```
SET TVARS NAMES.

GET DATA
  /TYPE=TXT
  /FILE='D:\durbin_watson_test\student_dw_spss_clean.csv'
  /ENCODING='UTF8'
  /DELCASE=LINE
  /DELIMITERS=","
  /QUALIFIER='"'
  /ARRANGEMENT=DELIMITED
  /FIRSTCASE=2
  /IMPORTCASE=ALL
  /VARIABLES=
  school A2
  sex A1
  age F3.0
  address A1
  famsize A3
  Pstatus A1
  Medu F3.0
  Fedu F3.0
  Mjob A20
  Fjob A20
  reason A20
  guardian A20
  traveltime F3.0
  studytime F3.0
  failures F3.0
  schoolsup A3
  famsup A3
  paid A3
  activities A3
  nursery A3
  higher A3
  internet A3
  romantic A3
  famrel F3.0
  freetime F3.0
  goout F3.0
  Dalc F3.0
  Walc F3.0
  health F3.0
```

```
  absences F5.0
  G1 F5.0
  G2 F5.0
  G3 F5.0.
CACHE.
EXECUTE.

DATASET NAME DWClean WINDOW=FRONT.
```

## Dataset Name

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:51 |
| Comments | | |
| Input | Data | D:\durbin_watson_test\student_dw_spss_clean.csv |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | DATASET NAME DWClean WINDOW=FRONT. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.00 |

### Warnings

The active dataset will replace the existing dataset named DWClean.

```
COMPUTE caseid = $CASENUM.
EXECUTE.

VALUE LABELS studytime
  1 '<2 hours'
  2 '2 to 5 hours'
  3 '5 to 10 hours'
  4 '>10 hours'.
EXECUTE.
```

```
TITLE 'Durbin Watson Test SPSS SAFE Import Check'.
```

```
FREQUENCIES VARIABLES=studytime.
```

# Frequencies

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:52 |
| Comments | | |
| Input | Data | D:\durbin_watson_test\student_dw_spss_clean.csv |
| | Active Dataset | DWClean |
| | 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 all cases with valid data. |
| Syntax | | FREQUENCIES VARIABLES=studytime. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.01 |

```
[DWClean]
```

### Statistics

studytime

| | | |
|---|---|---|
| N | Valid | 649 |
| | Missing | 0 |

**studytime**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | <2 hours | 212 | 32.7 | 32.7 | 32.7 |
| | 2 to 5 hours | 305 | 47.0 | 47.0 | 79.7 |
| | 5 to 10 hours | 97 | 14.9 | 14.9 | 94.6 |
| | >10 hours | 35 | 5.4 | 5.4 | 100.0 |
| | Total | 649 | 100.0 | 100.0 | |

```
DESCRIPTIVES VARIABLES=G1 G2 G3 absences failures age Medu Fedu traveltime hea
lth
  /STATISTICS=MEAN STDDEV MIN MAX.
```

## Descriptives

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:52 |
| Comments | | |
| Input | Data | D:\durbin_watson_test\student_dw_spss_clean.csv |
| | Active Dataset | DWClean |
| | 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 | All non-missing data are used. |
| Syntax | | DESCRIPTIVES VARIABLES=G1 G2 G3 absences failures age Medu Fedu traveltime health /STATISTICS=MEAN STDDEV MIN MAX. |

### Notes

| | | |
|---|---|---|
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.01 |

### Descriptive Statistics

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| G1 | 649 | 0 | 19 | 11.40 | 2.745 |
| G2 | 649 | 0 | 19 | 11.57 | 2.914 |
| G3 | 649 | 0 | 19 | 11.91 | 3.231 |
| absences | 649 | 0 | 32 | 3.66 | 4.641 |
| failures | 649 | 0 | 3 | .22 | .593 |
| age | 649 | 15 | 22 | 16.74 | 1.218 |
| Medu | 649 | 0 | 4 | 2.51 | 1.135 |
| Fedu | 649 | 0 | 4 | 2.31 | 1.100 |
| traveltime | 649 | 1 | 4 | 1.57 | .749 |
| health | 649 | 1 | 5 | 3.54 | 1.446 |
| Valid N (listwise) | 649 | | | | |

```
* ============================================================.
* A. MAIN MODEL: G3 ~ G1 + G2 + studytime + failures + absences + age + Medu +
 Fedu.
* ============================================================.

DATASET COPY DWMain.
```

## Dataset Copy

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:52 |
| Comments | | |
| Input | Data | D:\durbin_watson_test\student_dw_spss_clean.csv |
| | Active Dataset | DWClean |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| Syntax | | DATASET COPY DWMain. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.01 |

### Warnings

Replacing existing dataset named DWMain.

```
DATASET ACTIVATE DWMain.
SORT CASES BY caseid(A).
EXECUTE.

REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF R ANOVA COLLIN
  /DEPENDENT G3
  /METHOD=ENTER G1 G2 studytime failures absences age Medu Fedu
  /SAVE PRED(prd_main) RESID(res_main).
```

## Regression

Durbin Watson Test SPSS SAFE Import Check

## Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:52 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | 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<br>/MISSING LISTWISE<br>/STATISTICS COEFF R ANOVA COLLIN<br>/DEPENDENT G3<br>/METHOD=ENTER G1 G2 studytime failures absences age Medu Fedu<br>/SAVE PRED(prd_main) RESID(res_main). |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.04 |
| | Memory Required | 8592 bytes |
| | Additional Memory Required for Residual Plots | 0 bytes |
| Variables Created or Modified | prd_main | Unstandardized Predicted Value |
| | res_main | Unstandardized Residual |

[DWMain]

**Variables Entered/Removed[a]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | Fedu, absences, studytime, age, G2, failures, Medu, G1[b] | . | Enter |

a. Dependent Variable: G3

b. All requested variables entered.

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .922[a] | .851 | .849 | 1.256 |

a. Predictors: (Constant), Fedu, absences, studytime, age, G2, failures, Medu, G1

b. Dependent Variable: G3

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5754.033 | 8 | 719.254 | 456.111 | .000[b] |
| | Residual | 1009.234 | 640 | 1.577 | | |
| | Total | 6763.267 | 648 | | | |

a. Dependent Variable: G3

b. Predictors: (Constant), Fedu, absences, studytime, age, G2, failures, Medu, G1

## Coefficients[a]

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | -.501 | .774 | | -.648 | .518 |
| | G1 | .143 | .037 | .122 | 3.910 | .000 |
| | G2 | .885 | .034 | .798 | 25.744 | .000 |
| | studytime | .097 | .062 | .025 | 1.556 | .120 |
| | failures | -.235 | .095 | -.043 | -2.471 | .014 |
| | absences | .023 | .011 | .033 | 2.085 | .038 |
| | age | .023 | .044 | .009 | .520 | .604 |
| | Medu | -.045 | .058 | -.016 | -.776 | .438 |
| | Fedu | .022 | .059 | .007 | .371 | .711 |

a. Dependent Variable: G3

## Collinearity Diagnostics[a]

| Model | Dimension | Eigenvalue | Condition Index | Variance Proportions | | | |
|---|---|---|---|---|---|---|---|
| | | | | (Constant) | G1 | G2 | studytime |
| 1 | 1 | 7.051 | 1.000 | .00 | .00 | .00 | .00 |
| | 2 | .945 | 2.731 | .00 | .00 | .00 | .00 |
| | 3 | .570 | 3.518 | .00 | .00 | .00 | .00 |
| | 4 | .211 | 5.777 | .00 | .00 | .00 | .15 |
| | 5 | .108 | 8.064 | .00 | .01 | .01 | .83 |
| | 6 | .062 | 10.680 | .00 | .00 | .00 | .00 |
| | 7 | .043 | 12.869 | .02 | .06 | .08 | .01 |
| | 8 | .008 | 30.135 | .00 | .87 | .88 | .00 |
| | 9 | .002 | 56.814 | .97 | .06 | .02 | .00 |

## Collinearity Diagnostics[a]

| Model | Dimension | Variance Proportions | | | | |
|---|---|---|---|---|---|---|
| | | failures | absences | age | Medu | Fedu |
| 1 | 1 | .00 | .01 | .00 | .00 | .00 |
| | 2 | .61 | .05 | .00 | .00 | .00 |
| | 3 | .12 | .88 | .00 | .00 | .00 |
| | 4 | .01 | .00 | .00 | .13 | .19 |
| | 5 | .00 | .02 | .00 | .02 | .02 |
| | 6 | .00 | .00 | .00 | .84 | .76 |
| | 7 | .21 | .04 | .03 | .00 | .01 |
| | 8 | .00 | .00 | .00 | .00 | .00 |
| | 9 | .04 | .01 | .96 | .00 | .01 |

a. Dependent Variable: G3

## Residuals Statistics[a]

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | .25 | 19.55 | 11.91 | 2.980 | 649 |
| Residual | -9.051 | 5.782 | .000 | 1.248 | 649 |
| Std. Predicted Value | -3.911 | 2.565 | .000 | 1.000 | 649 |
| Std. Residual | -7.207 | 4.605 | .000 | .994 | 649 |

a. Dependent Variable: G3

```
SORT CASES BY caseid(A).
EXECUTE.

COMPUTE lag_res_main = LAG(res_main).
IF ($CASENUM = 1) lag_res_main = $SYSMIS.
COMPUTE res_diff_main = res_main - lag_res_main.
COMPUTE res_diff2_main = res_diff_main ** 2.
COMPUTE res2_main = res_main ** 2.
EXECUTE.

AGGREGATE
  /OUTFILE=* MODE=ADDVARIABLES
  /BREAK=
```

```
  /n_main = N(res_main)
  /sum_diff2_main = SUM(res_diff2_main)
  /sum_res2_main = SUM(res2_main)
  /mean_res_main = MEAN(res_main)
  /mean_lag_res_main = MEAN(lag_res_main)
  /sd_res_main = SD(res_main)
  /sd_lag_res_main = SD(lag_res_main).

COMPUTE zres = res_main - mean_res_main.
COMPUTE zlag = lag_res_main - mean_lag_res_main.
COMPUTE cross_main = zres * zlag.
EXECUTE.

AGGREGATE
  /OUTFILE=* MODE=ADDVARIABLES
  /BREAK=
  /sum_cross_main = SUM(cross_main).

COMPUTE dw_main = sum_diff2_main / sum_res2_main.
COMPUTE lag1_corr_main = sum_cross_main / ((n_main - 1) * sd_res_main * sd_lag
_res_main).
COMPUTE approx_dw_main = 2 * (1 - lag1_corr_main).
STRING interpretation_main (A90).
IF (dw_main < 1.5) interpretation_main = 'Possible positive first-order autoco
rrelation'.
IF (dw_main >= 1.5 AND dw_main <= 2.5) interpretation_main = 'No serious first
-order autocorrelation by the 1.5 to 2.5 rule of thumb'.
IF (dw_main > 2.5) interpretation_main = 'Possible negative first-order autoco
rrelation'.
EXECUTE.

FORMATS dw_main lag1_corr_main approx_dw_main sum_diff2_main sum_res2_main (F1
2.6).
TITLE 'Main Durbin Watson Result Computed Manually in SPSS'.
```

```
LIST VARIABLES=n_main dw_main lag1_corr_main approx_dw_main sum_diff2_main sum
_res2_main interpretation_main
  /CASES=FROM 2 TO 2.
```

## List

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:53 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | LIST VARIABLES=n_main dw_main lag1_corr_main approx_dw_main sum_diff2_main sum_res2_main interpretation_main /CASES=FROM 2 TO 2. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.00 |

```
The variables are listed in the following order:

LINE   1: n_main dw_main lag1_corr_main approx_dw_main sum_diff2_main sum_res2
_main

LINE   2: interpretation_main
```

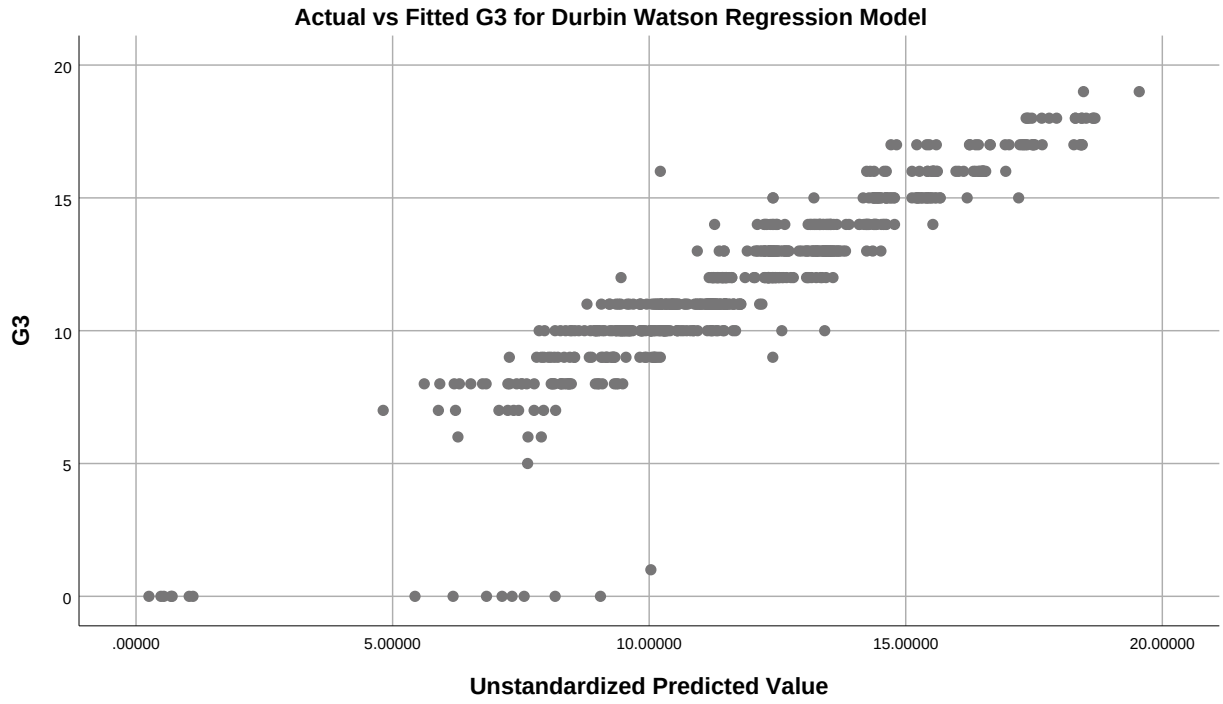
```
      n_main:     649     1.861535      .068491     1.863018  1878.723927  100
9.233586
interpretati: No serious first-order autocorrelation by the 1.5 to 2.5 rule of
 thumb


Number of cases read:  2    Number of cases listed:  1

SAVE TRANSLATE
  /TYPE=CSV
  /OUTFILE='D:\durbin_watson_test\durbin_watson_spss_main_result.csv'
  /REPLACE
  /FIELDNAMES
  /KEEP=n_main dw_main lag1_corr_main approx_dw_main sum_diff2_main sum_res2_m
ain interpretation_main
  /CELLS=VALUES.



SAVE TRANSLATE
  /TYPE=CSV
  /OUTFILE='D:\durbin_watson_test\durbin_watson_spss_main_residuals.csv'
  /REPLACE
  /FIELDNAMES
  /KEEP=caseid G3 prd_main res_main lag_res_main res_diff_main res_diff2_main
res2_main
  /CELLS=VALUES.

* Main model charts.
GRAPH
  /SCATTERPLOT(BIVAR)=prd_main WITH G3
  /TITLE='Actual vs Fitted G3 for Durbin Watson Regression Model'.
```

## Graph

Main Durbin Watson Result Computed Manually in SPSS

## Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:00:53 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /SCATTERPLOT(BIVAR) =prd_main WITH G3 /TITLE='Actual vs Fitted G3 for Durbin Watson Regression Model'. |
| Resources | Processor Time | 00:00:03.11 |
| | Elapsed Time | 00:00:34.95 |



