

```
689 0 OUTPUT ACTIVATE JohansenCointegrationTestOutput.  
689 0 M> OUTPUT ACTIVATE JohansenCointegrationTestOutput.  
690 0 TITLE 'Johansen Cointegration Test'.  
690 0 M> TITLE 'Johansen Cointegration Test'.
```

Johansen Cointegration Test

```
691 0 GET DATA /TYPE=TXT /FILE='D:\DATA ANALYSIS\N Time Series Tests and Fo
recasting\Johansen Cointegration Test\dataset.csv' /EN
      CODING='UTF8' /DELCASE=LINE /DELIMITERS=', ' /QUALIFIER='"' /ARRANG
EMENT=DELIMITED /FIRSTCASE=2
691 0 M> GET DATA /TYPE=TXT /FILE='D:\DATA ANALYSIS\N Time Series Tests and
Forecasting\Johansen Cointegration Test\dataset.csv'
      /ENCODING='UTF8' /DELCASE=LINE /DELIMITERS=', ' /QUALIFIER='"' /
ARRANGEMENT=DELIMITED /FIRSTCASE=2
692 0 /VARIABLES=school A8 sex A8 age F8.0 address A8 famsize A8 Pstatus A
8 Medu F8.0 Fedu F8.0 Mjob A16 Fjob A16 reason A16 gua
      rdian A16 traveltime F8.0 studytime F8.0 failures F8.0 schoolsup A
8 famsup A8 paid A8 activities A8 nursery A8 higher A8
      internet A8 romantic A8 famrel F8.0 freetime F8.0 goout F8.0 Dalc
F8.0 Walc F8.0 health F8.0 absences F8.0 G1 F8.0 G2 F
      8.0 G3 F8.0.
692 0 M> /VARIABLES=school A8 sex A8 age F8.0 address A8 famsize A8 Pstatu
s A8 Medu F8.0 Fedu F8.0 Mjob A16 Fjob A16 reason A16
      guardian A16 traveltime F8.0 studytime F8.0 failures F8.0 schoo
lsup A8 famsup A8 paid A8 activities A8 nursery A8 hig
      her A8 internet A8 romantic A8 famrel F8.0 freetime F8.0 goout
F8.0 Dalc F8.0 Walc F8.0 health F8.0 absences F8.0 G1
      F8.0 G2 F8.0 G3 F8.0.
693 0 DATASET NAME JohansenCointegrationTestData.
693 0 M> DATASET NAME JohansenCointegrationTestData.
694 0 COMPUTE time_index=$CASENUM.
694 0 M> COMPUTE time_index=$CASENUM.
695 0 EXECUTE.
695 0 M> EXECUTE.
696 0 * BEGIN METHOD-SPECIFIC SPSS WORKFLOW.
696 0 M> * BEGIN METHOD-SPECIFIC SPSS WORKFLOW.
697 0 COMPUTE dG1=G1-LAG(G1).
697 0 M> COMPUTE dG1=G1-LAG(G1).
698 0 COMPUTE dG2=G2-LAG(G2).
698 0 M> COMPUTE dG2=G2-LAG(G2).
699 0 COMPUTE dG3=G3-LAG(G3).
699 0 M> COMPUTE dG3=G3-LAG(G3).
700 0 COMPUTE g1_l1=LAG(G1,1).
700 0 M> COMPUTE g1_l1=LAG(G1,1).
701 0 EXECUTE.
```

Johansen Cointegration Test

```

701  0 M> EXECUTE.
702  0 COMPUTE g2_l1=LAG(G2,1).
702  0 M> COMPUTE g2_l1=LAG(G2,1).
703  0 EXECUTE.
703  0 M> EXECUTE.
704  0 COMPUTE g3_l1=LAG(G3,1).
704  0 M> COMPUTE g3_l1=LAG(G3,1).
705  0 EXECUTE.
705  0 M> EXECUTE.
706  0 REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG1 /METH
OD=ENTER g1_l1 g2_l1 g3_l1.
706  0 M> REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG1 /M
ETHOD=ENTER g1_l1 g2_l1 g3_l1.

```

Regression

Notes

Output Created		18-JUL-2026 15:52:48
Comments		
Input	Data	D:\DATA ANALYSIS\N Time Series Tests and Forecasting\Johansen Cointegration Test\dataset.csv
	Active Dataset	JohansenCointegrationTe stData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.

