.wf1.

4. Using the stock price, dividends, and CPI, construct the real S&P real rate of return. Plot the rate of return series.

```
In percent per annum,

series SPrealROR01 = 100*((p+d01)/cpi)*(cpi(-1)/p(-1))

series SPrealROR02 = 100*((p+d01(-1))/cpi)*(cpi(-1)/p(-1))
```

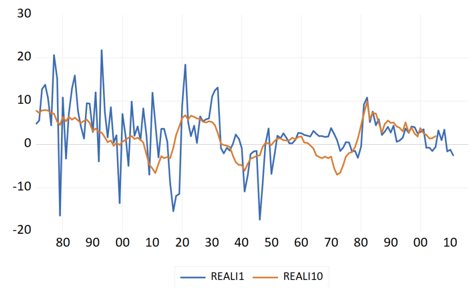


5. Compute the real yield on the one-year and on the 10-year bonds. Plot the yields in a single graph.

```
In percent per annumu,

series reali1 = i1- (cpi(+1)/cpi - 1)*100

series reali10 = i10-(cpi(+10)/cpi-1)*10
```



6. Report the descriptive statistics for all three series, and for the S&P excess return and the 10-year treasury excess return (i.e., over the 1-year treasury).

   I messed up in writing this question. Everyone gets credit for this one. I didn't give you bond prices, so you cannot compute bond returns. Bond returns are different from bond yields, remember? So what you might have done is to subtract the 1-year Treasury yield from the S&P rate of return and from the 10 year Treasury yield. If you did that, you would have written commands such as,

   ```
   series SPER = SPrealROR01 - reali1
   ```

   ```
   series TB10ER = reali10 - reali1
   ```

   and the descriptive stats would look like this:

	REALI1	REALI10	SPREALROR01	SPER	TB10ER
Mean	2.533891	1.617351	108.4213	105.8874	−0.916540
Median	2.162307	1.546177	107.4840	105.9062	−0.714187
Maximum	21.77308	9.945249	154.1052	155.5291	21.00483
Minimum	−17.37187	−6.994039	61.23038	48.08017	−18.98694
Std. Dev.	6.622068	3.866823	18.01988	20.28424	5.907642
Skewness	−0.163679	−0.236472	−0.029834	0.076734	0.440002
Kurtosis	4.433811	2.214827	2.892233	2.891978	5.237667
Jarque-Bera	12.07663	4.690964	0.084722	0.196652	32.28036
Probability	0.002386	0.095801	0.958524	0.906353	0.000000
Sum	339.5414	216.7250	14528.45	14188.91	−122.8164
Sum Sq. Dev.	5832.287	1988.658	43187.24	54722.88	4641.731
Observations	134	134	134	134	134

7. Now, for the S&P, construct the real gross return. Suppose you invest one dollar in the S&P index in 1970, and let it accrue to 2015. No further investments. How much

is does the investment accrue to (in real terms) in 2015? (Hint: @cumprod(x), where x is the series name).

Real gross return, (not in percent, but as a raw number).

```
series SPRGR = (p+d01)/cpi * (cpi(-1)/p(-1))
```

Two ways to do this:

(a) Compute cumulated product

```
series cumSP01 = @cumprod(SPRGR)
```

Notice in 1969, cumSP01=1030.672. To start from 1970, divide all values by 1030.672,

```
series cumSP02 = cumSP01/1030.672.
```

In 2015, one dollar invested in 1970 cumulates to 12.4916

(b) Create a new page, sample from 1970 to 2016, copy the S&P gross return series to the new page.

```
series cumSP01 = @cumprod(SPRGR)
```

computes the cumulated series starting in 1970. Again, cumulates to 12.4916.

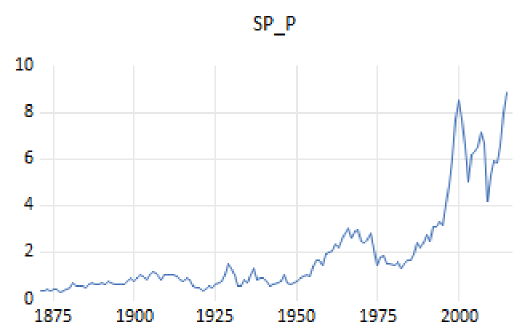
8. Construct the real (with dividend) price of the S&P index, and plot it over the entire sample period. Identify periods when the stock market performed badly and when it performed nicely.

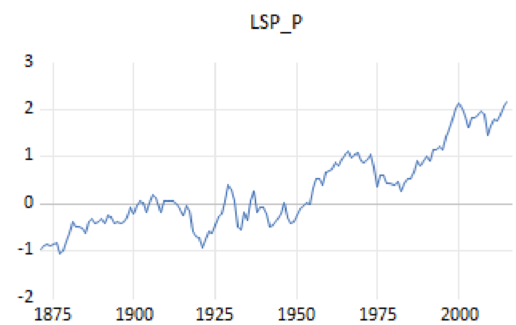
We can look at the price level,

```
series SP_P = (p+d01)/cpi
```

and/or the log price

```
series LSP_P = log(SP_P)
```





Hard times, in real terms, are early 1920s to 1950, the 1970s, and the 2000s, which included the bursting of the internet bubble (2001) and the global financial crisis.

9. Regress the one-year ahead S&P real return on the current-year dividend yield and a constant. Report the coefficient estimates, the 'regular' t-ratios and the Newey-West t-ratios.

```
Create the dividend yield,

series dy = d01/p

The ‘regular’ regression

equation eq0.ls SPrealROR01(+1) c dy
```

Dependent Variable: SPREALROR01(1)
Method: Least Squares
Date: 08/24/20 Time: 09:33
Sample (adjusted): 1871 2014
Included observations: 144 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	101.1948	4.674734	21.64718	0.0000
DY	159.3591	98.75591	1.613666	0.1088

R-squared	0.018007	Mean dependent var	108.3455
Adjusted R-squared	0.011092	S.D. dependent var	17.96454
S.E. of regression	17.86464	Akaike info criterion	8.617315
Sum squared resid	45318.62	Schwarz criterion	8.658562
Log likelihood	−618.4467	Hannan-Quinn criter.	8.634075
F-statistic	2.603918	Durbin-Watson stat	1.912104
Prob(F-statistic)	0.108820		

```
The ‘Newey-West’ regression

equation eq1.ls(n) SPrealROR01(+1) c dy
```

Dependent Variable: SPREALROR01(1)
Method: Least Squares
Date: 08/24/20 Time: 09:33
Sample (adjusted): 1871 2014
Included observations: 144 after adjustments
HAC Newey-West fixed
bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	101.1948	4.952518	20.43301	0.0000
DY	159.3591	110.2249	1.445763	0.1504

R-squared	0.018007	Mean dependent var	108.3455
Adjusted R-squared	0.011092	S.D. dependent var	17.96454
S.E. of regression	17.86464	Akaike info criterion	8.617315
Sum squared resid	45318.62	Schwarz criterion	8.658562
Log likelihood	−618.4467	Hannan-Quinn criter.	8.634075
F-statistic	2.603918	Durbin-Watson stat	1.912104
Prob(F-statistic)	0.108820	Wald F-statistic	2.090231
Prob(Wald F-statistic)	0.150447		