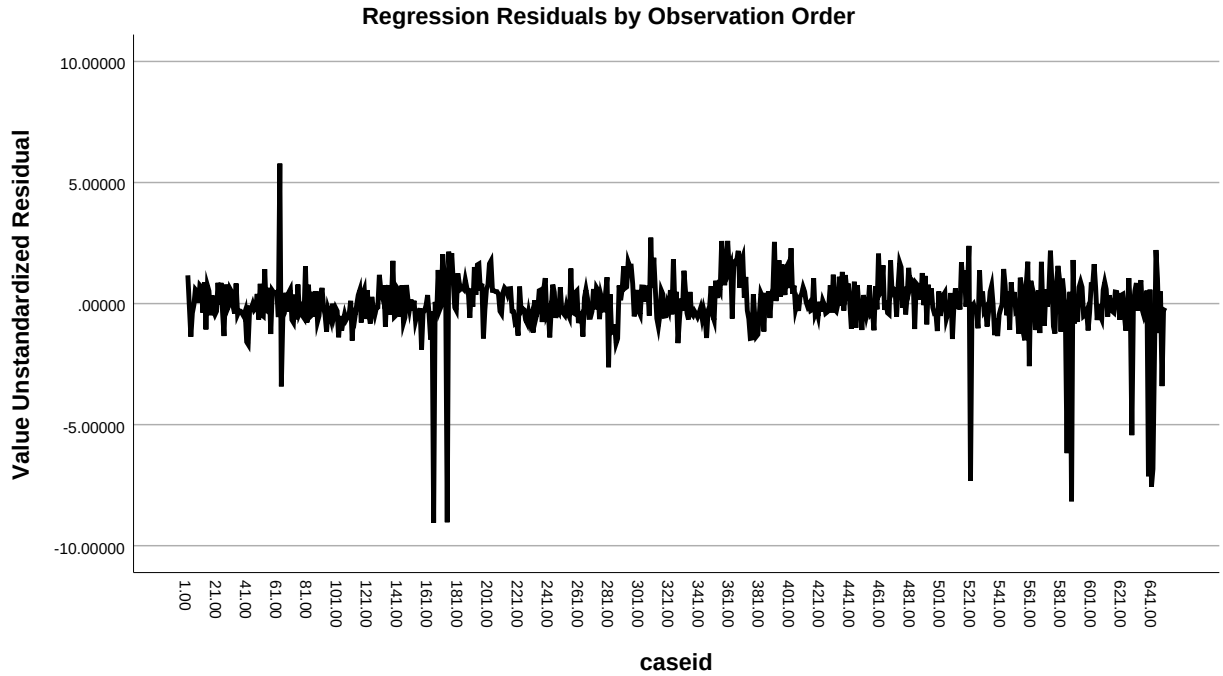

```
GRAPH
  /LINE(SIMPLE)=VALUE(res_main) BY caseid
```

```
  /TITLE='Regression Residuals by Observation Order'.
```

## Graph

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:28 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /LINE(SIMPLE)=VALUE (res_main) BY caseid /TITLE='Regression Residuals by Observation Order'. |
| Resources | Processor Time | 00:00:00.73 |
| | Elapsed Time | 00:00:00.34 |



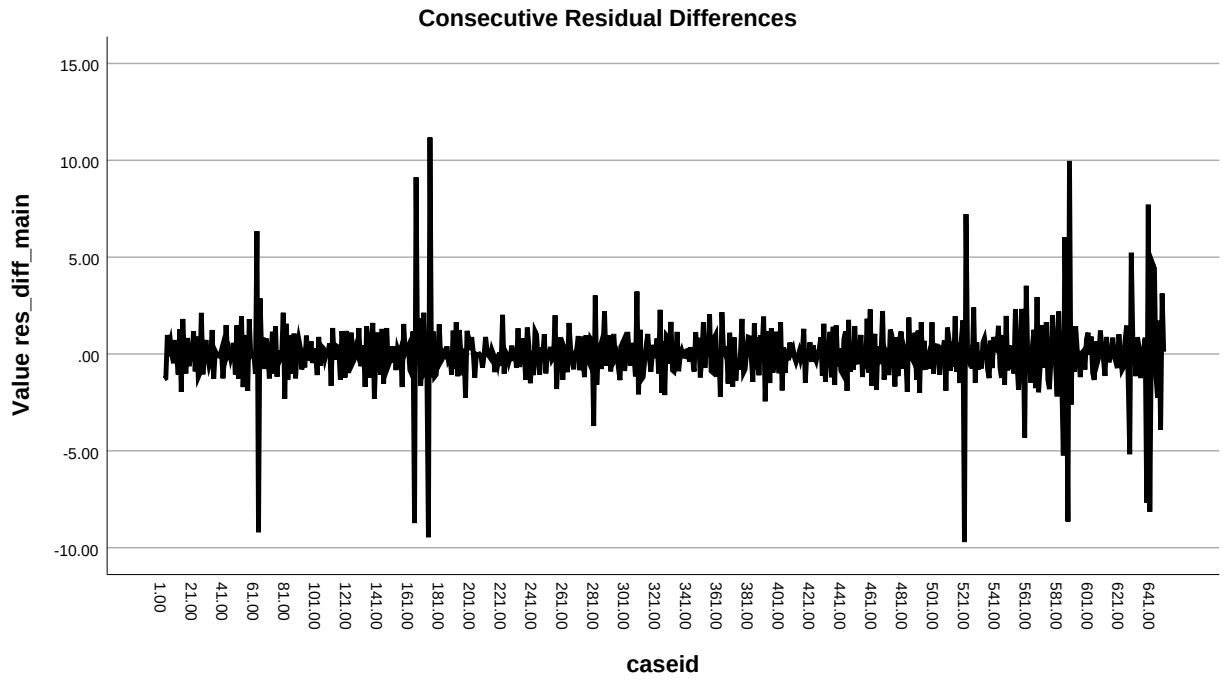
```
GRAPH
  /LINE(SIMPLE)=VALUE(res_diff_main) BY caseid
  /TITLE='Consecutive Residual Differences'.
```

## Graph

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:28 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /LINE(SIMPLE)=VALUE (res_diff_main) BY caseid /TITLE='Consecutive Residual Differences'. |
| Resources | Processor Time | 00:00:01.19 |
| | Elapsed Time | 00:00:00.35 |

Main Durbin Watson Result Computed Manually in SPSS



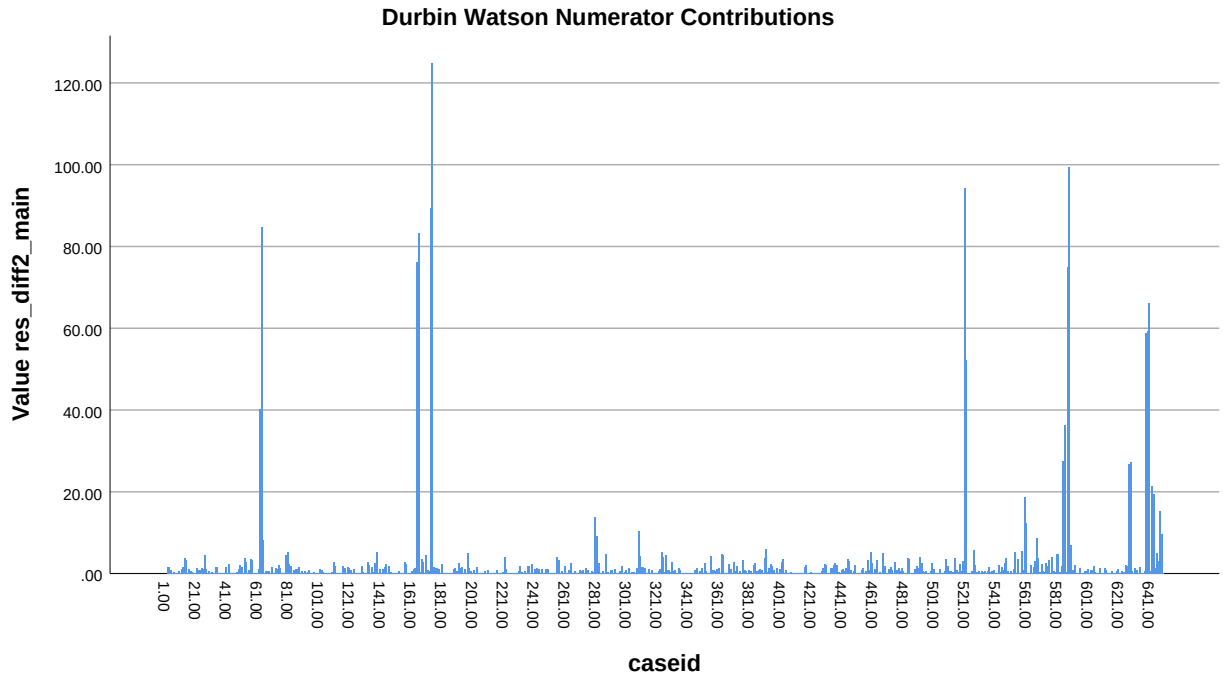

```
GRAPH
  /BAR(SIMPLE)=VALUE(res_diff2_main) BY caseid
  /TITLE='Durbin Watson Numerator Contributions'.
```

## Graph

Main Durbin Watson Result Computed Manually in SPSS

## Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:28 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /BAR(SIMPLE)=VALUE (res_diff2_main) BY caseid /TITLE='Durbin Watson Numerator Contributions'. |
| Resources | Processor Time | 00:00:01.03 |
| | Elapsed Time | 00:00:00.41 |




```
GRAPH
  /SCATTERPLOT(BIVAR)=lag_res_main WITH res_main
```

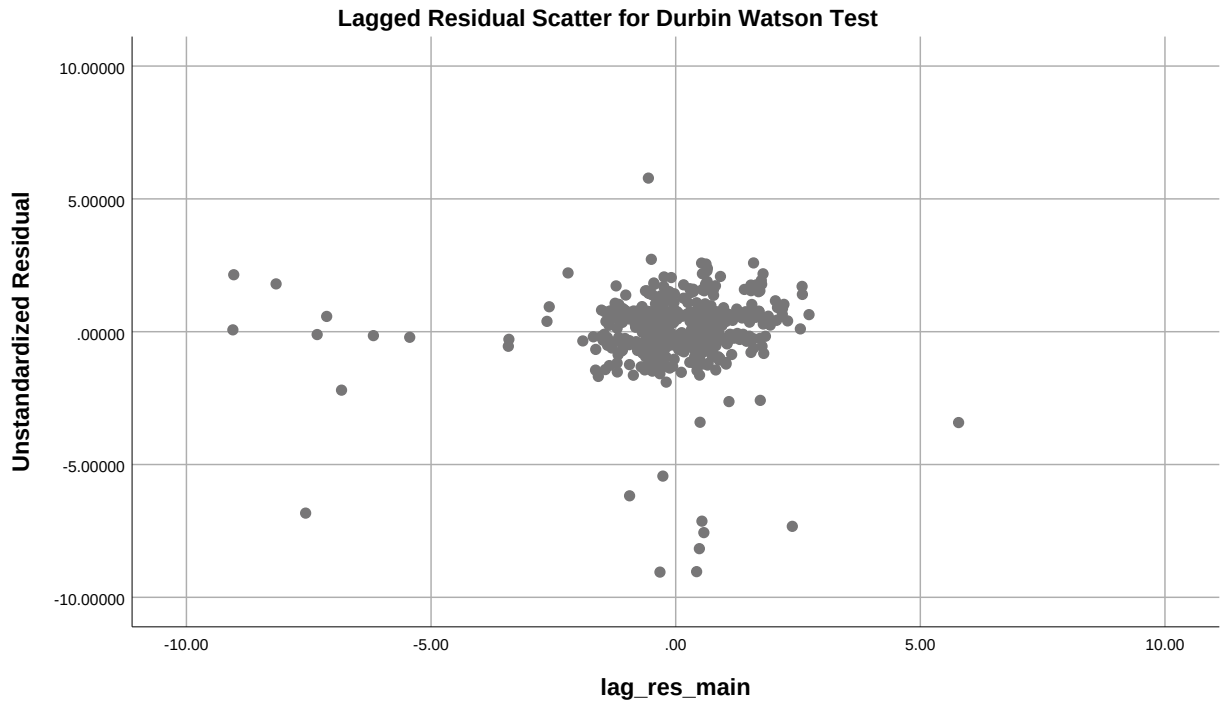
```
  /TITLE='Lagged Residual Scatter for Durbin Watson Test'.
```

## Graph

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:29 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /SCATTERPLOT(BIVAR) =lag_res_main WITH res_main /TITLE='Lagged Residual Scatter for Durbin Watson Test'. |
| Resources | Processor Time | 00:00:00.56 |
| | Elapsed Time | 00:00:00.25 |

Main Durbin Watson Result Computed Manually in SPSS




```
* ============================================================.
* B. SIMPLE MODEL: G3 ~ G1 + G2.
* ============================================================.

DATASET ACTIVATE DWClean.
DATASET COPY DWSimple.
```

## Dataset Copy

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:29 |
| Comments | | |
| Input | Active Dataset | DWClean |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| Syntax | | DATASET COPY DWSimple. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.01 |

Main Durbin Watson Result Computed Manually in SPSS

```
[DWClean]
```

**Warnings**

Replacing existing dataset named DWSimple.

```
DATASET ACTIVATE DWSimple.
SORT CASES BY caseid(A).
EXECUTE.

REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF R ANOVA
  /DEPENDENT G3
  /METHOD=ENTER G1 G2
  /SAVE RESID(res_simple).
```

## Regression

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:29 |
| Comments | | |
| Input | Active Dataset | DWSimple |
| | 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. |

Main Durbin Watson Result Computed Manually in SPSS

**Notes**

| | | |
|---|---|---|
| Syntax | | REGRESSION<br>/MISSING LISTWISE<br>/STATISTICS COEFF R ANOVA<br>/DEPENDENT G3<br>/METHOD=ENTER G1 G2<br>/SAVE RESID (res_simple). |
| Resources | Processor Time | 00:00:00.34 |
| | Elapsed Time | 00:00:00.21 |
| | Memory Required | 4464 bytes |
| | Additional Memory Required for Residual Plots | 0 bytes |
| Variables Created or Modified | res_simple | Unstandardized Residual |

[DWSimple]

**Variables Entered/Removed[a]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | G2, G1[b] | . | Enter |

a. Dependent Variable: G3

b. All requested variables entered.

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .921[a] | .848 | .847 | 1.262 |

a. Predictors: (Constant), G2, G1

b. Dependent Variable: G3

Main Durbin Watson Result Computed Manually in SPSS

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5733.637 | 2 | 2866.819 | 1798.671 | .000[b] |
| | Residual | 1029.629 | 646 | 1.594 | | |
| | Total | 6763.267 | 648 | | | |

a. Dependent Variable: G3

b. Predictors: (Constant), G2, G1

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -.171 | .215 | | -.796 | .426 |
| | G1 | .149 | .036 | .127 | 4.136 | .000 |
| | G2 | .897 | .034 | .809 | 26.448 | .000 |

a. Dependent Variable: G3

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | .42 | 19.55 | 11.91 | 2.975 | 649 |
| Residual | -9.541 | 5.711 | .000 | 1.261 | 649 |
| Std. Predicted Value | -3.860 | 2.571 | .000 | 1.000 | 649 |
| Std. Residual | -7.557 | 4.524 | .000 | .998 | 649 |

a. Dependent Variable: G3

```
SORT CASES BY caseid(A).
EXECUTE.

COMPUTE lag_res_simple = LAG(res_simple).
IF ($CASENUM = 1) lag_res_simple = $SYSMIS.
COMPUTE diff_simple = res_simple - lag_res_simple.
COMPUTE diff2_simple = diff_simple ** 2.
COMPUTE res2_simple = res_simple ** 2.
```

Main Durbin Watson Result Computed Manually in SPSS

```
EXECUTE.

AGGREGATE
  /OUTFILE=* MODE=ADDVARIABLES
  /BREAK=
  /dw_simple_num = SUM(diff2_simple)
  /dw_simple_den = SUM(res2_simple).

COMPUTE dw_simple = dw_simple_num / dw_simple_den.
STRING interpretation_simple (A90).
IF (dw_simple < 1.5) interpretation_simple = 'Possible positive first-order au
tocorrelation'.
IF (dw_simple >= 1.5 AND dw_simple <= 2.5) interpretation_simple = 'No serious
 first-order autocorrelation by the 1.5 to 2.5 rule of thumb'.
IF (dw_simple > 2.5) interpretation_simple = 'Possible negative first-order au
tocorrelation'.
EXECUTE.

FORMATS dw_simple dw_simple_num dw_simple_den (F12.6).
TITLE 'Simple G1 Plus G2 Model Durbin Watson Result'.
```

```
LIST VARIABLES=dw_simple dw_simple_num dw_simple_den interpretation_simple
  /CASES=FROM 2 TO 2.
```

## List

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:30 |
| Comments | | |
| Input | Active Dataset | DWSimple |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | LIST VARIABLES=dw_simple dw_simple_num dw_simple_den interpretation_simple /CASES=FROM 2 TO 2. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.03 |

```
   dw_simple dw_simple_num dw_simple_den interpretation_simple

    1.851560   1906.420488   1029.629329 No serious first-order autocorrelatio
n by the 1.5 to 2.5 rule of thumb


Number of cases read:  2    Number of cases listed:  1
```

```
SAVE TRANSLATE
  /TYPE=CSV
  /OUTFILE='D:\durbin_watson_test\durbin_watson_spss_simple_model_result.csv'
  /REPLACE
  /FIELDNAMES
  /KEEP=dw_simple dw_simple_num dw_simple_den interpretation_simple
  /CELLS=VALUES.
```

```
* ============================================================.
* C. BACKGROUND MODEL: G3 ~ studytime + failures + absences + age + Medu + Fed
u + traveltime + health.
* ============================================================.

DATASET ACTIVATE DWClean.
DATASET COPY DWBack.
```

## Dataset Copy

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:30 |
| Comments | | |
| Input | Active Dataset | DWClean |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| Syntax | | DATASET COPY DWBack. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.01 |

```
[DWClean]
```

### Warnings

Replacing existing dataset named DWBack.

```
DATASET ACTIVATE DWBack.
SORT CASES BY caseid(A).
EXECUTE.

REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF R ANOVA
  /DEPENDENT G3
  /METHOD=ENTER studytime failures absences age Medu Fedu traveltime health
  /SAVE RESID(res_back).
```

# Regression

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:30 |
| Comments | | |
| Input | Active Dataset | DWBack |
| | 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<br>/MISSING LISTWISE<br>/STATISTICS COEFF R ANOVA<br>/DEPENDENT G3<br>/METHOD=ENTER studytime failures absences age Medu Fedu traveltime health<br>/SAVE RESID(res_back). |
| Resources | Processor Time | 00:00:00.06 |
| | Elapsed Time | 00:00:00.02 |
| | Memory Required | 8592 bytes |
| | Additional Memory Required for Residual Plots | 0 bytes |
| Variables Created or Modified | res_back | Unstandardized Residual |

[DWBack]

Simple G1 Plus G2 Model Durbin Watson Result

**Variables Entered/Removed[a]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | health, Medu, absences, studytime, age, traveltime, failures, Fedu[b] | . | Enter |

a. Dependent Variable: G3

b. All requested variables entered.