Johansen Cointegration Test

Notes

Syntax	REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG1 /METHOD=ENTER g1_l1 g2_l1 g3_l1.	
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02
	Memory Required	5056 bytes
	Additional Memory Required for Residual Plots	0 bytes

[JohansenCointegrationTestData]

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	g3_l1, g1_l1, g2_l1 ^b	.	Enter

a. Dependent Variable: dG1

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.620 ^a	.384	.381	2.61566

a. Predictors: (Constant), g3_l1, g1_l1, g2_l1

Johansen Cointegration Test

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2747.801	3	915.934	133.875	.000 ^b
	Residual	4406.044	644	6.842		
	Total	7153.846	647			

a. Dependent Variable: dG1

b. Predictors: (Constant), g3_l1, g1_l1, g2_l1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.686	.446		19.475	.000
	g1_l1	-.626	.076	-.517	-8.284	.000
	g2_l1	-.201	.101	-.176	-1.980	.048
	g3_l1	.067	.082	.065	.817	.414

Coefficients^a

Model		95.0% Confidence Interval for B	
		Lower Bound	Upper Bound
1	(Constant)	7.810	9.562
	g1_l1	-.775	-.478
	g2_l1	-.400	-.002
	g3_l1	-.093	.227

a. Dependent Variable: dG1

```
707 0 REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG2 /METHOD=ENTER g1_l1 g2_l1 g3_l1.
```

```
707 0 M> REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG2 /METHOD=ENTER g1_l1 g2_l1 g3_l1.
```

Regression

Johansen Cointegration Test

Notes

Output Created		18-JUL-2026 15:52:48
Comments		
Input	Data	D:\DATA ANALYSIS\N Time Series Tests and Forecasting\Johansen Cointegration Test\dataset.csv
	Active Dataset	JohansenCointegrationTestData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG2 /METHOD=ENTER g1_l1 g2_l1 g3_l1.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.05
	Memory Required	5056 bytes
	Additional Memory Required for Residual Plots	0 bytes

Johansen Cointegration Test

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	g3_l1, g1_l1, g2_l1 ^b	.	Enter

a. Dependent Variable: dG2

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.653 ^a	.426	.423	2.87098

a. Predictors: (Constant), g3_l1, g1_l1, g2_l1

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3935.806	3	1311.935	159.166	.000 ^b
	Residual	5308.194	644	8.243		
	Total	9244.000	647			

a. Dependent Variable: dG2

b. Predictors: (Constant), g3_l1, g1_l1, g2_l1

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.349	.490		19.096	.000
	g1_l1	.185	.083	.135	2.232	.026
	g2_l1	-1.063	.111	-.820	-9.546	.000
	g3_l1	.070	.089	.060	.787	.431

Johansen Cointegration Test

Coefficients^a

Model		95.0% Confidence Interval for B	
		Lower Bound	Upper Bound
1	(Constant)	8.387	10.310
	g1_l1	.022	.348
	g2_l1	-1.282	-.844
	g3_l1	-.105	.246

a. Dependent Variable: dG2

```
708 0 REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG3 /METHOD=ENTER g1_l1 g2_l1 g3_l1.
```

```
708 0 M> REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG3 /METHOD=ENTER g1_l1 g2_l1 g3_l1.
```

Regression

Notes

Output Created		18-JUL-2026 15:52:48
Comments		
Input	Data	D:\DATA ANALYSIS\N Time Series Tests and Forecasting\Johansen Cointegration Test\dataset.csv
	Active Dataset	JohansenCointegrationTestData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.

Johansen Cointegration Test

Notes

Syntax	REGRESSION /STATISTICS=COEFF OUTS R ANOVA CI(95) /DEPENDENT dG3 /METHOD=ENTER g1_l1 g2_l1 g3_l1.	
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03
	Memory Required	5056 bytes
	Additional Memory Required for Residual Plots	0 bytes

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	g3_l1, g1_l1, g2_l1 ^b	.	Enter

a. Dependent Variable: dG3

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.640 ^a	.409	.407	3.16976

a. Predictors: (Constant), g3_l1, g1_l1, g2_l1

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4485.478	3	1495.159	148.811	.000 ^b
	Residual	6470.522	644	10.047		
	Total	10956.000	647			

a. Dependent Variable: dG3

b. Predictors: (Constant), g3_l1, g1_l1, g2_l1

Johansen Cointegration Test

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.237	.540		17.091	.000
	g1_l1	.200	.092	.133	2.183	.029
	g2_l1	-.117	.123	-.083	-.952	.341
	g3_l1	-.853	.099	-.671	-8.640	.000

