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Assignment 5

1. Test whether the series spot and future are stationary series.

```
. dfuller spot, trend lags(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =      7682

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -2.438            -3.960            -3.410            -3.120
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.3597

------------------------------------------------------------------------------
D.spot |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------+----------------------------------------------------------------------
spot   |
   L1. |  -.001489   .0006108    -2.44   0.015    -.0026862   -.0002917
   LD. |   .0440347  .0114011     3.86   0.000     .0216855    .0663839
 _trend |  .0000171  8.32e-06     2.05   0.040     7.62e-07    .0000334
  _cons |  .7447753   .302873     2.46   0.014     .1510615    1.338489
------------------------------------------------------------------------------
```

To test the stationary series for spot, we set the hypothesis of H_0: $\beta = 1$. The p-value is 0.3597 which is larger than the critical region of 0.05. We cannot reject the null hypothesis, meaning that it is a unit root and the time trend is significant at 95% confidence level. Therefore, the spot is a nonstationary series.

```
. dfuller future, trend lags(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =      7682

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -2.563            -3.960            -3.410            -3.120
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.2971

------------------------------------------------------------------------------
D.future |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------+--------------------------------------------------------------------
future   |
   L1.   |  -.001768   .0006898    -2.56   0.010    -.0031202   -.0004159
   LD.   |  -.0275938  .0114077    -2.42   0.016    -.0499561   -.0052315
 _trend  |   .0000222    .00001     2.22   0.026     2.62e-06    .0000418
  _cons  |    .86276   .3338726     2.58   0.010     .2082785    1.517241
------------------------------------------------------------------------------
```

To test the stationary series for future, we set the hypothesis of H_0: $\beta = 1$. The p-value is 0.2971 which is larger than the critical region of 0.05. We cannot reject the null hypothesis, meaning that it is a unit root and the time trend is significant at 95% confidence level. Therefore, the future is a nonstationary series.

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2. Determine the order of integration of the series spot and future.

```
. dfuller d.spot, trend lags(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =      7681

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)           -63.765            -3.960            -3.410            -3.120
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
D2.spot      |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
         D1. |  -1.005364   .0157667   -63.77   0.000    -1.036271    -.974457
         LD. |   .0508571    .011398     4.46   0.000     .0285139    .0732003
       _trend |   7.82e-07   4.94e-06     0.16   0.874    -8.90e-06    .0000105
        _cons |   .0088178   .0219189     0.40   0.687    -.0341492    .0517848
------------------------------------------------------------------------------
```

From the previous question, both series spot and future are not integrated at order 0. Then, it needs to test whether the series are integrated at order 1 or not calculating from unit root test of ΔY_t. The null hypotheses are H_0: $\gamma_i = 0$.

The result shows that we can reject the null hypothesis since the p-value is 0.00 which is lower than 0.05 and statistically significant at 95% confidence level.Then, the series spot is stationary at I(1).

```
. dfuller d.future, trend lags(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =      7681

                                 ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)           -65.269            -3.960            -3.410            -3.120
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
D2.future    |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
future       |
         D1. |  -1.067592   .0163567   -65.27   0.000    -1.099655   -1.035528
         LD. |    .038008   .0114045     3.33   0.001     .0156522    .0603639
       _trend |   1.01e-06   5.59e-06     0.18   0.856    -9.94e-06     .000012
        _cons |   .0096235   .0247823     0.39   0.698    -.0389566    .0582036
------------------------------------------------------------------------------
```

We also perform the same test with future. The result shows that we can reject the null hypothesis since the p-value is 0.00 which is lower than 0.05 and statistically significant at 95% confidence level. Then, the series future is stationary at I(1).

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3. Generate series of the return of spot (*rspot*) and return of future (*rfuture*) and test whether they are stationary.

```
. g rspot = (spot/l.spot)-1
(1 missing value generated)

. g rfuture = (future/l.future)-1
(1 missing value generated)


. dfuller rspot, trend lags(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =      7681

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -63.787            -3.960            -3.410            -3.120
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
D.rspot |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------+---------------------------------------------------------------------
rspot    |
    L1. |  -1.005168   .0157581   -63.79   0.000    -1.036058   -.9742776
    LD. |   .0517018   .0113974     4.54   0.000     .0293598    .0740439
 _trend |   9.56e-10   9.19e-09     0.10   0.917    -1.71e-08    1.90e-08
  _cons |   .0000199   .0000408     0.49   0.626      -.00006    .0000998
------------------------------------------------------------------------------
```

To test the stationary series for spot return, we set the hypothesis of H_0: $\beta = 1$. The p-value is 0.00 which is statistically significant at 95% confidence level. We reject the null hypothesis, meaning that it is not a unit root and the time trend is insignificant. Therefore, the future return is a stationary series.

```
. dfuller rfuture, trend lags(1) regress

Augmented Dickey-Fuller test for unit root         Number of obs   =      7681

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic             Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -65.070            -3.960            -3.410            -3.120
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
D.rfuture |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------+---------------------------------------------------------------------
rfuture    |
    L1. |  -1.063572   .0163449   -65.07   0.000    -1.095612   -1.031531
    LD. |     .03575   .0114053     3.13   0.002     .0133924    .0581076
 _trend |   1.17e-09   1.06e-08     0.11   0.912    -1.96e-08    2.19e-08
  _cons |   .0000231    .000047     0.49   0.624    -.0000691    .0001152
------------------------------------------------------------------------------
```

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To test the stationary series for future return, we set the hypothesis of H_0: $\beta = 1$. The p-value is 0.00 which is statistically significant at 95% confidence level. We reject the null hypothesis, meaning that it is not a unit root and the time trend is insignificant. Therefore, the future return is a stationary series.