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .481[a] | .231 | .222 | 2.850 |

a. Predictors: (Constant), health, Medu, absences, studytime, age, traveltime, failures, Fedu

b. Dependent Variable: G3

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 1564.195 | 8 | 195.524 | 24.069 | .000[b] |
| | Residual | 5199.072 | 640 | 8.124 | | |
| | Total | 6763.267 | 648 | | | |

a. Dependent Variable: G3

b. Predictors: (Constant), health, Medu, absences, studytime, age, traveltime, failures, Fedu

Simple G1 Plus G2 Model Durbin Watson Result

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 9.473 | 1.739 | | 5.449 | .000 |
| | studytime | .679 | .138 | .174 | 4.919 | .000 |
| | failures | -1.817 | .205 | -.334 | -8.876 | .000 |
| | absences | -.027 | .025 | -.038 | -1.084 | .279 |
| | age | .077 | .098 | .029 | .788 | .431 |
| | Medu | .305 | .132 | .107 | 2.302 | .022 |
| | Fedu | .228 | .135 | .078 | 1.692 | .091 |
| | traveltime | -.192 | .156 | -.044 | -1.230 | .219 |
| | health | -.188 | .078 | -.084 | -2.414 | .016 |

a. Dependent Variable: G3

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | 5.14 | 14.73 | 11.91 | 1.554 | 649 |
| Residual | -12.840 | 6.695 | .000 | 2.833 | 649 |
| Std. Predicted Value | -4.354 | 1.818 | .000 | 1.000 | 649 |
| Std. Residual | -4.505 | 2.349 | .000 | .994 | 649 |

a. Dependent Variable: G3

```
SORT CASES BY caseid(A).
EXECUTE.

COMPUTE lag_res_back = LAG(res_back).
IF ($CASENUM = 1) lag_res_back = $SYSMIS.
COMPUTE diff_back = res_back - lag_res_back.
COMPUTE diff2_back = diff_back ** 2.
COMPUTE res2_back = res_back ** 2.
EXECUTE.

AGGREGATE
  /OUTFILE=* MODE=ADDVARIABLES
```

```
  /BREAK=
  /dw_back_num = SUM(diff2_back)
  /dw_back_den = SUM(res2_back).

COMPUTE dw_back = dw_back_num / dw_back_den.
STRING interpretation_back (A90).
IF (dw_back < 1.5) interpretation_back = 'Possible positive first-order autoco
rrelation'.
IF (dw_back >= 1.5 AND dw_back <= 2.5) interpretation_back = 'No serious first
-order autocorrelation by the 1.5 to 2.5 rule of thumb'.
IF (dw_back > 2.5) interpretation_back = 'Possible negative first-order autoco
rrelation'.
EXECUTE.

FORMATS dw_back dw_back_num dw_back_den (F12.6).
TITLE 'Background Model Durbin Watson Result'.
```

```
LIST VARIABLES=dw_back dw_back_num dw_back_den interpretation_back
  /CASES=FROM 2 TO 2.
```

## List

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:30 |
| Comments | | |
| Input | Active Dataset | DWBack |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | LIST VARIABLES=dw_back dw_back_num dw_back_den interpretation_back /CASES=FROM 2 TO 2. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.01 |

```
     dw_back  dw_back_num  dw_back_den interpretation_back

    1.807975  9399.793241  5199.071863 No serious first-order autocorrelation
by the 1.5 to 2.5 rule of thumb


Number of cases read:  2    Number of cases listed:  1

SAVE TRANSLATE
  /TYPE=CSV
  /OUTFILE='D:\durbin_watson_test\durbin_watson_spss_background_model_result.c
sv'
  /REPLACE
  /FIELDNAMES
  /KEEP=dw_back dw_back_num dw_back_den interpretation_back
  /CELLS=VALUES.
```

```
* ============================================================.
* D. MODEL COMPARISON DATASET.
* ============================================================.

DATASET ACTIVATE DWClean.
DATASET COPY DWCompare.
DATASET ACTIVATE DWCompare.

SELECT IF ($CASENUM <= 3).
EXECUTE.

STRING model_name (A20).
COMPUTE model_id = $CASENUM.

DO IF (model_id = 1).
  COMPUTE model_name = 'Main'.
  COMPUTE dw_stat = 1.861535.
ELSE IF (model_id = 2).
  COMPUTE model_name = 'G1+G2'.
  COMPUTE dw_stat = 1.851560.
ELSE IF (model_id = 3).
  COMPUTE model_name = 'Background'.
  COMPUTE dw_stat = 1.807975.
END IF.
EXECUTE.

FORMATS dw_stat (F12.6).
TITLE 'Durbin Watson Statistic Across Regression Models'.
```

```
LIST VARIABLES=model_name dw_stat.
```

## List

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:31 |
| Comments | | |
| Input | Active Dataset | DWCompare |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 3 |
| Syntax | | LIST VARIABLES=model_name dw_stat. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.01 |

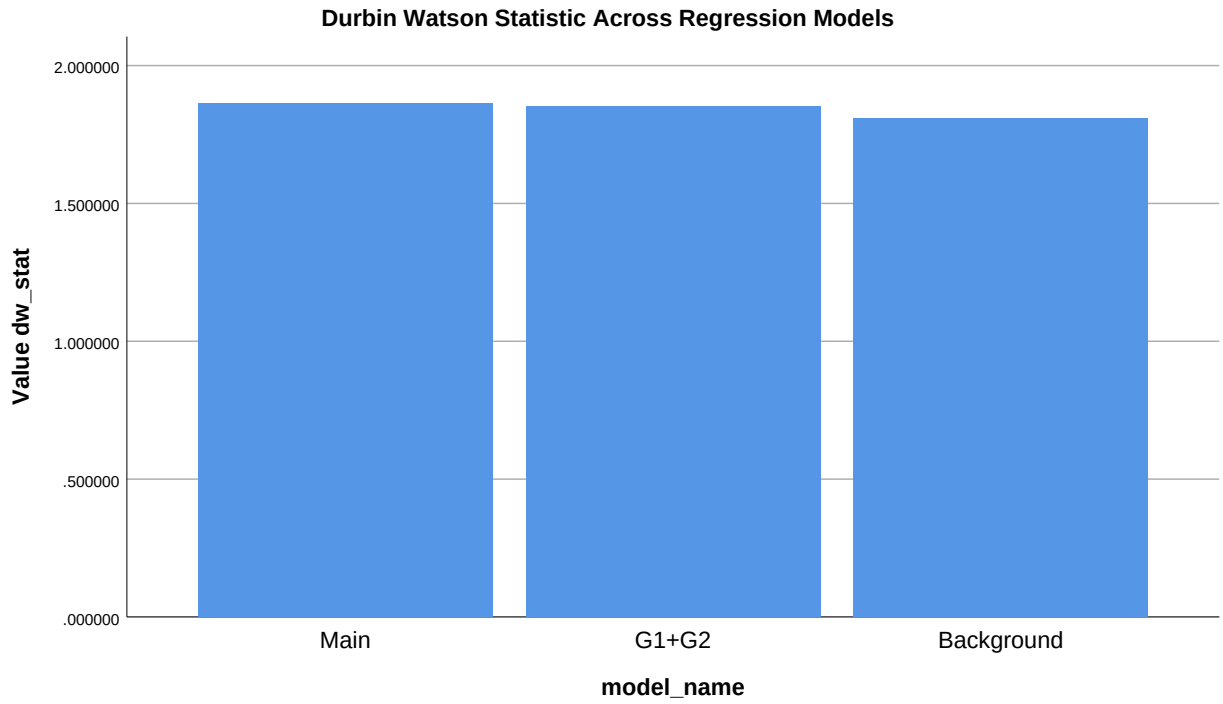
```
[DWCompare]

model_name                dw_stat

Main                     1.861535
G1+G2                    1.851560
Background               1.807975


Number of cases read:  3    Number of cases listed:  3

SAVE TRANSLATE
  /TYPE=CSV
  /OUTFILE='D:\durbin_watson_test\durbin_watson_spss_model_comparison.csv'
  /REPLACE
  /FIELDNAMES
  /KEEP=model_name dw_stat
  /CELLS=VALUES.
```

```
GRAPH
  /BAR(SIMPLE)=VALUE(dw_stat) BY model_name
  /TITLE='Durbin Watson Statistic Across Regression Models'.
```

## Graph

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:31 |
| Comments | | |
| Input | Active Dataset | DWCompare |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 3 |
| Syntax | | GRAPH /BAR(SIMPLE)=VALUE (dw_stat) BY model_name /TITLE='Durbin Watson Statistic Across Regression Models'. |
| Resources | Processor Time | 00:00:00.50 |
| | Elapsed Time | 00:00:00.28 |




```
* ============================================================.
* E. RESIDUAL AUTOCORRELATION BY LAG 1 TO 20 FOR MAIN MODEL.
* ============================================================.

DATASET ACTIVATE DWMain.
SORT CASES BY caseid(A).
EXECUTE.

COMPUTE lag1 = LAG(res_main,1).
COMPUTE lag2 = LAG(res_main,2).
COMPUTE lag3 = LAG(res_main,3).
COMPUTE lag4 = LAG(res_main,4).
COMPUTE lag5 = LAG(res_main,5).
COMPUTE lag6 = LAG(res_main,6).
COMPUTE lag7 = LAG(res_main,7).
COMPUTE lag8 = LAG(res_main,8).
COMPUTE lag9 = LAG(res_main,9).
COMPUTE lag10 = LAG(res_main,10).
COMPUTE lag11 = LAG(res_main,11).
COMPUTE lag12 = LAG(res_main,12).
```

```
COMPUTE lag13 = LAG(res_main,13).
COMPUTE lag14 = LAG(res_main,14).
COMPUTE lag15 = LAG(res_main,15).
COMPUTE lag16 = LAG(res_main,16).
COMPUTE lag17 = LAG(res_main,17).
COMPUTE lag18 = LAG(res_main,18).
COMPUTE lag19 = LAG(res_main,19).
COMPUTE lag20 = LAG(res_main,20).
EXECUTE.

TITLE 'Residual Autocorrelation Matrix for Main Model Lags 1 to 20'.
```