Coefficients^a

Model		95.0% Confidence Interval for B	
		Lower Bound	Upper Bound
1	(Constant)	8.176	10.299
	g1_l1	.020	.380
	g2_l1	-.358	.124
	g3_l1	-1.047	-.660

a. Dependent Variable: dG3

```

709 0 * END METHOD-SPECIFIC SPSS WORKFLOW.
709 0 M> * END METHOD-SPECIFIC SPSS WORKFLOW.
710 0 SAVE OUTFILE='D:\DATA ANALYSIS\N Time Series Tests and Forecasting\Jo
hansen Cointegration Test\SPSS_Output\sav\johansen-coi
      ntegration-test_spss_ready_data.sav' /COMPRESSED.
710 0 M> SAVE OUTFILE='D:\DATA ANALYSIS\N Time Series Tests and Forecasting
\Johansen Cointegration Test\SPSS_Output\sav\johansen-
      cointegration-test_spss_ready_data.sav' /COMPRESSED.
711 0 ECHO 'Johansen Cointegration Test'.
711 0 M> ECHO 'Johansen Cointegration Test'.
Johansen Cointegration Test
712 0 ECHO 'Method type: multivariate_cointegration_test'.
712 0 M> ECHO 'Method type: multivariate_cointegration_test'.
Method type: multivariate_cointegration_test
713 0 ECHO 'Design: Johansen trace test for G1, G2, and G3 with restricted
constant and one differenced lag.'.
713 0 M> ECHO 'Design: Johansen trace test for G1, G2, and G3 with restrict
ed constant and one differenced lag.'.

```

Johansen Cointegration Test

Design: Johansen trace test for G1, G2, and G3 with restricted constant and one differenced lag.

```
714 0 ECHO 'Formula: Trace(r)=-T*sum(log(1-lambda_i)), i=r+1..k'.
714 0 M> ECHO 'Formula: Trace(r)=-T*sum(log(1-lambda_i)), i=r+1..k'.
Formula: Trace(r)=-T*sum(log(1-lambda_i)), i=r+1..k
715 0 ECHO 'Series order: source-row order'.
715 0 M> ECHO 'Series order: source-row order'.
Series order: source-row order
716 0 ECHO 'trace_r0 = 548.5816478640644'.
716 0 M> ECHO 'trace_r0 = 548.5816478640644'.
trace_r0 = 548.5816478640644
717 0 ECHO 'critical_95_r0 = 29.7961'.
717 0 M> ECHO 'critical_95_r0 = 29.7961'.
critical_95_r0 = 29.7961
718 0 ECHO 'trace_r1 = 328.2810553543704'.
718 0 M> ECHO 'trace_r1 = 328.2810553543704'.
trace_r1 = 328.2810553543704
719 0 ECHO 'critical_95_r1 = 15.4943'.
719 0 M> ECHO 'critical_95_r1 = 15.4943'.
critical_95_r1 = 15.4943
720 0 ECHO 'estimated_rank_5_percent = 3'.
720 0 M> ECHO 'estimated_rank_5_percent = 3'.
estimated_rank_5_percent = 3
721 0 ECHO 'largest_eigenvalue = 0.2885822764786495'.
721 0 M> ECHO 'largest_eigenvalue = 0.2885822764786495'.
largest_eigenvalue = 0.2885822764786495
722 0 ECHO 'n_series = 649'.
722 0 M> ECHO 'n_series = 649'.
n_series = 649
723 0 ECHO 'Cross-check status: pass'.
723 0 M> ECHO 'Cross-check status: pass'.
Cross-check status: pass
724 0 OUTPUT SAVE OUTFILE='D:\DATA ANALYSIS\N Time Series Tests and Forecasting\Johansen Cointegration Test\SPSS_Output\spv\johansen-cointegration-test_spss_output.spv'.
724 0 M> OUTPUT SAVE OUTFILE='D:\DATA ANALYSIS\N Time Series Tests and Forecasting\Johansen Cointegration Test\SPSS_Output\spv\johansen-cointegration-test_spss_output.spv'.
```

Johansen Cointegration Test

```
725 0 OUTPUT EXPORT /CONTENTS EXPORT=ALL LAYERS=PRINTSETTING MODELVIEWS=PRI
NTSETTING /PDF DOCUMENTFILE='D:\DATA ANALYSIS\N Time S
eries Tests and Forecasting\Johansen Cointegration Test\SPSS_Outpu
t\pdf\johansen-cointegration-test_spss_output.pdf'.
```

```
725 0 M> OUTPUT EXPORT /CONTENTS EXPORT=ALL LAYERS=PRINTSETTING MODELVIEWS=
PRINTSETTING /PDF DOCUMENTFILE='D:\DATA ANALYSIS\N Tim
e Series Tests and Forecasting\Johansen Cointegration Test\SPSS
_Output\pdf\johansen-cointegration-test_spss_output.pd
f'.
```