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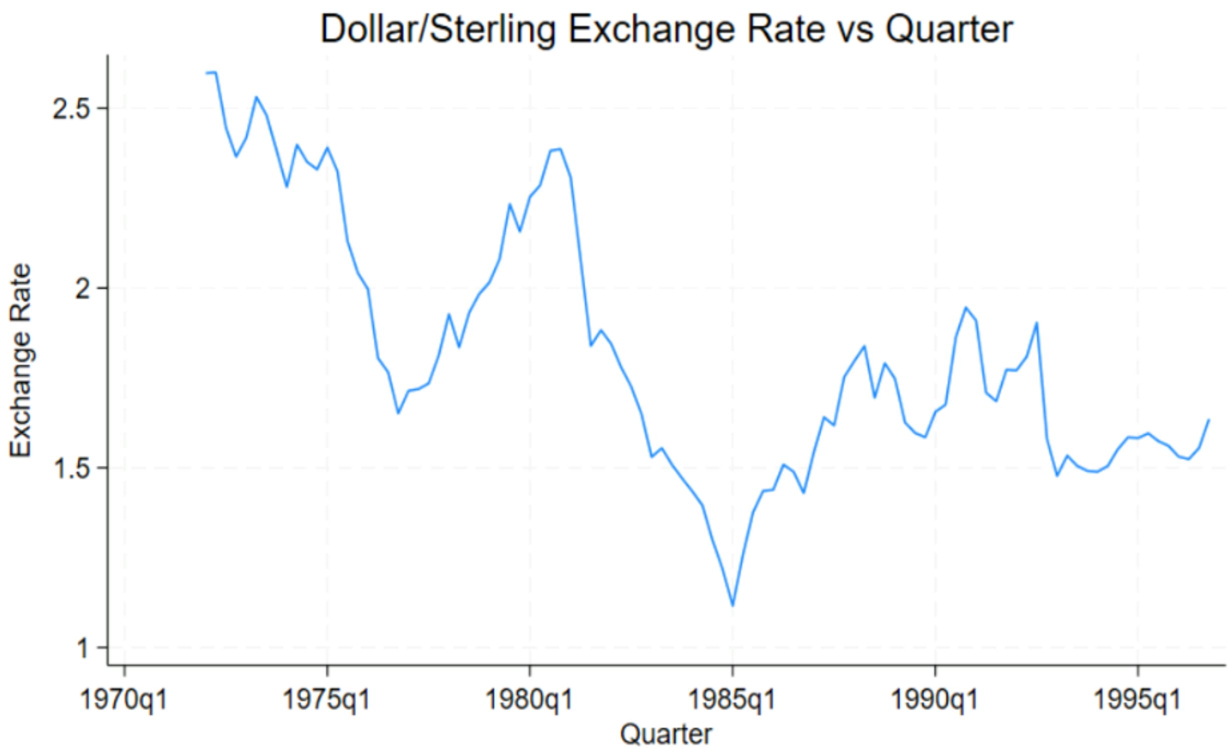
FINANCIAL ECONOMETRICS

Problem Set-2

Q1.

a.



b.

Akaike's information criterion and Bayesian information criterion

Model	N	ll(null)	ll(model)	df	AIC	BIC
ar_0	96	92.69684	92.69684	1	-183.3937	-180.8293
ar_1	96	92.69684	94.58035	2	-185.1607	-180.032
ar_2	96	92.69684	94.71068	3	-183.4214	-175.7283
ar_3	96	92.69684	94.82935	4	-181.6587	-171.4013

Note: BIC uses N = number of observations. See [R] IC note.

AR(1) is selected by AIC since it has the lowest AIC Value (-185.1607)
AR(0) is selected by BIC since it has the lowest BIC Value (-180.8293)

c.

```
Augmented Dickey-Fuller test for unit root

Variable: y_t                              Number of obs  = 98
                                           Number of lags =  1

H0: Random walk without drift, d = 0

                                       Dickey-Fuller
                   Test          -------- critical value ---------
              statistic           1%           5%          10%
------------------------------------------------------------------
 Z(t)            -2.503       -3.513       -2.892       -2.581
------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.1149.

Regression table
------------------------------------------------------------------------------
       D.y_t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         y_t |
         L1. |  -.0663886   .0265286    -2.50   0.014    -.1190546   -.0137226
         LD. |    .213392   .0979294     2.18   0.032     .0189775    .4078065
             |
       _cons |   .1125429   .0488938     2.30   0.024     .0154765    .2096093
------------------------------------------------------------------------------
```