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

```
CORRELATIONS
  /VARIABLES=res_main lag1 lag2 lag3 lag4 lag5 lag6 lag7 lag8 lag9 lag10 lag11
 lag12 lag13 lag14 lag15 lag16 lag17 lag18 lag19 lag20
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

## Correlations

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 18:01:31 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | 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 for each pair of variables are based on all the cases with valid data for that pair. |
| Syntax | | CORRELATIONS /VARIABLES=res_main lag1 lag2 lag3 lag4 lag5 lag6 lag7 lag8 lag9 lag10 lag11 lag12 lag13 lag14 lag15 lag16 lag17 lag18 lag19 lag20 /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE. |
| Resources | Processor Time | 00:00:00.13 |
| | Elapsed Time | 00:00:00.08 |

[DWMain]

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | res_main | lag1 | lag2 | lag3 | lag4 | lag5 |
|---|---|---|---|---|---|---|---|
| res_main | Pearson Correlation | 1 | .069 | .130** | .099* | .078* | .060 |
| | Sig. (2-tailed) | | .081 | .001 | .012 | .049 | .129 |
| | N | 649 | 648 | 647 | 646 | 645 | 644 |
| lag1 | Pearson Correlation | .069 | 1 | .069 | .131** | .099* | .078* |
| | Sig. (2-tailed) | .081 | | .081 | .001 | .012 | .049 |
| | N | 648 | 648 | 647 | 646 | 645 | 644 |
| lag2 | Pearson Correlation | .130** | .069 | 1 | .068 | .131** | .099* |
| | Sig. (2-tailed) | .001 | .081 | | .084 | .001 | .012 |
| | N | 647 | 647 | 647 | 646 | 645 | 644 |
| lag3 | Pearson Correlation | .099* | .131** | .068 | 1 | .070 | .127** |
| | Sig. (2-tailed) | .012 | .001 | .084 | | .075 | .001 |
| | N | 646 | 646 | 646 | 646 | 645 | 644 |
| lag4 | Pearson Correlation | .078* | .099* | .131** | .070 | 1 | .071 |
| | Sig. (2-tailed) | .049 | .012 | .001 | .075 | | .073 |
| | N | 645 | 645 | 645 | 645 | 645 | 644 |
| lag5 | Pearson Correlation | .060 | .078* | .099* | .127** | .071 | 1 |
| | Sig. (2-tailed) | .129 | .049 | .012 | .001 | .073 | |
| | N | 644 | 644 | 644 | 644 | 644 | 644 |
| lag6 | Pearson Correlation | -.004 | .060 | .078* | .103** | .127** | .072 |
| | Sig. (2-tailed) | .917 | .128 | .048 | .009 | .001 | .068 |
| | N | 643 | 643 | 643 | 643 | 643 | 643 |
| lag7 | Pearson Correlation | .096* | -.004 | .061 | .086* | .102** | .130** |
| | Sig. (2-tailed) | .015 | .925 | .123 | .029 | .009 | .001 |
| | N | 642 | 642 | 642 | 642 | 642 | 642 |
| lag8 | Pearson Correlation | .025 | .096* | -.004 | .054 | .087* | .100* |
| | Sig. (2-tailed) | .525 | .015 | .912 | .174 | .027 | .011 |
| | N | 641 | 641 | 641 | 641 | 641 | 641 |
| lag9 | Pearson Correlation | .133** | .025 | .096* | -.029 | .059 | .081* |
| | Sig. (2-tailed) | .001 | .535 | .015 | .469 | .139 | .041 |
| | N | 640 | 640 | 640 | 640 | 640 | 640 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | lag6 | lag7 | lag8 | lag9 | lag10 | lag11 |
|---|---|---|---|---|---|---|---|
| res_main | Pearson Correlation | -.004 | .096* | .025 | .133** | -.011 | .052 |
| | Sig. (2-tailed) | .917 | .015 | .525 | .001 | .772 | .187 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag1 | Pearson Correlation | .060 | -.004 | .096* | .025 | .136** | -.011 |
| | Sig. (2-tailed) | .128 | .925 | .015 | .535 | .001 | .774 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag2 | Pearson Correlation | .078* | .061 | -.004 | .096* | .023 | .136** |
| | Sig. (2-tailed) | .048 | .123 | .912 | .015 | .561 | .001 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag3 | Pearson Correlation | .103** | .086* | .054 | -.029 | .072 | .025 |
| | Sig. (2-tailed) | .009 | .029 | .174 | .469 | .069 | .526 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag4 | Pearson Correlation | .127** | .102** | .087* | .059 | -.026 | .072 |
| | Sig. (2-tailed) | .001 | .009 | .027 | .139 | .518 | .070 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag5 | Pearson Correlation | .072 | .130** | .100* | .081* | .051 | -.025 |
| | Sig. (2-tailed) | .068 | .001 | .011 | .041 | .202 | .530 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag6 | Pearson Correlation | 1 | .070 | .133** | .110** | .092* | .050 |
| | Sig. (2-tailed) | | .076 | .001 | .005 | .020 | .207 |
| | N | 643 | 642 | 641 | 640 | 639 | 638 |
| lag7 | Pearson Correlation | .070 | 1 | .075 | .152** | .132** | .091* |
| | Sig. (2-tailed) | .076 | | .057 | .000 | .001 | .022 |
| | N | 642 | 642 | 641 | 640 | 639 | 638 |
| lag8 | Pearson Correlation | .133** | .075 | 1 | .062 | .139** | .133** |
| | Sig. (2-tailed) | .001 | .057 | | .119 | .000 | .001 |
| | N | 641 | 641 | 641 | 640 | 639 | 638 |
| lag9 | Pearson Correlation | .110** | .152** | .062 | 1 | .008 | .147** |
| | Sig. (2-tailed) | .005 | .000 | .119 | | .838 | .000 |
| | N | 640 | 640 | 640 | 640 | 639 | 638 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | lag12 | lag13 | lag14 | lag15 | lag16 | lag17 |
|---|---|---|---|---|---|---|---|
| res_main | Pearson Correlation | .023 | .025 | .009 | .024 | -.035 | .008 |
| | Sig. (2-tailed) | .557 | .527 | .825 | .542 | .374 | .843 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag1 | Pearson Correlation | .053 | .023 | .025 | .009 | .024 | -.035 |
| | Sig. (2-tailed) | .185 | .556 | .528 | .827 | .543 | .377 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag2 | Pearson Correlation | -.014 | .053 | .023 | .025 | .009 | .025 |
| | Sig. (2-tailed) | .725 | .184 | .558 | .531 | .829 | .538 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag3 | Pearson Correlation | .114** | -.012 | .052 | .021 | .024 | .012 |
| | Sig. (2-tailed) | .004 | .759 | .192 | .591 | .549 | .761 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag4 | Pearson Correlation | .030 | .114** | -.012 | .052 | .022 | .023 |
| | Sig. (2-tailed) | .452 | .004 | .763 | .190 | .588 | .558 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag5 | Pearson Correlation | .064 | .031 | .114** | -.013 | .052 | .023 |
| | Sig. (2-tailed) | .105 | .442 | .004 | .749 | .194 | .566 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag6 | Pearson Correlation | -.018 | .064 | .031 | .114** | -.012 | .051 |
| | Sig. (2-tailed) | .657 | .108 | .437 | .004 | .756 | .203 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag7 | Pearson Correlation | .069 | -.019 | .065 | .032 | .116** | -.015 |
| | Sig. (2-tailed) | .081 | .635 | .103 | .416 | .004 | .713 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag8 | Pearson Correlation | .076 | .071 | -.020 | .064 | .032 | .118** |
| | Sig. (2-tailed) | .054 | .075 | .619 | .109 | .427 | .003 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag9 | Pearson Correlation | .085* | .082* | .070 | -.024 | .063 | .040 |
| | Sig. (2-tailed) | .032 | .038 | .079 | .538 | .115 | .320 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | lag18 | lag19 | lag20 |
|---|---|---|---|---|
| res_main | Pearson Correlation | -.070 | -.027 | .016 |
| | Sig. (2-tailed) | .079 | .495 | .688 |
| | N | 631 | 630 | 629 |
| lag1 | Pearson Correlation | .008 | -.070 | -.027 |
| | Sig. (2-tailed) | .841 | .079 | .498 |
| | N | 631 | 630 | 629 |
| lag2 | Pearson Correlation | -.035 | .008 | -.070 |
| | Sig. (2-tailed) | .379 | .843 | .080 |
| | N | 631 | 630 | 629 |
| lag3 | Pearson Correlation | .027 | -.037 | .011 |
| | Sig. (2-tailed) | .504 | .360 | .783 |
| | N | 631 | 630 | 629 |
| lag4 | Pearson Correlation | .012 | .027 | -.037 |
| | Sig. (2-tailed) | .766 | .501 | .354 |
| | N | 631 | 630 | 629 |
| lag5 | Pearson Correlation | .024 | .011 | .028 |
| | Sig. (2-tailed) | .546 | .775 | .484 |
| | N | 631 | 630 | 629 |
| lag6 | Pearson Correlation | .022 | .025 | .011 |
| | Sig. (2-tailed) | .577 | .539 | .793 |
| | N | 631 | 630 | 629 |
| lag7 | Pearson Correlation | .050 | .023 | .023 |
| | Sig. (2-tailed) | .214 | .562 | .572 |
| | N | 631 | 630 | 629 |
| lag8 | Pearson Correlation | -.013 | .049 | .025 |
| | Sig. (2-tailed) | .736 | .221 | .528 |
| | N | 631 | 630 | 629 |
| lag9 | Pearson Correlation | .125** | -.016 | .056 |
| | Sig. (2-tailed) | .002 | .682 | .158 |
| | N | 631 | 630 | 629 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | res_main | lag1 | lag2 | lag3 | lag4 | lag5 |
|---|---|---|---|---|---|---|---|
| lag10 | Pearson Correlation | -.011 | .136** | .023 | .072 | -.026 | .051 |
| | Sig. (2-tailed) | .772 | .001 | .561 | .069 | .518 | .202 |
| | N | 639 | 639 | 639 | 639 | 639 | 639 |
| lag11 | Pearson Correlation | .052 | -.011 | .136** | .025 | .072 | -.025 |
| | Sig. (2-tailed) | .187 | .774 | .001 | .526 | .070 | .530 |
| | N | 638 | 638 | 638 | 638 | 638 | 638 |
| lag12 | Pearson Correlation | .023 | .053 | -.014 | .114** | .030 | .064 |
| | Sig. (2-tailed) | .557 | .185 | .725 | .004 | .452 | .105 |
| | N | 637 | 637 | 637 | 637 | 637 | 637 |
| lag13 | Pearson Correlation | .025 | .023 | .053 | -.012 | .114** | .031 |
| | Sig. (2-tailed) | .527 | .556 | .184 | .759 | .004 | .442 |
| | N | 636 | 636 | 636 | 636 | 636 | 636 |
| lag14 | Pearson Correlation | .009 | .025 | .023 | .052 | -.012 | .114** |
| | Sig. (2-tailed) | .825 | .528 | .558 | .192 | .763 | .004 |
| | N | 635 | 635 | 635 | 635 | 635 | 635 |
| lag15 | Pearson Correlation | .024 | .009 | .025 | .021 | .052 | -.013 |
| | Sig. (2-tailed) | .542 | .827 | .531 | .591 | .190 | .749 |
| | N | 634 | 634 | 634 | 634 | 634 | 634 |
| lag16 | Pearson Correlation | -.035 | .024 | .009 | .024 | .022 | .052 |
| | Sig. (2-tailed) | .374 | .543 | .829 | .549 | .588 | .194 |
| | N | 633 | 633 | 633 | 633 | 633 | 633 |
| lag17 | Pearson Correlation | .008 | -.035 | .025 | .012 | .023 | .023 |
| | Sig. (2-tailed) | .843 | .377 | .538 | .761 | .558 | .566 |
| | N | 632 | 632 | 632 | 632 | 632 | 632 |
| lag18 | Pearson Correlation | -.070 | .008 | -.035 | .027 | .012 | .024 |
| | Sig. (2-tailed) | .079 | .841 | .379 | .504 | .766 | .546 |
| | N | 631 | 631 | 631 | 631 | 631 | 631 |
| lag19 | Pearson Correlation | -.027 | -.070 | .008 | -.037 | .027 | .011 |
| | Sig. (2-tailed) | .495 | .079 | .843 | .360 | .501 | .775 |
| | N | 630 | 630 | 630 | 630 | 630 | 630 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | lag6 | lag7 | lag8 | lag9 | lag10 | lag11 |
|---|---|---|---|---|---|---|---|
| lag10 | Pearson Correlation | .092* | .132** | .139** | .008 | 1 | .013 |
| | Sig. (2-tailed) | .020 | .001 | .000 | .838 | | .742 |
| | N | 639 | 639 | 639 | 639 | 639 | 638 |
| lag11 | Pearson Correlation | .050 | .091* | .133** | .147** | .013 | 1 |
| | Sig. (2-tailed) | .207 | .022 | .001 | .000 | .742 | |
| | N | 638 | 638 | 638 | 638 | 638 | 638 |
| lag12 | Pearson Correlation | -.018 | .069 | .076 | .085* | .093* | .018 |
| | Sig. (2-tailed) | .657 | .081 | .054 | .032 | .019 | .649 |
| | N | 637 | 637 | 637 | 637 | 637 | 637 |
| lag13 | Pearson Correlation | .064 | -.019 | .071 | .082* | .092* | .092* |
| | Sig. (2-tailed) | .108 | .635 | .075 | .038 | .020 | .020 |
| | N | 636 | 636 | 636 | 636 | 636 | 636 |
| lag14 | Pearson Correlation | .031 | .065 | -.020 | .070 | .082* | .092* |
| | Sig. (2-tailed) | .437 | .103 | .619 | .079 | .039 | .020 |
| | N | 635 | 635 | 635 | 635 | 635 | 635 |
| lag15 | Pearson Correlation | .114** | .032 | .064 | -.024 | .067 | .082* |
| | Sig. (2-tailed) | .004 | .416 | .109 | .538 | .092 | .039 |
| | N | 634 | 634 | 634 | 634 | 634 | 634 |
| lag16 | Pearson Correlation | -.012 | .116** | .032 | .063 | -.028 | .067 |
| | Sig. (2-tailed) | .756 | .004 | .427 | .115 | .480 | .091 |
| | N | 633 | 633 | 633 | 633 | 633 | 633 |
| lag17 | Pearson Correlation | .051 | -.015 | .118** | .040 | .073 | -.029 |
| | Sig. (2-tailed) | .203 | .713 | .003 | .320 | .067 | .470 |
| | N | 632 | 632 | 632 | 632 | 632 | 632 |
| lag18 | Pearson Correlation | .022 | .050 | -.013 | .125** | .046 | .073 |
| | Sig. (2-tailed) | .577 | .214 | .736 | .002 | .252 | .068 |
| | N | 631 | 631 | 631 | 631 | 631 | 631 |
| lag19 | Pearson Correlation | .025 | .023 | .049 | -.016 | .126** | .046 |
| | Sig. (2-tailed) | .539 | .562 | .221 | .682 | .001 | .250 |
| | N | 630 | 630 | 630 | 630 | 630 | 630 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | lag12 | lag13 | lag14 | lag15 | lag16 | lag17 |
|---|---|---|---|---|---|---|---|
| lag10 | Pearson Correlation | .093* | .092* | .082* | .067 | -.028 | .073 |
| | Sig. (2-tailed) | .019 | .020 | .039 | .092 | .480 | .067 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag11 | Pearson Correlation | .018 | .092* | .092* | .082* | .067 | -.029 |
| | Sig. (2-tailed) | .649 | .020 | .020 | .039 | .091 | .470 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag12 | Pearson Correlation | 1 | .023 | .092* | .090* | .082* | .077 |
| | Sig. (2-tailed) | | .563 | .020 | .023 | .039 | .052 |
| | N | 637 | 636 | 635 | 634 | 633 | 632 |
| lag13 | Pearson Correlation | .023 | 1 | .023 | .093* | .091* | .081* |
| | Sig. (2-tailed) | .563 | | .560 | .020 | .022 | .041 |
| | N | 636 | 636 | 635 | 634 | 633 | 632 |
| lag14 | Pearson Correlation | .092* | .023 | 1 | .023 | .092* | .091* |
| | Sig. (2-tailed) | .020 | .560 | | .564 | .020 | .022 |
| | N | 635 | 635 | 635 | 634 | 633 | 632 |
| lag15 | Pearson Correlation | .090* | .093* | .023 | 1 | .023 | .093* |
| | Sig. (2-tailed) | .023 | .020 | .564 | | .568 | .019 |
| | N | 634 | 634 | 634 | 634 | 633 | 632 |
| lag16 | Pearson Correlation | .082* | .091* | .092* | .023 | 1 | .023 |
| | Sig. (2-tailed) | .039 | .022 | .020 | .568 | | .562 |
| | N | 633 | 633 | 633 | 633 | 633 | 632 |
| lag17 | Pearson Correlation | .077 | .081* | .091* | .093* | .023 | 1 |
| | Sig. (2-tailed) | .052 | .041 | .022 | .019 | .562 | |
| | N | 632 | 632 | 632 | 632 | 632 | 632 |
| lag18 | Pearson Correlation | -.025 | .077 | .082* | .092* | .093* | .023 |
| | Sig. (2-tailed) | .530 | .053 | .040 | .021 | .019 | .572 |
| | N | 631 | 631 | 631 | 631 | 631 | 631 |
| lag19 | Pearson Correlation | .072 | -.025 | .077 | .081* | .091* | .094* |
| | Sig. (2-tailed) | .071 | .534 | .053 | .041 | .022 | .019 |
| | N | 630 | 630 | 630 | 630 | 630 | 630 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | lag18 | lag19 | lag20 |
|---|---|---|---|---|
| lag10 | Pearson Correlation | .046 | .126** | -.010 |
| | Sig. (2-tailed) | .252 | .001 | .808 |
| | N | 631 | 630 | 629 |
| lag11 | Pearson Correlation | .073 | .046 | .126** |
| | Sig. (2-tailed) | .068 | .250 | .002 |
| | N | 631 | 630 | 629 |
| lag12 | Pearson Correlation | -.025 | .072 | .054 |
| | Sig. (2-tailed) | .530 | .071 | .174 |
| | N | 631 | 630 | 629 |
| lag13 | Pearson Correlation | .077 | -.025 | .072 |
| | Sig. (2-tailed) | .053 | .534 | .073 |
| | N | 631 | 630 | 629 |
| lag14 | Pearson Correlation | .082* | .077 | -.025 |
| | Sig. (2-tailed) | .040 | .053 | .539 |
| | N | 631 | 630 | 629 |
| lag15 | Pearson Correlation | .092* | .081* | .078 |
| | Sig. (2-tailed) | .021 | .041 | .052 |
| | N | 631 | 630 | 629 |
| lag16 | Pearson Correlation | .093* | .091* | .082* |
| | Sig. (2-tailed) | .019 | .022 | .040 |
| | N | 631 | 630 | 629 |
| lag17 | Pearson Correlation | .023 | .094* | .091* |
| | Sig. (2-tailed) | .572 | .019 | .023 |
| | N | 631 | 630 | 629 |
| lag18 | Pearson Correlation | 1 | .023 | .093* |
| | Sig. (2-tailed) | | .569 | .019 |
| | N | 631 | 630 | 629 |
| lag19 | Pearson Correlation | .023 | 1 | .023 |
| | Sig. (2-tailed) | .569 | | .563 |
| | N | 630 | 630 | 629 |

Residual Autocorrelation Matrix for Main Model Lags 1 to 20

**Correlations**

| | | res_main | lag1 | lag2 | lag3 | lag4 | lag5 |
|---|---|---|---|---|---|---|---|
| lag20 | Pearson Correlation | .016 | -.027 | -.070 | .011 | -.037 | .028 |
| | Sig. (2-tailed) | .688 | .498 | .080 | .783 | .354 | .484 |
| | N | 629 | 629 | 629 | 629 | 629 | 629 |

**Correlations**

| | | lag6 | lag7 | lag8 | lag9 | lag10 | lag11 |
|---|---|---|---|---|---|---|---|
| lag20 | Pearson Correlation | .011 | .023 | .025 | .056 | -.010 | .126** |
| | Sig. (2-tailed) | .793 | .572 | .528 | .158 | .808 | .002 |
| | N | 629 | 629 | 629 | 629 | 629 | 629 |

**Correlations**

| | | lag12 | lag13 | lag14 | lag15 | lag16 | lag17 |
|---|---|---|---|---|---|---|---|
| lag20 | Pearson Correlation | .054 | .072 | -.025 | .078 | .082* | .091* |
| | Sig. (2-tailed) | .174 | .073 | .539 | .052 | .040 | .023 |
| | N | 629 | 629 | 629 | 629 | 629 | 629 |

**Correlations**

| | | lag18 | lag19 | lag20 |
|---|---|---|---|---|
| lag20 | Pearson Correlation | .093* | .023 | 1 |
| | Sig. (2-tailed) | .019 | .563 | |
| | N | 629 | 629 | 629 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

```
TITLE 'Durbin Watson SPSS SAFE Step 3 v2 Completed'.
```

```
EXECUTE.
* ============================================================.
* Goldfeld Quandt Test â€” SPSS Syntax Step 3.
* Universal workflow style for final SEO data-analysis post.
*
* Folder:
* D:\low kda score priority basis posts\first post\Goldfeld Quandt Test
*
* Recommended input file:
* D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\Python
\goldfeld_quandt_clean_data_for_spss.csv
*
* Output folder created/used:
* D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\SPSS
*
* Important:
* SPSS does not provide a one-click Goldfeld Quandt Test command in the
* standard regression menu. This syntax manually reproduces the test:
* 1. Fit the G3 regression model.
* 2. Save fitted values and residuals.
* 3. Sort cases by fitted G3.
* 4. Drop the middle 20 percent.
* 5. Compare residual variance in the low and high ordered groups.
* 6. Compute F ratio and p-values.
*
* Main regression model:
* G3 = G1 + G2 + studytime + failures + absences + age + Medu + Fedu.
*
* Expected main result from R/Python verification:
* Low ordered variance about 2.8659.
* High ordered variance about 0.5892.
* F high/low about 0.2056.
* Two-sided p-value about 6.88247E-33.
* ============================================================.

