Solutions to **Problem Set 1**
Econ 40357 Financial Econometrics
University of Notre Dame
Professor Nelson Mark
FALL 2022

100 points total on this problem set. Please read the problem set carefully, especially about **what you should report** as your answers. Questions 1-6 use the data in Excel file PS01.xlsx and Eviews. For questions 1-6, group answers report only what I ask. In an appendix, each person needs to report their own Eviews output. To begin, you need to load these data into an Eviews workfile. These data are monthly data and are from Ken French's data library. MKT_ER is the market excess return, SMB is the return on small minus big firms, HML is the high minus low portfolio return, and RF is the risk-free rate. For full description of the variables, see
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html.

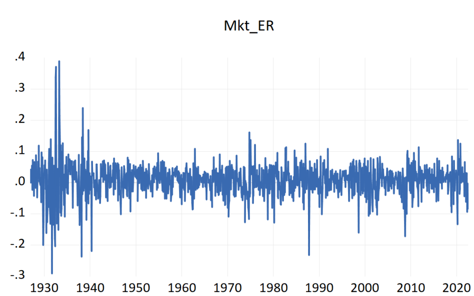
For submission, create **a single pdf** document. The first part of the document will have the group answers. The second part will be an appendix with individual Eviews output. The first page of the solutions needs to have your group number (or group name) with a list of your group members. In the appendix, list your name on the first page of your Eviews output.

1. (7 points) These monthly series are all rates of return, in percent. Convert them to raw rates of return, preserving the series names. **Report** the mean rates of return of the converted series in this order: MKT_ER, HML, SMB, RF.

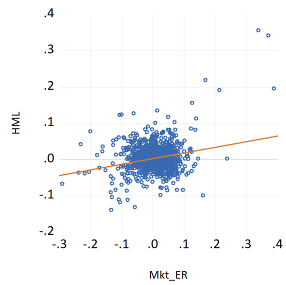
```
' [1] Convert the data from percent but preserve series names
series hml = hml/100
series mkt_er = mkt_er/100
series rf = rf/100
series smb = smb/100
' Compute descriptive statistics
group a0 mkt_er hml smb rf
show a0.stats
```

	MKT_ER	HML	SMB	RF
Mean	0.006657	0.003545	0.001967	0.002665

2. (7 points) **Report** a time-series plot of MKT_ER.



3. (7 points) **Report** a scatter plot of HML (on the vertical axis) against MKT_ER with a regression line fit through it.



4. Working with MKT_ER, construct a simple annualized excess return. (Hint: If r_t is the monthly excess rate of return and r_t^a is the annualized rate of return, we want $r_t^a = \sum_{j=0}^{11} r_{t-j}$. Give the result the series name ANN_S.

   Again, working with MKT_ER, construct the compound annualized excess return. (Hint: we want $\Pi_{j=0}^{11}(1 + r_{t-j}) - 1$). Give the result the series name ANN_C.

```
' Simple and compound annualized excess returns
series ann_s = @movsum(mkt_er,12)
series gross = 1+mkt_er
series ann_c = gross
for !j = 1 to 11
series ann_c = ann_c * gross(-!j)
next
series ann_c = ann_c - 1
```

   (a) (8 points) **Report** the mean values of ANN_S and ANN_C.

	ANN_C	ANN_S
Mean	0.087036	0.081193

   Now convert ANN_S and ANN_C to annual data by **taking the last monthly observation of each year**. (Hint: you need to create a new page, with annual frequency. Give it the name ANNUAL, then copy ANN_S and ANN_C to the new page, with paste special by choosing the correct options.

```
' Annual data worksheet
pagecreate(page=annual) a 1927 2022
copy(link, c=last) Ps01\ANN_C *
copy(link, c=last) Ps01\ANN_S *
```

   (b) (8 points) From this annual data page, **report** the mean annual rates of return for ANN_S and ANN_C, in percent.

	ANN_C	ANN_S
Mean	0.084581	0.080304

5. (7 points) Return to the monthly worksheet. Regress HML on MKT_ER. **Report** the following: Point estimates on the constant and slope, their t-statistics, and the regression R^2.

```
pageselect Ps01
smpl @all
equation eq_full.ls hml c mkt_er
```

Dependent Variable: HML
Method: Least Squares
Date: 09/07/22 Time: 09:58
Sample: 1927M01 2022M06
Included observations: 1146

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002512	0.001033	2.431863	0.0152
MKT_ER	0.155159	0.019157	8.099503	0.0000
R-squared	0.054234	Mean dependent var		0.003545

6. (7 points) Re-run the regression but with sample period 1990m01 2022m06. **Report** the point estimates and t-statistics on the constant and slope, and the regression $R^{2\cdot}$.

```
smpl 1990m01 2022m06
equation eq_late.ls hml c mkt_er
```

Dependent Variable: HML
Method: Least Squares
Date: 09/07/22 Time: 09:53
Sample: 1990M01 2022M06
Included observations: 390

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002175	0.001649	1.319072	0.1879
MKT_ER	−0.088770	0.037108	−2.392226	0.0172
R-squared	0.014535	Mean dependent var		0.001575

7. Suppose the time series $\{y_t\}_{t=1}^{T}$ is independently and identically distributed as $N\left(\mu, \sigma^2\right)$. Let $\hat{\mu} = \frac{1}{T}\sum_{t=1}^{T} y_t$. Assume $T = 21$.

(a) (7 points) **Report** how the statistic

$$\frac{\sqrt{T}\,(\hat{\mu}-\mu)}{\sigma}$$

is distributed.

`The standard normal distribution.`

(b) (7 points) Let $\hat{\sigma}^2 = \frac{1}{T-1}\sum_{t=1}^{T}(y_t-\hat{\mu})^2$. **Report** how the statistic

$$\frac{\sqrt{T}\,(\hat{\mu}-\mu)}{\hat{\sigma}}$$

is distributed.

`The student-t with 20 degrees of freedom`

(c) (7 points) Now let $T \to \infty$. **Report** how the statistic in 5.(b) is distributed.

`Standard normal`

8. Consider the regression

$$y_t = \alpha + \beta x_t + \epsilon_t$$

where the ϵ_t are i.i.d., with mean 0 and variance σ_ϵ^2.

(a) (7 points) **Report** the formula for the standard error of the least squares estimator $\hat{\beta}$.

$$\frac{\hat{\sigma}_\epsilon}{\sqrt{\sum_{t=1}^{T}(x_t-\hat{\mu}_x)^2}}$$

(b) (7 points) **Report** in words, what is a standard error and how the concept is different from the standard deviation.

`The standard error is the sample standard deviation of an estimator or of a statistic.`

`The standard deviation is a parameter of a distribution that regulates its dispersion.`

(c) (7 points) If $T = 21$, **report** how the statistic

$$\frac{\left(\hat{\beta}-\beta\right)}{\text{se}\left(\hat{\beta}\right)}$$

is distributed.

`Unknown`

(d) (7 points) If $T \to \infty$, **report** how the statistic in part 6.(c) is distributed. Also **report** what we do with this information.

`Standard normal.`

`We use it to do hypothesis testing.`