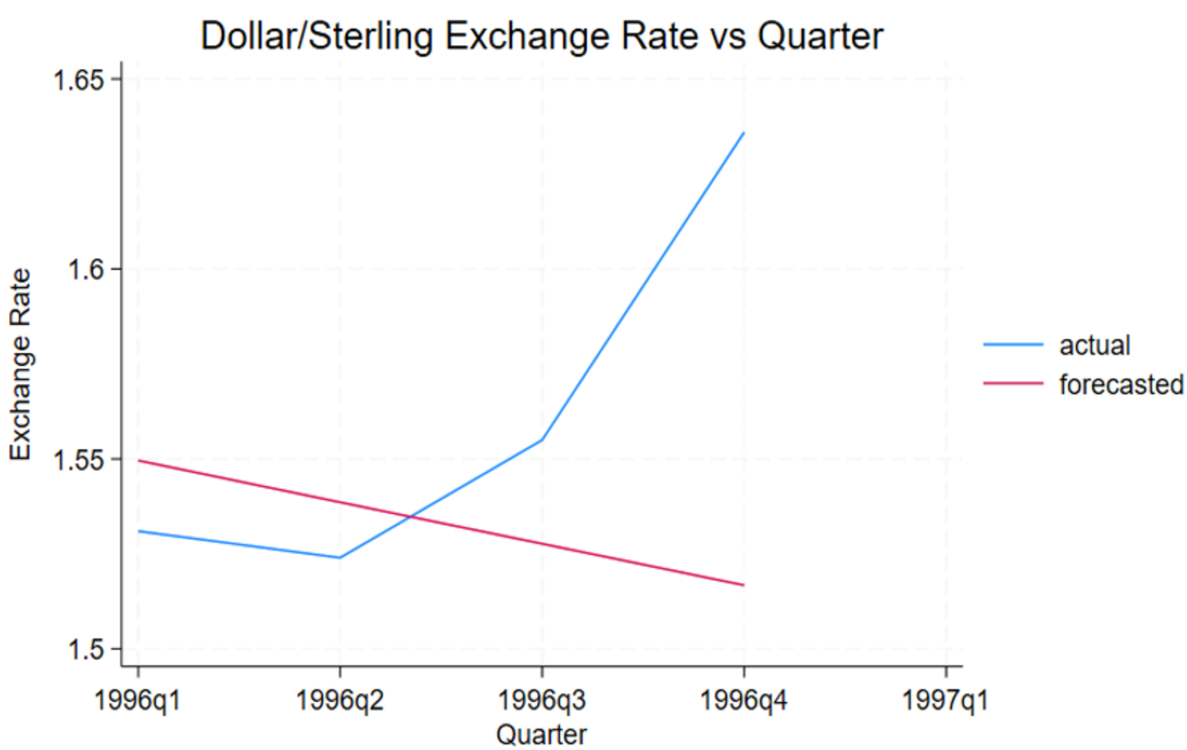
Since the absolute value of the test statistic, which is |-2.503|, is less than the absolute value of the 10% Dickey-Fuller critical value, which is |-2.581|, we do not have enough evidence to reject the null hypothesis at a 10% significance level. Therefore, we fail to reject the null hypothesis, suggesting that yt follows a random walk (unit root).

d.

```
ARIMA regression

Sample: 1972q2 thru 1995q4                      Number of obs     =         95
                                                Wald chi2(1)      =       3.52
Log likelihood = 92.18392                       Prob > chi2       =     0.0606

------------------------------------------------------------------------------
             |                 OPG
       D.y_t | Coefficient  std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
y_t          |
       _cons |  -.0109099    .012526    -0.87   0.384    -.0354605    .0136407
-------------+----------------------------------------------------------------
ARMA         |
          ar |
         L1. |   .1955817   .1042143     1.88   0.061    -.0086745     .399838
-------------+----------------------------------------------------------------
      /sigma |   .0916716   .0060908    15.05   0.000     .0797339    .1036093
------------------------------------------------------------------------------
Note: The test of the variance against zero is one sided, and the two-sided
      confidence interval is truncated at zero.
```