SET DECIMAL=DOT.
SET PRINTBACK=ON.
SET MPRINT=ON.
SET TVARS=NAMES.
```

```
 801  0 M>  SET TVARS=NAMES.

 802  0 M>
* ------------------------------------------------------------.
 803  0 M>  * ------------------------------------------------------------.
* 0. Create SPSS output folder on Windows.
 804  0 M>  * 0. Create SPSS output folder on Windows.
* If this HOST command does not run in your SPSS installation,
 805  0 M>  * If this HOST command does not run in your SPSS installation,
* create the SPSS folder manually and run the syntax again.
 806  0 M>  * create the SPSS folder manually and run the syntax again.
* ------------------------------------------------------------.
 807  0 M>  * ------------------------------------------------------------.

 808  0 M>
HOST COMMAND=['if not exist "D:\low kda score priority basis posts\first post\
Goldfeld Quandt Test\SPSS" mkdir "D:\low kda score priority basis posts\first
post\Goldfeld Quandt Test\SPSS"'].
 809  0 M>  HOST COMMAND=['if not exist "D:\low kda score priority basis posts
\first post\Goldfeld Quandt Test\SPSS" mkdir "D:\low k
              da score priority basis posts\first post\Goldfeld Quandt Test\S
PSS"'].
```

## Host

## Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:28 |
| Comments | | |
| Input | Active Dataset | DWMain |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| Syntax | | HOST COMMAND=['if not exist "D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\SPSS" mkdir "D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\SPSS"']. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.10 |

```
 810  0 M>
* ------------------------------------------------------------.
 811  0 M>  * ------------------------------------------------------------.
* 1. Import clean CSV made by the Python script.
 812  0 M>  * 1. Import clean CSV made by the Python script.
* This avoids delimiter problems from the original UCI semicolon CSV.
 813  0 M>  * This avoids delimiter problems from the original UCI semicolon C
SV.
* ------------------------------------------------------------.
 814  0 M>  * ------------------------------------------------------------.

 815  0 M>
GET DATA
 816  0 M>  GET DATA
 /TYPE=TXT
 817  0 M>   /TYPE=TXT
 /FILE='D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\
Python\goldfeld_quandt_clean_data_for_spss.csv'
 818  0 M>   /FILE='D:\low kda score priority basis posts\first post\Goldfeld
Quandt Test\Python\goldfeld_quandt_clean_data_for_spss
```

```
              .csv'
/ENCODING='UTF8'
819  0 M>   /ENCODING='UTF8'
/DELCASE=LINE
820  0 M>   /DELCASE=LINE
/DELIMITERS=','
821  0 M>   /DELIMITERS=','
/QUALIFIER='"'
822  0 M>   /QUALIFIER='"'
/ARRANGEMENT=DELIMITED
823  0 M>   /ARRANGEMENT=DELIMITED
/FIRSTCASE=2
824  0 M>   /FIRSTCASE=2
/VARIABLES=
825  0 M>   /VARIABLES=
school A8
826  0 M>   school A8
sex A8
827  0 M>   sex A8
age F8.0
828  0 M>   age F8.0
address A8
829  0 M>   address A8
famsize A8
830  0 M>   famsize A8
Pstatus A8
831  0 M>   Pstatus A8
Medu F8.0
832  0 M>   Medu F8.0
Fedu F8.0
833  0 M>   Fedu F8.0
Mjob A16
834  0 M>   Mjob A16
Fjob A16
835  0 M>   Fjob A16
reason A16
836  0 M>   reason A16
guardian A16
837  0 M>   guardian A16
```

```
traveltime F8.0
838  0 M>   traveltime F8.0
studytime F8.0
839  0 M>   studytime F8.0
failures F8.0
840  0 M>   failures F8.0
schoolsup A8
841  0 M>   schoolsup A8
famsup A8
842  0 M>   famsup A8
paid A8
843  0 M>   paid A8
activities A8
844  0 M>   activities A8
nursery A8
845  0 M>   nursery A8
higher A8
846  0 M>   higher A8
internet A8
847  0 M>   internet A8
romantic A8
848  0 M>   romantic A8
famrel F8.0
849  0 M>   famrel F8.0
freetime F8.0
850  0 M>   freetime F8.0
goout F8.0
851  0 M>   goout F8.0
Dalc F8.0
852  0 M>   Dalc F8.0
Walc F8.0
853  0 M>   Walc F8.0
health F8.0
854  0 M>   health F8.0
absences F8.0
855  0 M>   absences F8.0
G1 F8.0
856  0 M>   G1 F8.0
G2 F8.0
```

```
 857  0 M>   G2 F8.0
 G3 F8.0
 858  0 M>   G3 F8.0
 caseid F8.0
 859  0 M>   caseid F8.0
 studytime_label A24.
 860  0 M>   studytime_label A24.
CACHE.
 861  0 M>  CACHE.
EXECUTE.
 862  0 M>  EXECUTE.

 863  0 M>
DATASET NAME GQ_RAW WINDOW=FRONT.
 864  0 M>  DATASET NAME GQ_RAW WINDOW=FRONT.

 865  0 M>
VALUE LABELS studytime
 866  0 M>  VALUE LABELS studytime
 1 '<2 hours'
 867  0 M>   1 '<2 hours'
 2 '2 to 5 hours'
 868  0 M>   2 '2 to 5 hours'
 3 '5 to 10 hours'
 869  0 M>   3 '5 to 10 hours'
 4 '>10 hours'.
 870  0 M>   4 '>10 hours'.

 871  0 M>
FORMATS age Medu Fedu traveltime studytime failures famrel freetime goout Dalc
 872  0 M>  FORMATS age Medu Fedu traveltime studytime failures famrel freetim
e goout Dalc
 Walc health absences G1 G2 G3 caseid (F8.0).
 873  0 M>   Walc health absences G1 G2 G3 caseid (F8.0).

 874  0 M>
VARIABLE LABELS
 875  0 M>  VARIABLE LABELS
 G3 'Final grade'
```

```
 876  0 M>   G3 'Final grade'
 G1 'First period grade'
 877  0 M>   G1 'First period grade'
 G2 'Second period grade'
 878  0 M>   G2 'Second period grade'
 FIT_G3 'Fitted G3 final grade from regression model'
 879  0 M>   FIT_G3 'Fitted G3 final grade from regression model'

>Warning # 4461 in column 2.  Text: FIT_G3
>An unknown variable name was specified on the VAR LABELS command.  The name
>and the label will be ignored.
 RESID_MAIN 'Regression residual from main G3 model'.
 880  0 M>   RESID_MAIN 'Regression residual from main G3 model'.

>Warning # 4461 in column 2.  Text: RESID_MAIN
>An unknown variable name was specified on the VAR LABELS command.  The name
>and the label will be ignored.

 881  0 M>
EXECUTE.
 882  0 M>  EXECUTE.

 883  0 M>
* ------------------------------------------------------------.
 884  0 M>  * ------------------------------------------------------------.
* 2. Import check.
 885  0 M>  * 2. Import check.
* Expected: 649 rows, zero missing in G3, G1, G2, studytime.
 886  0 M>  * Expected: 649 rows, zero missing in G3, G1, G2, studytime.
* ------------------------------------------------------------.
 887  0 M>  * ------------------------------------------------------------.

 888  0 M>
FREQUENCIES VARIABLES=studytime failures sex internet higher
 889  0 M>  FREQUENCIES VARIABLES=studytime failures sex internet higher
 /ORDER=ANALYSIS.
 890  0 M>   /ORDER=ANALYSIS.
```

## Frequencies

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:29 |
| Comments | | |
| Input | Data | D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\Python\goldfeld_quandt_clean_data_for_spss.csv |
| | Active Dataset | GQ_RAW |
| | 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 all cases with valid data. |
| Syntax | | FREQUENCIES VARIABLES=studytime failures sex internet higher /ORDER=ANALYSIS. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.00 |

[GQ_RAW]

### Statistics

| | | studytime | failures | sex | internet | higher |
|---|---|---|---|---|---|---|
| N | Valid | 649 | 649 | 649 | 649 | 649 |
| | Missing | 0 | 0 | 0 | 0 | 0 |

## Frequency Table

**studytime**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | <2 hours | 212 | 32.7 | 32.7 | 32.7 |
| | 2 to 5 hours | 305 | 47.0 | 47.0 | 79.7 |
| | 5 to 10 hours | 97 | 14.9 | 14.9 | 94.6 |
| | >10 hours | 35 | 5.4 | 5.4 | 100.0 |
| | Total | 649 | 100.0 | 100.0 | |

**failures**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 549 | 84.6 | 84.6 | 84.6 |
| | 1 | 70 | 10.8 | 10.8 | 95.4 |
| | 2 | 16 | 2.5 | 2.5 | 97.8 |
| | 3 | 14 | 2.2 | 2.2 | 100.0 |
| | Total | 649 | 100.0 | 100.0 | |

**sex**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | F | 383 | 59.0 | 59.0 | 59.0 |
| | M | 266 | 41.0 | 41.0 | 100.0 |
| | Total | 649 | 100.0 | 100.0 | |

**internet**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | no | 151 | 23.3 | 23.3 | 23.3 |
| | yes | 498 | 76.7 | 76.7 | 100.0 |
| | Total | 649 | 100.0 | 100.0 | |

**higher**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | no | 69 | 10.6 | 10.6 | 10.6 |
| | yes | 580 | 89.4 | 89.4 | 100.0 |
| | Total | 649 | 100.0 | 100.0 | |

```
 891  0 M>
DESCRIPTIVES VARIABLES=G1 G2 G3 studytime failures absences age Medu Fedu
 892  0 M>  DESCRIPTIVES VARIABLES=G1 G2 G3 studytime failures absences age Me
du Fedu
 /STATISTICS=MEAN STDDEV MIN MAX.
 893  0 M>   /STATISTICS=MEAN STDDEV MIN MAX.
```

## Descriptives

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:29 |
| Comments | | |
| Input | Data | D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\Python\goldfeld_quandt_clean_data_for_spss.csv |
| | Active Dataset | GQ_RAW |
| | 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 | All non-missing data are used. |

## Notes

| | | |
|---|---|---|
| Syntax | | DESCRIPTIVES VARIABLES=G1 G2 G3 studytime failures absences age Medu Fedu /STATISTICS=MEAN STDDEV MIN MAX. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.01 |

## Descriptive Statistics

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| G1 | 649 | 0 | 19 | 11.40 | 2.745 |
| G2 | 649 | 0 | 19 | 11.57 | 2.914 |
| G3 | 649 | 0 | 19 | 11.91 | 3.231 |
| studytime | 649 | 1 | 4 | 1.93 | .830 |
| failures | 649 | 0 | 3 | .22 | .593 |
| absences | 649 | 0 | 32 | 3.66 | 4.641 |
| age | 649 | 15 | 22 | 16.74 | 1.218 |
| Medu | 649 | 0 | 4 | 2.51 | 1.135 |
| Fedu | 649 | 0 | 4 | 2.31 | 1.100 |
| Valid N (listwise) | 649 | | | | |

```
 894  0 M>
* ------------------------------------------------------------.
 895  0 M>  * ------------------------------------------------------------.
* 3. Main regression model.
 896  0 M>  * 3. Main regression model.
* IMPORTANT: /STATISTICS is before /DEPENDENT to avoid syntax issues
 897  0 M>  * IMPORTANT: /STATISTICS is before /DEPENDENT to avoid syntax issu
es
* in some SPSS versions.
 898  0 M>  * in some SPSS versions.
* ------------------------------------------------------------.
 899  0 M>  * ------------------------------------------------------------.

 900  0 M>
REGRESSION
```

```
901  0 M>  REGRESSION
/MISSING LISTWISE
902  0 M>   /MISSING LISTWISE
/STATISTICS COEFF OUTS R ANOVA
903  0 M>   /STATISTICS COEFF OUTS R ANOVA
/DEPENDENT G3
904  0 M>   /DEPENDENT G3
/METHOD=ENTER G1 G2 studytime failures absences age Medu Fedu
905  0 M>   /METHOD=ENTER G1 G2 studytime failures absences age Medu Fedu
/SAVE PRED(FIT_G3) RESID(RESID_MAIN).
906  0 M>   /SAVE PRED(FIT_G3) RESID(RESID_MAIN).
```

## Regression

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:29 |
| Comments | | |
| Input | Data | D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\Python\goldfeld_quandt_clean_data_for_spss.csv |
| | Active Dataset | GQ_RAW |
| | 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. |

## Notes

| | | |
|---|---|---|
| Syntax | | REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /DEPENDENT G3 /METHOD=ENTER G1 G2 studytime failures absences age Medu Fedu /SAVE PRED(FIT_G3) RESID(RESID_MAIN). |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.02 |
| | Memory Required | 8560 bytes |
| | Additional Memory Required for Residual Plots | 0 bytes |
| Variables Created or Modified | FIT_G3 | Unstandardized Predicted Value |
| | RESID_MAIN | Unstandardized Residual |

## Variables Entered/Removed[a]

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | Fedu, absences, studytime, age, G2, failures, Medu, G1[b] | . | Enter |

a. Dependent Variable: G3

b. All requested variables entered.

## Model Summary[b]

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .922[a] | .851 | .849 | 1.256 |

a. Predictors: (Constant), Fedu, absences, studytime, age, G2, failures, Medu, G1

b. Dependent Variable: G3

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5754.033 | 8 | 719.254 | 456.111 | .000[b] |
| | Residual | 1009.234 | 640 | 1.577 | | |
| | Total | 6763.267 | 648 | | | |

a. Dependent Variable: G3

b. Predictors: (Constant), Fedu, absences, studytime, age, G2, failures, Medu, G1

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -.501 | .774 | | -.648 | .518 |
| | G1 | .143 | .037 | .122 | 3.910 | .000 |
| | G2 | .885 | .034 | .798 | 25.744 | .000 |
| | studytime | .097 | .062 | .025 | 1.556 | .120 |
| | failures | -.235 | .095 | -.043 | -2.471 | .014 |
| | absences | .023 | .011 | .033 | 2.085 | .038 |
| | age | .023 | .044 | .009 | .520 | .604 |
| | Medu | -.045 | .058 | -.016 | -.776 | .438 |
| | Fedu | .022 | .059 | .007 | .371 | .711 |

a. Dependent Variable: G3

**Residuals Statistics[a]**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | .25 | 19.55 | 11.91 | 2.980 | 649 |
| Residual | -9.051 | 5.782 | .000 | 1.248 | 649 |
| Std. Predicted Value | -3.911 | 2.565 | .000 | 1.000 | 649 |
| Std. Residual | -7.207 | 4.605 | .000 | .994 | 649 |

a. Dependent Variable: G3

```
 907  0 M>
EXECUTE.
```

```
 908  0 M>  EXECUTE.

 909  0 M>
COMPUTE RESID_SQ = RESID_MAIN * RESID_MAIN.
 910  0 M>  COMPUTE RESID_SQ = RESID_MAIN * RESID_MAIN.
COMPUTE ABS_RESID = ABS(RESID_MAIN).
 911  0 M>  COMPUTE ABS_RESID = ABS(RESID_MAIN).
EXECUTE.
 912  0 M>  EXECUTE.