Q2.

a.

```
. reg D.exchq L(1)D.exchq

      Source |       SS           df       MS      Number of obs   =        98
-------------+----------------------------------   F(1, 96)        =      4.04
       Model |  .033983147         1  .033983147   Prob > F        =    0.0472
    Residual |  .807228202        96  .008408627   R-squared       =    0.0404
-------------+----------------------------------   Adj R-squared   =    0.0304
       Total |  .841211349        97  .008672282   Root MSE        =     .0917

------------------------------------------------------------------------------
     D.exchq | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
       exchq |
         LD. |    .201976   .1004686     2.01   0.047     .0025473    .4014047
             |
       _cons |  -.0076871   .0093245    -0.82   0.412     -.026196    .0108218
------------------------------------------------------------------------------
```

```
. ar2sim 100 0.2020 0.0917
Number of observations (_N) was 0, now 100.

Time variable: __000000, 1 to 100
        Delta: 1 unit
(98 missing values generated)
(98 real changes made)

Augmented Dickey–Fuller test for unit root

Variable: __000002                          Number of obs  = 98
                                            Number of lags =  1

H0: Random walk without drift, d = 0

                                       Dickey–Fuller
                   Test         -------- critical value ---------
                statistic           1%           5%          10%
------------------------------------------------------------------
 Z(t)              -0.725       -3.513       -2.892       -2.581
------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8401.
```

b.

```
. set seed 6219

. quietly simulate pval=r(p), reps(5000): ar2sim 100 0.2020 0.0917

. summarize

    Variable |        Obs        Mean    Std. dev.       Min        Max
-------------+---------------------------------------------------------
        pval |      5,000     .501461    .2941342   2.41e-07    .998769

. count if pval<=0.10
  551

. gen prob_1=551/5000

. display prob
.1102
```

Rejection Fraction = 11.02%

There were 551 observations with a p-value less than or equal to 0.10 out of a total of 5000 observations. Consequently, the estimated probability is calculated as 551/5000, resulting in a probability of approximately 0.1102. This implies that the fraction of rejections, which stands at 11.02%, is in close alignment with the significance level of 10%. These findings are consistent with our expectations because we were unable to reject the null hypothesis, indicating that the data exhibits a unit root.

c.

```
. reg D.exchq L(1)exchq L(1)D.exchq
```

Source	SS	df	MS			
Model	.083906618	2	.041953309	Number of obs	=	98
Residual	.757304731	95	.007971629	F(2, 95)	=	5.26
				Prob > F	=	0.0068
Total	.841211349	97	.008672282	R-squared	=	0.0997
				Adj R-squared	=	0.0808
				Root MSE	=	.08928

D.exchq	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
exchq						
L1.	-.0663886	.0265286	-2.50	0.014	-.1190546	-.0137226
LD.	.213392	.0979294	2.18	0.032	.0189775	.4078065
_cons	.1125429	.0488938	2.30	0.024	.0154765	.2096093

```
. summarize
```

Variable	Obs	Mean	Std. dev.	Min	Max
pval	5,000	.205647	.1843937	4.34e-07	.9732851

Rejection Fraction = 37.22%

There were 1861 observations with a p-value less than or equal to 0.10 out of a total of 5000 observations. Consequently, the estimated probability is calculated as 1861/5000, resulting in a probability of approximately 0.3722. This implies that the fraction of rejections, which stands at 37.22%, is significantly higher than the significance level of 10%. These findings are consistent with our expectations because we have rejected the null hypothesis, indicating that the data does not exhibit a unit root.

d.

```
. summarize
```

Variable	Obs	Mean	Std. dev.	Min	Max
pval	5,000	.4961497	.289873	4.54e-06	.9987869

Rejection Fraction = 10.74%

```
. summarize
```

Variable	Obs	Mean	Std. dev.	Min	Max
pval	5,000	.0515017	.0682822	2.03e-06	.7604713

Rejection Fraction = 83.94%

Observing the data, we note that when the number of observations is doubled, the rejection fractions are 10.74% and 83.94%. In the case where the null hypothesis holds true, the increase in the sample size doesn't significantly impact the rejection rate, which remains close to 10%. However, for the second scenario, where the null hypothesis is false, the rejection fraction exceeds the significance level of 10% and actually grows as the sample size increases. These outcomes are consistent with our anticipated results.