 913  0 M>
SAVE OUTFILE='D:\low kda score priority basis posts\first post\Goldfeld Quandt
 Test\SPSS\goldfeld_quandt_spss_main_model_with_residuals.sav'
 914  0 M>  SAVE OUTFILE='D:\low kda score priority basis posts\first post\Gol
dfeld Quandt Test\SPSS\goldfeld_quandt_spss_main_model
               _with_residuals.sav'
 /COMPRESSED.
 915  0 M>   /COMPRESSED.

 916  0 M>
SAVE TRANSLATE
 917  0 M>  SAVE TRANSLATE
 /OUTFILE='D:\low kda score priority basis posts\first post\Goldfeld Quandt Te
st\SPSS\goldfeld_quandt_spss_main_model_residuals.csv'
 918  0 M>   /OUTFILE='D:\low kda score priority basis posts\first post\Goldfe
ld Quandt Test\SPSS\goldfeld_quandt_spss_main_model_re
               siduals.csv'
 /TYPE=CSV
 919  0 M>   /TYPE=CSV
 /REPLACE
 920  0 M>   /REPLACE
 /FIELDNAMES
 921  0 M>   /FIELDNAMES
 /CELLS=VALUES.
 922  0 M>   /CELLS=VALUES.



 923  0 M>
```

```
* ------------------------------------------------------------.
 924  0 M>  * ------------------------------------------------------------.
* 4. Manual Goldfeld Quandt Test ordered by fitted G3.
 925  0 M>  * 4. Manual Goldfeld Quandt Test ordered by fitted G3.
* Middle 20 percent of ordered cases is omitted.
 926  0 M>  * Middle 20 percent of ordered cases is omitted.
* Lower and upper ordered groups are compared by residual variance.
 927  0 M>  * Lower and upper ordered groups are compared by residual variance
.
* ------------------------------------------------------------.
 928  0 M>  * ------------------------------------------------------------.

 929  0 M>
SORT CASES BY FIT_G3 (A) caseid (A).
 930  0 M>  SORT CASES BY FIT_G3 (A) caseid (A).
COMPUTE ORDER_POS = $CASENUM.
 931  0 M>  COMPUTE ORDER_POS = $CASENUM.
EXECUTE.
 932  0 M>  EXECUTE.

 933  0 M>
AGGREGATE
 934  0 M>  AGGREGATE
 /OUTFILE=* MODE=ADDVARIABLES
 935  0 M>   /OUTFILE=* MODE=ADDVARIABLES
 /BREAK=
 936  0 M>   /BREAK=
 /TOTAL_N=N(caseid).
 937  0 M>   /TOTAL_N=N(caseid).

 938  0 M>
COMPUTE MID_DROP = TRUNC(TOTAL_N * .20).
 939  0 M>  COMPUTE MID_DROP = TRUNC(TOTAL_N * .20).
COMPUTE LOW_N_TARGET = TRUNC((TOTAL_N - MID_DROP) / 2).
 940  0 M>  COMPUTE LOW_N_TARGET = TRUNC((TOTAL_N - MID_DROP) / 2).
COMPUTE HIGH_START = LOW_N_TARGET + MID_DROP + 1.
 941  0 M>  COMPUTE HIGH_START = LOW_N_TARGET + MID_DROP + 1.

 942  0 M>
```

```
COMPUTE GQ_GROUP = 0.
 943  0 M>  COMPUTE GQ_GROUP = 0.
IF (ORDER_POS <= LOW_N_TARGET) GQ_GROUP = 1.
 944  0 M>  IF (ORDER_POS <= LOW_N_TARGET) GQ_GROUP = 1.
IF (ORDER_POS >= HIGH_START) GQ_GROUP = 2.
 945  0 M>  IF (ORDER_POS >= HIGH_START) GQ_GROUP = 2.

 946  0 M>
VALUE LABELS GQ_GROUP
 947  0 M>  VALUE LABELS GQ_GROUP
 0 'Middle omitted'
 948  0 M>   0 'Middle omitted'
 1 'Low ordered group'
 949  0 M>   1 'Low ordered group'
 2 'High ordered group'.
 950  0 M>   2 'High ordered group'.

 951  0 M>
VARIABLE LABELS
 952  0 M>  VARIABLE LABELS
 ORDER_POS 'Observation order after sorting by fitted G3'
 953  0 M>   ORDER_POS 'Observation order after sorting by fitted G3'
 GQ_GROUP 'Goldfeld Quandt subgroup after dropping middle 20 percent'.
 954  0 M>   GQ_GROUP 'Goldfeld Quandt subgroup after dropping middle 20 perce
nt'.

 955  0 M>
EXECUTE.
 956  0 M>  EXECUTE.

 957  0 M>
* Conditional variables for low and high ordered groups.
 958  0 M>  * Conditional variables for low and high ordered groups.
COMPUTE RESID_LOW = $SYSMIS.
 959  0 M>  COMPUTE RESID_LOW = $SYSMIS.
IF (GQ_GROUP = 1) RESID_LOW = RESID_MAIN.
 960  0 M>  IF (GQ_GROUP = 1) RESID_LOW = RESID_MAIN.

 961  0 M>
```

```
COMPUTE RESID_HIGH = $SYSMIS.
 962  0 M>  COMPUTE RESID_HIGH = $SYSMIS.
IF (GQ_GROUP = 2) RESID_HIGH = RESID_MAIN.
 963  0 M>  IF (GQ_GROUP = 2) RESID_HIGH = RESID_MAIN.

 964  0 M>
COMPUTE SQ_LOW = $SYSMIS.
 965  0 M>  COMPUTE SQ_LOW = $SYSMIS.
IF (GQ_GROUP = 1) SQ_LOW = RESID_SQ.
 966  0 M>  IF (GQ_GROUP = 1) SQ_LOW = RESID_SQ.

 967  0 M>
COMPUTE SQ_HIGH = $SYSMIS.
 968  0 M>  COMPUTE SQ_HIGH = $SYSMIS.
IF (GQ_GROUP = 2) SQ_HIGH = RESID_SQ.
 969  0 M>  IF (GQ_GROUP = 2) SQ_HIGH = RESID_SQ.

 970  0 M>
COMPUTE ABS_LOW = $SYSMIS.
 971  0 M>  COMPUTE ABS_LOW = $SYSMIS.
IF (GQ_GROUP = 1) ABS_LOW = ABS_RESID.
 972  0 M>  IF (GQ_GROUP = 1) ABS_LOW = ABS_RESID.

 973  0 M>
COMPUTE ABS_HIGH = $SYSMIS.
 974  0 M>  COMPUTE ABS_HIGH = $SYSMIS.
IF (GQ_GROUP = 2) ABS_HIGH = ABS_RESID.
 975  0 M>  IF (GQ_GROUP = 2) ABS_HIGH = ABS_RESID.
EXECUTE.
 976  0 M>  EXECUTE.

 977  0 M>
AGGREGATE
 978  0 M>  AGGREGATE
 /OUTFILE=* MODE=ADDVARIABLES
 979  0 M>   /OUTFILE=* MODE=ADDVARIABLES
 /BREAK=
 980  0 M>   /BREAK=
 /N_LOW=N(RESID_LOW)
```

```
 981  0 M>   /N_LOW=N(RESID_LOW)
 /N_HIGH=N(RESID_HIGH)
 982  0 M>   /N_HIGH=N(RESID_HIGH)
 /RSS_LOW=SUM(SQ_LOW)
 983  0 M>   /RSS_LOW=SUM(SQ_LOW)
 /RSS_HIGH=SUM(SQ_HIGH)
 984  0 M>   /RSS_HIGH=SUM(SQ_HIGH)
 /SD_LOW=SD(RESID_LOW)
 985  0 M>   /SD_LOW=SD(RESID_LOW)
 /SD_HIGH=SD(RESID_HIGH)
 986  0 M>   /SD_HIGH=SD(RESID_HIGH)
 /MEANABS_LOW=MEAN(ABS_LOW)
 987  0 M>   /MEANABS_LOW=MEAN(ABS_LOW)
 /MEANABS_HIGH=MEAN(ABS_HIGH).
 988  0 M>   /MEANABS_HIGH=MEAN(ABS_HIGH).

 989  0 M>
* Number of coefficients in the main regression model:
 990  0 M>  * Number of coefficients in the main regression model:
* intercept + 8 predictors = 9.
 991  0 M>  * intercept + 8 predictors = 9.
COMPUTE P_COUNT = 9.
 992  0 M>  COMPUTE P_COUNT = 9.
COMPUTE DF_LOW = N_LOW - P_COUNT.
 993  0 M>  COMPUTE DF_LOW = N_LOW - P_COUNT.
COMPUTE DF_HIGH = N_HIGH - P_COUNT.
 994  0 M>  COMPUTE DF_HIGH = N_HIGH - P_COUNT.

 995  0 M>
COMPUTE VAR_LOW = RSS_LOW / DF_LOW.
 996  0 M>  COMPUTE VAR_LOW = RSS_LOW / DF_LOW.
COMPUTE VAR_HIGH = RSS_HIGH / DF_HIGH.
 997  0 M>  COMPUTE VAR_HIGH = RSS_HIGH / DF_HIGH.
COMPUTE F_HIGH_LOW = VAR_HIGH / VAR_LOW.
 998  0 M>  COMPUTE F_HIGH_LOW = VAR_HIGH / VAR_LOW.

 999  0 M>
* Directional and two-sided p-values.
1000  0 M>  * Directional and two-sided p-values.
```

```
* F_HIGH_LOW uses df_high as numerator df and df_low as denominator df.
1001  0 M>  * F_HIGH_LOW uses df_high as numerator df and df_low as denominato
r df.
COMPUTE P_LESS_HIGH = CDF.F(F_HIGH_LOW, DF_HIGH, DF_LOW).
1002  0 M>  COMPUTE P_LESS_HIGH = CDF.F(F_HIGH_LOW, DF_HIGH, DF_LOW).
COMPUTE P_GREATER_HIGH = 1 - CDF.F(F_HIGH_LOW, DF_HIGH, DF_LOW).
1003  0 M>  COMPUTE P_GREATER_HIGH = 1 - CDF.F(F_HIGH_LOW, DF_HIGH, DF_LOW).
COMPUTE P_TWO_SIDED = MIN(1, 2 * MIN(P_LESS_HIGH, P_GREATER_HIGH)).
1004  0 M>  COMPUTE P_TWO_SIDED = MIN(1, 2 * MIN(P_LESS_HIGH, P_GREATER_HIGH))
.

1005  0 M>
STRING GQ_DECISION (A120).
1006  0 M>  STRING GQ_DECISION (A120).
IF (P_TWO_SIDED < .05) GQ_DECISION = 'Reject H0: evidence that residual varian
ce differs between ordered groups'.
1007  0 M>  IF (P_TWO_SIDED < .05) GQ_DECISION = 'Reject H0: evidence that res
idual variance differs between ordered groups'.
IF (P_TWO_SIDED >= .05) GQ_DECISION = 'Fail to reject H0: no strong evidence o
f unequal residual variance'.
1008  0 M>  IF (P_TWO_SIDED >= .05) GQ_DECISION = 'Fail to reject H0: no stron
g evidence of unequal residual variance'.
EXECUTE.
1009  0 M>  EXECUTE.

1010  0 M>
FORMATS TOTAL_N MID_DROP LOW_N_TARGET HIGH_START N_LOW N_HIGH DF_LOW DF_HIGH P
_COUNT (F8.0).
1011  0 M>  FORMATS TOTAL_N MID_DROP LOW_N_TARGET HIGH_START N_LOW N_HIGH DF_L
OW DF_HIGH P_COUNT (F8.0).
FORMATS RSS_LOW RSS_HIGH VAR_LOW VAR_HIGH F_HIGH_LOW MEANABS_LOW MEANABS_HIGH
P_LESS_HIGH P_GREATER_HIGH P_TWO_SIDED (F12.6).
1012  0 M>  FORMATS RSS_LOW RSS_HIGH VAR_LOW VAR_HIGH F_HIGH_LOW MEANABS_LOW M
EANABS_HIGH P_LESS_HIGH P_GREATER_HIGH P_TWO_SIDED (F1
              2.6).

1013  0 M>
* ------------------------------------------------------------.
1014  0 M>  * ------------------------------------------------------------.
```

```
* 5. Main result table.
1015  0 M>  * 5. Main result table.
* In the output, this is the main SPSS Goldfeld Quandt Test result.
1016  0 M>  * In the output, this is the main SPSS Goldfeld Quandt Test result
.
* ------------------------------------------------------------.
1017  0 M>  * ------------------------------------------------------------.

1018  0 M>
TEMPORARY.
1019  0 M>  TEMPORARY.
SELECT IF ($CASENUM = 1).
1020  0 M>  SELECT IF ($CASENUM = 1).
LIST VARIABLES=
1021  0 M>  LIST VARIABLES=
 TOTAL_N MID_DROP N_LOW N_HIGH DF_LOW DF_HIGH RSS_LOW RSS_HIGH
1022  0 M>   TOTAL_N MID_DROP N_LOW N_HIGH DF_LOW DF_HIGH RSS_LOW RSS_HIGH
 VAR_LOW VAR_HIGH F_HIGH_LOW P_GREATER_HIGH P_LESS_HIGH P_TWO_SIDED GQ_DECISIO
N.
1023  0 M>   VAR_LOW VAR_HIGH F_HIGH_LOW P_GREATER_HIGH P_LESS_HIGH P_TWO_SIDE
D GQ_DECISION.
```

## List

## Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:30 |
| Comments | | |
| Input | Data | D:\low kda score priority basis posts\first post\Goldfeld Quandt Test\SPSS\goldfeld_quandt_spss_main_model_with_residuals.sav |
| | Active Dataset | GQ_RAW |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 1 |
| Syntax | | LIST VARIABLES= TOTAL_N MID_DROP N_LOW N_HIGH DF_LOW DF_HIGH RSS_LOW RSS_HIGH VAR_LOW VAR_HIGH F_HIGH_LOW P_GREATER_HIGH P_LESS_HIGH P_TWO_SIDED GQ_DECISION. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.01 |

```
[GQ_RAW] D:\low kda score priority basis posts\first post\Goldfeld Quandt Test
\SPSS\goldfeld_quandt_spss_main_model_with_residuals.sav

The variables are listed in the following order:

LINE   1: TOTAL_N MID_DROP N_LOW N_HIGH DF_LOW DF_HIGH RSS_LOW RSS_HIGH VAR_LO
W VAR_HIGH F_HIGH_LOW

LINE   2: P_GREATER_HIGH P_LESS_HIGH P_TWO_SIDED

LINE   3: GQ_DECISION
```

```
     TOTAL_N:      649      129      260      260      251      251   740.1659
99   156.372264     2.948869      .622997      .211266
P_GREATER_HI:     1.000000      .000000      .000000
 GQ_DECISION: Reject H0: evidence that residual variance differs between order
ed groups


Number of cases read:  1    Number of cases listed:  1

1024  0 M>
DATASET COPY GQ_MAIN_RESULT.
1025  0 M>  DATASET COPY GQ_MAIN_RESULT.
DATASET ACTIVATE GQ_MAIN_RESULT.
1026  0 M>  DATASET ACTIVATE GQ_MAIN_RESULT.
SELECT IF ($CASENUM = 1).
1027  0 M>  SELECT IF ($CASENUM = 1).
MATCH FILES FILE=*
1028  0 M>  MATCH FILES FILE=*
 /KEEP=TOTAL_N MID_DROP N_LOW N_HIGH DF_LOW DF_HIGH RSS_LOW RSS_HIGH
1029  0 M>   /KEEP=TOTAL_N MID_DROP N_LOW N_HIGH DF_LOW DF_HIGH RSS_LOW RSS_HI
GH
       VAR_LOW VAR_HIGH F_HIGH_LOW P_GREATER_HIGH P_LESS_HIGH P_TWO_SIDED GQ_D
ECISION.
1030  0 M>         VAR_LOW VAR_HIGH F_HIGH_LOW P_GREATER_HIGH P_LESS_HIGH P_TW
O_SIDED GQ_DECISION.
EXECUTE.
1031  0 M>  EXECUTE.

1032  0 M>
SAVE TRANSLATE
1033  0 M>  SAVE TRANSLATE
 /OUTFILE='D:\low kda score priority basis posts\first post\Goldfeld Quandt Te
st\SPSS\goldfeld_quandt_spss_main_result.csv'
1034  0 M>   /OUTFILE='D:\low kda score priority basis posts\first post\Goldfe
ld Quandt Test\SPSS\goldfeld_quandt_spss_main_result.c
               sv'
 /TYPE=CSV
```

```
1035  0 M>   /TYPE=CSV
 /REPLACE
1036  0 M>   /REPLACE
 /FIELDNAMES
1037  0 M>   /FIELDNAMES
 /CELLS=VALUES.
1038  0 M>   /CELLS=VALUES.



1039  0 M>
DATASET ACTIVATE GQ_RAW.
1040  0 M>  DATASET ACTIVATE GQ_RAW.

1041  0 M>
* ------------------------------------------------------------.
1042  0 M>  * ------------------------------------------------------------.
* 6. Subgroup residual variance table.
1043  0 M>  * 6. Subgroup residual variance table.
* ------------------------------------------------------------.
1044  0 M>  * ------------------------------------------------------------.

1045  0 M>
DATASET COPY GQ_GROUP_TABLE.
1046  0 M>  DATASET COPY GQ_GROUP_TABLE.
DATASET ACTIVATE GQ_GROUP_TABLE.
1047  0 M>  DATASET ACTIVATE GQ_GROUP_TABLE.
SELECT IF (GQ_GROUP = 1 OR GQ_GROUP = 2).
1048  0 M>  SELECT IF (GQ_GROUP = 1 OR GQ_GROUP = 2).
EXECUTE.
1049  0 M>  EXECUTE.

1050  0 M>
AGGREGATE
1051  0 M>  AGGREGATE
 /OUTFILE=* MODE=ADDVARIABLES
1052  0 M>   /OUTFILE=* MODE=ADDVARIABLES
 /BREAK=GQ_GROUP
1053  0 M>   /BREAK=GQ_GROUP
```

```
 /N_CASES=N(RESID_MAIN)
1054  0 M>   /N_CASES=N(RESID_MAIN)
 /RSS_GROUP=SUM(RESID_SQ)
1055  0 M>   /RSS_GROUP=SUM(RESID_SQ)
 /SD_GROUP=SD(RESID_MAIN)
1056  0 M>   /SD_GROUP=SD(RESID_MAIN)
 /MEANABS_GROUP=MEAN(ABS_RESID).
1057  0 M>   /MEANABS_GROUP=MEAN(ABS_RESID).

1058  0 M>
COMPUTE DF_GROUP = N_CASES - 9.
1059  0 M>  COMPUTE DF_GROUP = N_CASES - 9.
COMPUTE VAR_GROUP = RSS_GROUP / DF_GROUP.
1060  0 M>  COMPUTE VAR_GROUP = RSS_GROUP / DF_GROUP.
EXECUTE.
1061  0 M>  EXECUTE.

1062  0 M>
SORT CASES BY GQ_GROUP (A).
1063  0 M>  SORT CASES BY GQ_GROUP (A).
MATCH FILES FILE=* /BY GQ_GROUP /FIRST=FIRST_GROUP.
1064  0 M>  MATCH FILES FILE=* /BY GQ_GROUP /FIRST=FIRST_GROUP.
SELECT IF (FIRST_GROUP = 1).
1065  0 M>  SELECT IF (FIRST_GROUP = 1).
MATCH FILES FILE=*
1066  0 M>  MATCH FILES FILE=*
 /KEEP=GQ_GROUP N_CASES DF_GROUP RSS_GROUP SD_GROUP VAR_GROUP MEANABS_GROUP.
1067  0 M>   /KEEP=GQ_GROUP N_CASES DF_GROUP RSS_GROUP SD_GROUP VAR_GROUP MEAN
ABS_GROUP.
EXECUTE.
1068  0 M>  EXECUTE.

1069  0 M>
FORMATS N_CASES DF_GROUP (F8.0).
1070  0 M>  FORMATS N_CASES DF_GROUP (F8.0).
FORMATS RSS_GROUP SD_GROUP VAR_GROUP MEANABS_GROUP (F12.6).
1071  0 M>  FORMATS RSS_GROUP SD_GROUP VAR_GROUP MEANABS_GROUP (F12.6).

1072  0 M>
```

```
LIST VARIABLES=GQ_GROUP N_CASES DF_GROUP RSS_GROUP SD_GROUP VAR_GROUP MEANABS_
GROUP.
1073  0 M>  LIST VARIABLES=GQ_GROUP N_CASES DF_GROUP RSS_GROUP SD_GROUP VAR_GR
OUP MEANABS_GROUP.
```

## List

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:30 |
| Comments | | |
| Input | Active Dataset | GQ_GROUP_TABLE |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 2 |
| Syntax | | LIST VARIABLES=GQ_GROUP N_CASES DF_GROUP RSS_GROUP SD_GROUP VAR_GROUP MEANABS_GROUP. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.01 |

```
[GQ_GROUP_TABLE]

GQ_GROUP   N_CASES DF_GROUP     RSS_GROUP      SD_GROUP     VAR_GROUP MEANABS_GROU
P

    1.00       260       251   740.165999      1.690462      2.948869        .95653
7
    2.00       260       251   156.372264       .774509       .622997        .62027
0


Number of cases read:  2    Number of cases listed:  2

1074  0 M>
SAVE TRANSLATE
```

```
1075  0 M>  SAVE TRANSLATE
 /OUTFILE='D:\low kda score priority basis posts\first post\Goldfeld Quandt Te
st\SPSS\goldfeld_quandt_spss_group_variance_table.csv'
1076  0 M>   /OUTFILE='D:\low kda score priority basis posts\first post\Goldfe
ld Quandt Test\SPSS\goldfeld_quandt_spss_group_varianc
               e_table.csv'
 /TYPE=CSV
1077  0 M>   /TYPE=CSV
 /REPLACE
1078  0 M>   /REPLACE
 /FIELDNAMES
1079  0 M>   /FIELDNAMES
 /CELLS=VALUES.
1080  0 M>   /CELLS=VALUES.



1081  0 M>
DATASET ACTIVATE GQ_RAW.
1082  0 M>  DATASET ACTIVATE GQ_RAW.

1083  0 M>
* ------------------------------------------------------------.
1084  0 M>  * ------------------------------------------------------------.
* 7. SPSS charts for article screenshots/PDF.
1085  0 M>  * 7. SPSS charts for article screenshots/PDF.
* These are SPSS diagnostic versions. R/Python charts remain the
1086  0 M>  * These are SPSS diagnostic versions. R/Python charts remain the
* cleaner web images for WordPress upload.
1087  0 M>  * cleaner web images for WordPress upload.
* ------------------------------------------------------------.
1088  0 M>  * ------------------------------------------------------------.

1089  0 M>
TITLE 'Actual vs Fitted G3 for Goldfeld Quandt Regression Model'.
1090  0 M>  TITLE 'Actual vs Fitted G3 for Goldfeld Quandt Regression Model'.
```

Actual vs Fitted G3 for Goldfeld Quandt Regression Model

```
GRAPH
1091  0 M>  GRAPH
 /SCATTERPLOT(BIVAR)=FIT_G3 WITH G3
1092  0 M>   /SCATTERPLOT(BIVAR)=FIT_G3 WITH G3
 /MISSING=LISTWISE.
1093  0 M>   /MISSING=LISTWISE.
```

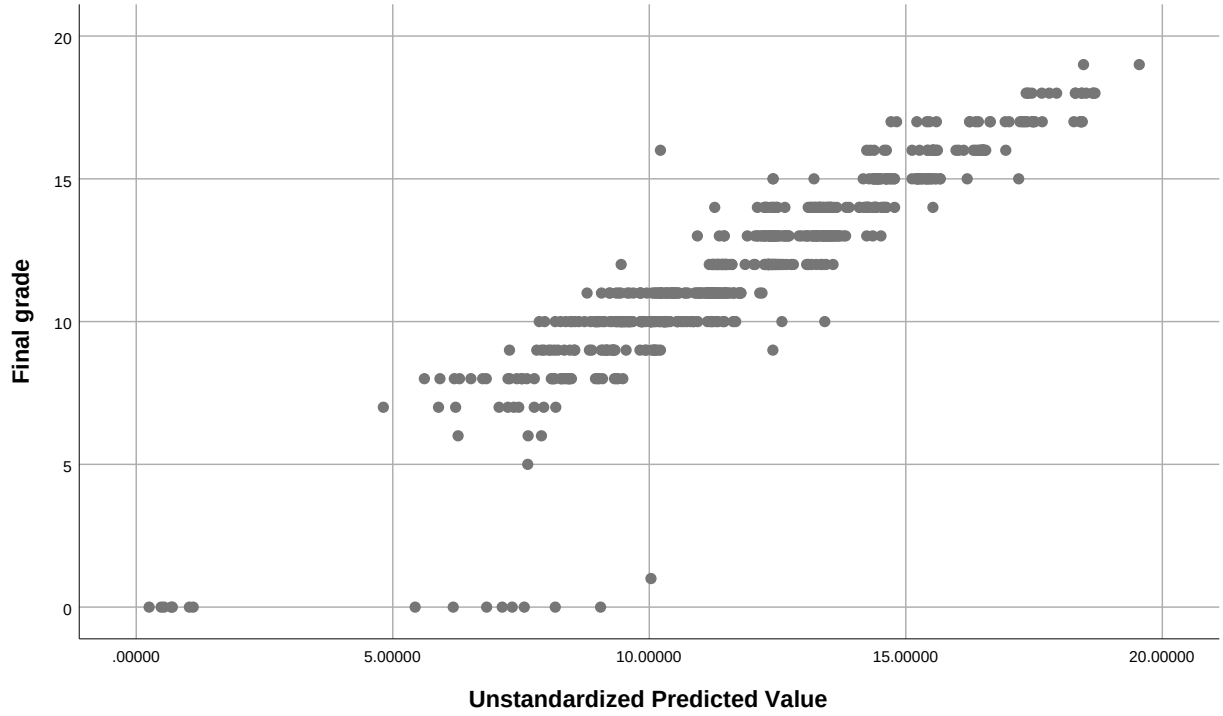
## Graph

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:30 |
| Comments | | |
| Input | Active Dataset | GQ_RAW |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /SCATTERPLOT(BIVAR) =FIT_G3 WITH G3 /MISSING=LISTWISE. |
| Resources | Processor Time | 00:00:00.33 |
| | Elapsed Time | 00:00:00.52 |

```
[GQ_RAW] D:\low kda score priority basis posts\first post\Goldfeld Quandt Test
\SPSS\goldfeld_quandt_spss_main_model_with_residuals.sav
```

Actual vs Fitted G3 for Goldfeld Quandt Regression Model




```
1094  0 M>
TITLE 'Residuals vs Fitted Values for Goldfeld Quandt Test'.
1095  0 M>  TITLE 'Residuals vs Fitted Values for Goldfeld Quandt Test'.
```

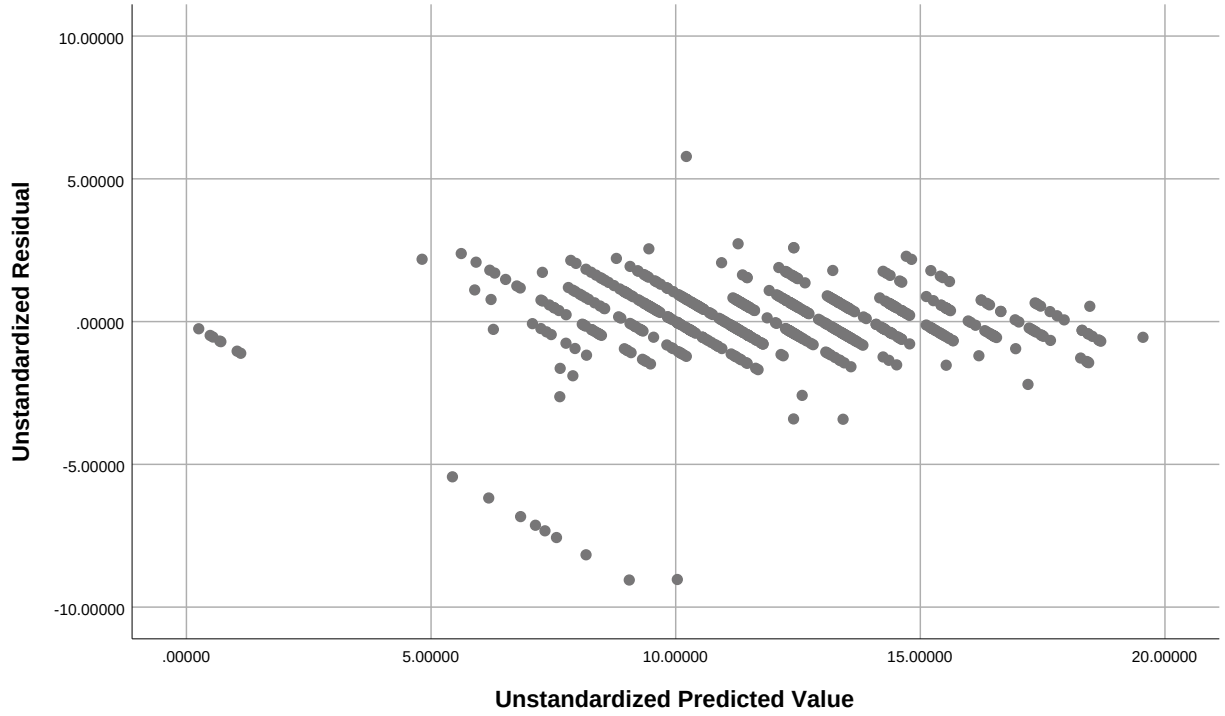
```
GRAPH
1096  0 M>  GRAPH
 /SCATTERPLOT(BIVAR)=FIT_G3 WITH RESID_MAIN
1097  0 M>   /SCATTERPLOT(BIVAR)=FIT_G3 WITH RESID_MAIN
 /MISSING=LISTWISE.
1098  0 M>   /MISSING=LISTWISE.
```

## Graph

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:31 |
| Comments | | |
| Input | Active Dataset | GQ_RAW |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /SCATTERPLOT(BIVAR) =FIT_G3 WITH RESID_MAIN /MISSING=LISTWISE. |
| Resources | Processor Time | 00:00:00.25 |
| | Elapsed Time | 00:00:00.26 |

Residuals vs Fitted Values for Goldfeld Quandt Test



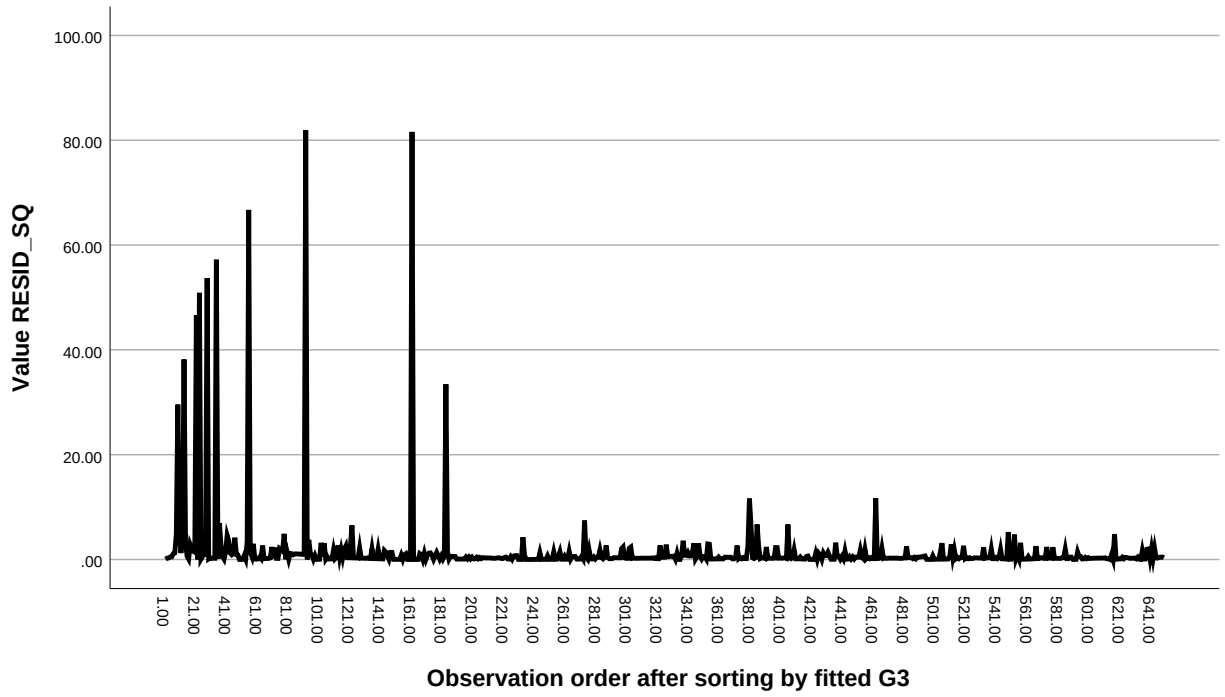