STATA CODE

Q1.

a.
```
clear all
use http://fmwww.bc.edu/ec-p/data/Mills2d/exchq.dta
twoway (line exchq qtr), name(graph1) xtitle("Quarter") ytitle("Exchange Rate")
title("Dollar/Sterling Exchange Rate vs Quarter")
```

b.
```
//Create two variables
gen y_t = exchq
gen dy_t = y_t - L.y_t

//AR(0) model:
reg dy_t if qtr >= tq(1973q1)
estimate store ar_0
//AR(1) model:
reg dy_t L.dy_t if qtr >= tq(1973q1)
estimate store ar_1
//AR(2) model:
reg dy_t L(1/2).dy_t if qtr >= tq(1973q1)
estimate store ar_2
//AR(3) model:
reg dy_t L(1/3).dy_t if qtr >= tq(1973q1)
estimate store ar_3

estimate stats ar_0 ar_1 ar_2 ar_3
```

c.
```
dfuller y_t, lags(1) regress
```

d.
```
save y_t, replace
drop if qtr >= tq(1996q1)
arima y_t, arima(1,1,0)
tsappend, add(4)
predict fory_t, y dynamic(tq(1995q4))
drop y_t

merge m:1 qtr using y_t
gen qtr_trunc = qtr if qtr >= tq(1996q1)
format qtr_trunc %tq
gen actual = y_t if qtr >= tq(1996q1)
gen forecasted = fory_t if qtr >= tq(1996q1)
```

```
twoway (line actual qtr_trunc,title("Actual")) (line forecasted qtr_trunc,title("Forecast")),
name(graph2) xtitle("Quarter") ytitle("Exchange Rate") title("Dollar/Sterling Exchange
Rate vs Quarter")
```

Q2.

a.

```
clear all
use http://fmwww.bc.edu/ec-p/data/Mills2d/exchq.dta

program ar2sim, rclass
        drop _all
        set obs `1'
        tempvar time
        gen `time' = _n
        tsset `time'
        tempvar e
        gen `e' = rnormal()
        tempvar y
        gen `y' = 0 in 1/2
        replace `y' = (1+`2')*L.`y' - `2'*L2.`y' + (`3'*`e') in 3/l
        dfuller `y', lags(1)
        return scalar p = r(p)
end

reg D.exchq L(1)D.exchq

set seed 6219
ar2sim 100 0.2020 0.0917
```

b.

```
set seed 6219
quietly simulate pval=r(p), reps(5000): ar2sim 100 0.2020 0.0917
summarize
count if pval <=0.10
gen prob_1=551/5000
display prob
```

c.

```
clear all
use http://fmwww.bc.edu/ec-p/data/Mills2d/exchq.dta

program ar2sim_2, rclass
        drop _all
        set obs `1'
```

```
		tempvar time
		gen `time' = _n
		tsset `time'
		tempvar e
		gen `e' = rnormal()
		tempvar y
		gen `y' = 0 in 1/2
		replace `y' = (1+`2'+`3’)*L.`y' - `2'*L2.`y' + (`4'*`e') in 3/l
		dfuller `y', lags(1)
		return scalar p = r(p)
	end

	reg D.exchq L(1)exchq L(1)D.exchq

	set seed 6219
	quietly simulate pval=r(p), reps(5000): ar2sim_2 100 0.2134 -0.0664 0.0893
	summarize
	count if pval<=0.10
	gen prob_2=1861/5000
	display prob_2
```

d.

```
	program ar2sim, rclass
		drop _all
		set obs `1'
		tempvar time
		gen `time' = _n
		tsset `time'
		tempvar e
		gen `e' = rnormal()
		tempvar y
		gen `y' = 0 in 1/2
		replace `y' = (1+`2')*L.`y' - `2'*L2.`y' + (`3'*`e') in 3/l
		dfuller `y', lags(1)
		return scalar p = r(p)
	end

	set seed 6219
	quietly simulate pval=r(p), reps(5000): ar2sim 200 0.2020 0.0917
	summarize
	count if pval <=0.10
	gen prob_3=537/5000
	display prob_3
```

```
set seed 6219
quietly simulate pval=r(p), reps(5000): ar2sim_2 200 0.2134 -0.0664 0.0893
summarize
count if pval <=0.10
gen prob_4=4197/5000
display prob_4
```