```
1099  0 M>
TITLE 'Squared Residuals Ordered by Fitted G3'.
1100  0 M>  TITLE 'Squared Residuals Ordered by Fitted G3'.
```

```
GRAPH
1101  0 M>  GRAPH
 /LINE(SIMPLE)=VALUE(RESID_SQ) BY ORDER_POS
1102  0 M>   /LINE(SIMPLE)=VALUE(RESID_SQ) BY ORDER_POS
 /MISSING=LISTWISE.
1103  0 M>   /MISSING=LISTWISE.
```

## Graph

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:31 |
| Comments | | |
| Input | Active Dataset | GQ_RAW |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 649 |
| Syntax | | GRAPH /LINE(SIMPLE)=VALUE (RESID_SQ) BY ORDER_POS /MISSING=LISTWISE. |
| Resources | Processor Time | 00:00:00.39 |
| | Elapsed Time | 00:00:00.38 |




```
1104  0 M>
TITLE 'Regression Residuals in Goldfeld Quandt Subgroups'.
1105  0 M>  TITLE 'Regression Residuals in Goldfeld Quandt Subgroups'.
```

```
TEMPORARY.
1106  0 M>  TEMPORARY.
SELECT IF (GQ_GROUP = 1 OR GQ_GROUP = 2).
1107  0 M>  SELECT IF (GQ_GROUP = 1 OR GQ_GROUP = 2).
EXAMINE VARIABLES=RESID_MAIN BY GQ_GROUP
1108  0 M>  EXAMINE VARIABLES=RESID_MAIN BY GQ_GROUP
 /PLOT=BOXPLOT
1109  0 M>   /PLOT=BOXPLOT
 /STATISTICS=DESCRIPTIVES
1110  0 M>   /STATISTICS=DESCRIPTIVES
 /MISSING=LISTWISE.
1111  0 M>   /MISSING=LISTWISE.
```

## Explore

### Notes

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:31 |
| Comments | | |
| Input | Active Dataset | GQ_RAW |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 520 |
| Missing Value Handling | Definition of Missing | User-defined missing values for dependent variables are treated as missing. |
| | Cases Used | Statistics are based on cases with no missing values for any dependent variable or factor used. |
| Syntax | | EXAMINE VARIABLES=RESID_MAIN BY GQ_GROUP /PLOT=BOXPLOT<br><br>/STATISTICS=DESCRIPTIVES /MISSING=LISTWISE. |
| Resources | Processor Time | 00:00:00.52 |
| | Elapsed Time | 00:00:00.41 |

# Total Sample

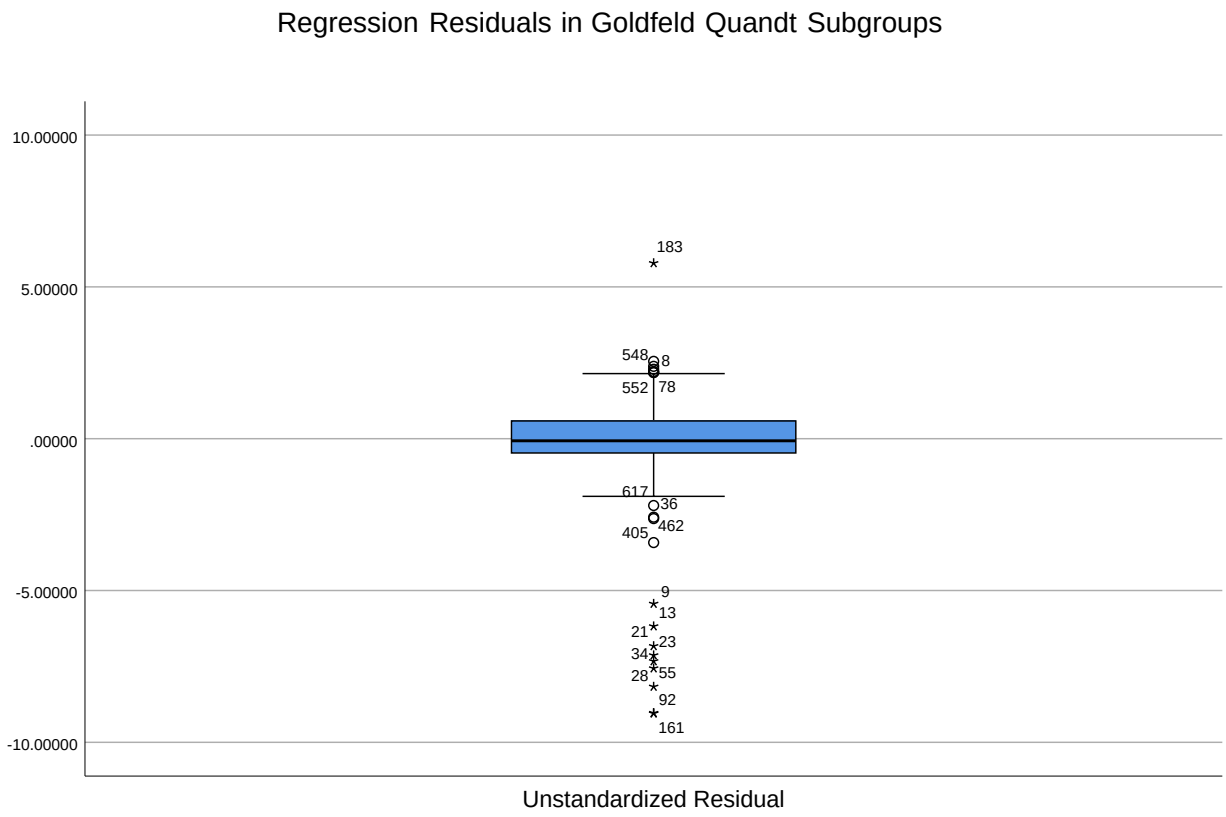
### Case Processing Summary

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| RESID_MAIN | 520 | 100.0% | 0 | 0.0% | 520 | 100.0% |

### Descriptives

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| RESID_MAIN | Mean | | -.0366620 | .05761422 |
| | 95% Confidence Interval for Mean | Lower Bound | -.1498478 | |
| | | Upper Bound | .0765237 | |
| | 5% Trimmed Mean | | .0511773 | |
| | Median | | -.0691016 | |
| | Variance | | 1.726 | |
| | Std. Deviation | | 1.31380643 | |
| | Minimum | | -9.05080 | |
| | Maximum | | 5.78244 | |
| | Range | | 14.83324 | |
| | Interquartile Range | | 1.05656 | |
| | Skewness | | -3.005 | .107 |
| | Kurtosis | | 18.305 | .214 |

# Unstandardized Residual




## Goldfeld Quandt subgroup after dropping middle 20 percent

### Case Processing Summary

| | | Cases | | | | | |
|---|---|---|---|---|---|---|---|
| | | Valid | | Missing | | Total | |
| | GQ_GROUP | N | Percent | N | Percent | N | Percent |
| RESID_MAIN | Low ordered group | 260 | 100.0% | 0 | 0.0% | 260 | 100.0% |
| | High ordered group | 260 | 100.0% | 0 | 0.0% | 260 | 100.0% |

Regression Residuals in Goldfeld Quandt Subgroups

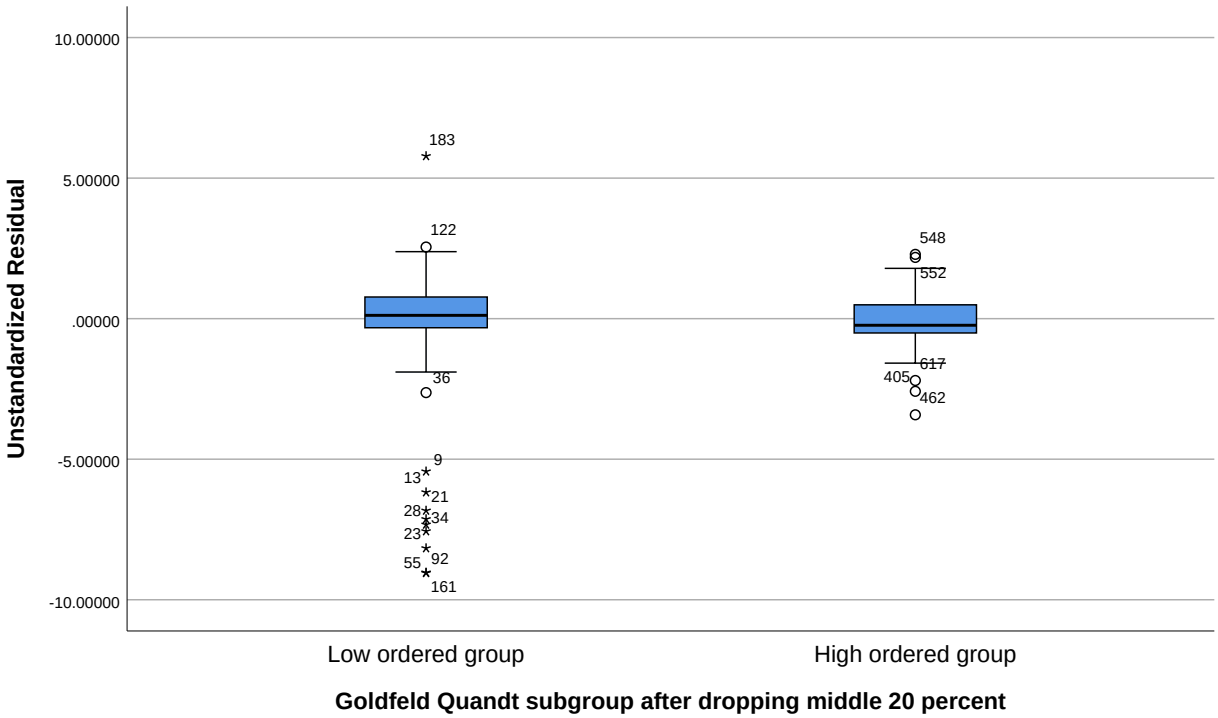
## Descriptives

| | GQ_GROUP | | | Statistic |
|---|---|---|---|---|
| RESID_MAIN | Low ordered group | Mean | | -.0110770 |
| | | 95% Confidence Interval for Mean | Lower Bound | -.2175203 |
| | | | Upper Bound | .1953664 |
| | | 5% Trimmed Mean | | .1739925 |
| | | Median | | .1180935 |
| | | Variance | | 2.858 |
| | | Std. Deviation | | 1.69046166 |
| | | Minimum | | -9.05080 |
| | | Maximum | | 5.78244 |
| | | Range | | 14.83324 |
| | | Interquartile Range | | 1.09963 |
| | | Skewness | | -2.869 |
| | | Kurtosis | | 12.706 |
| | High ordered group | Mean | | -.0622471 |
| | | 95% Confidence Interval for Mean | Lower Bound | -.1568321 |
| | | | Upper Bound | .0323378 |
| | | 5% Trimmed Mean | | -.0671714 |
| | | Median | | -.2349673 |
| | | Variance | | .600 |
| | | Std. Deviation | | .77450904 |
| | | Minimum | | -3.42083 |
| | | Maximum | | 2.28735 |
| | | Range | | 5.70818 |
| | | Interquartile Range | | 1.00309 |
| | | Skewness | | -.058 |
| | | Kurtosis | | 1.597 |

**Descriptives**

| | GQ_GROUP | | | Std. Error |
|---|---|---|---|---|
| RESID_MAIN | Low ordered group | Mean | | .10483798 |
| | | 95% Confidence Interval for Mean | Lower Bound | |
| | | | Upper Bound | |
| | | 5% Trimmed Mean | | |
| | | Median | | |
| | | Variance | | |
| | | Std. Deviation | | |
| | | Minimum | | |
| | | Maximum | | |
| | | Range | | |
| | | Interquartile Range | | |
| | | Skewness | | .151 |
| | | Kurtosis | | .301 |
| | High ordered group | Mean | | .04803301 |
| | | 95% Confidence Interval for Mean | Lower Bound | |
| | | | Upper Bound | |
| | | 5% Trimmed Mean | | |
| | | Median | | |
| | | Variance | | |
| | | Std. Deviation | | |
| | | Minimum | | |
| | | Maximum | | |
| | | Range | | |
| | | Interquartile Range | | |
| | | Skewness | | .151 |
| | | Kurtosis | | .301 |

## Unstandardized Residual




```
1112  0 M>
TITLE 'Goldfeld Quandt Group Residual Variances'.
1113  0 M>  TITLE 'Goldfeld Quandt Group Residual Variances'.
```

```
DATASET ACTIVATE GQ_GROUP_TABLE.
1114  0 M>  DATASET ACTIVATE GQ_GROUP_TABLE.
GRAPH
1115  0 M>  GRAPH
 /BAR(SIMPLE)=MEAN(VAR_GROUP) BY GQ_GROUP
1116  0 M>   /BAR(SIMPLE)=MEAN(VAR_GROUP) BY GQ_GROUP
 /MISSING=LISTWISE.
1117  0 M>   /MISSING=LISTWISE.
```

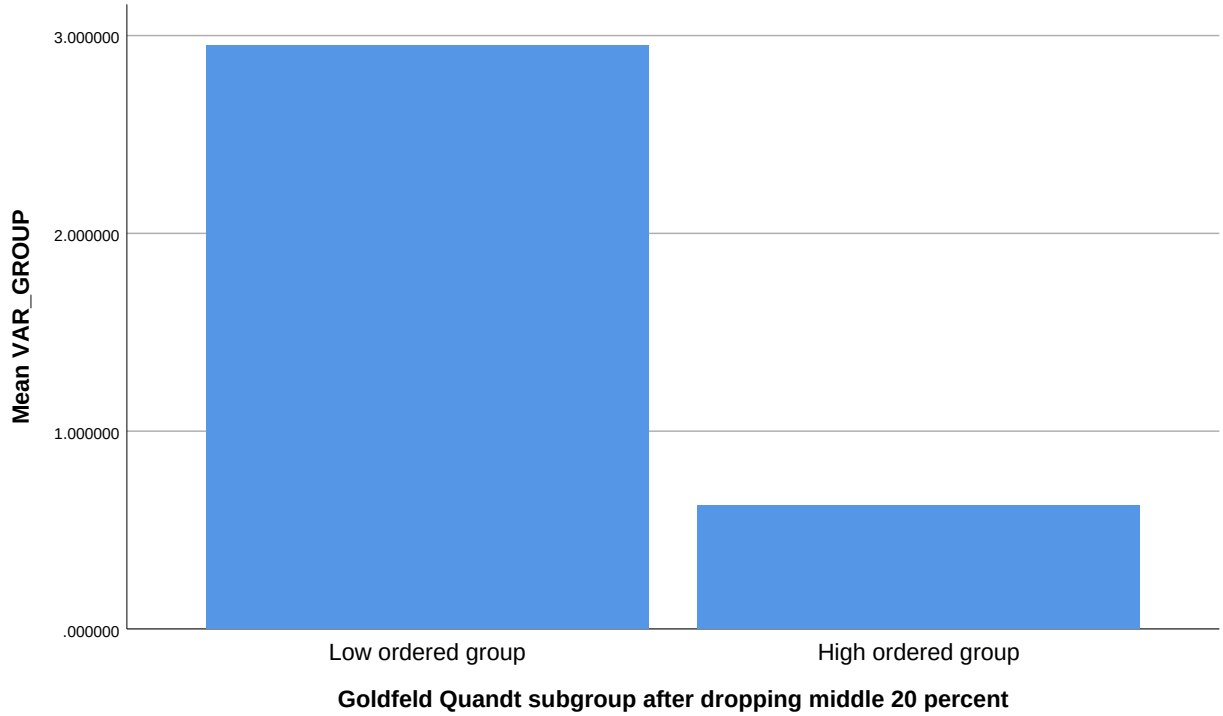
## Graph

**Notes**

| | | |
|---|---|---|
| Output Created | | 31-MAY-2026 19:33:32 |
| Comments | | |
| Input | Active Dataset | GQ_GROUP_TABLE |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 2 |
| Syntax | | GRAPH /BAR(SIMPLE)=MEAN (VAR_GROUP) BY GQ_GROUP /MISSING=LISTWISE. |
| Resources | Processor Time | 00:00:00.25 |
| | Elapsed Time | 00:00:00.26 |

```
[GQ_GROUP_TABLE]
```

Goldfeld Quandt Group Residual Variances




```
1118  0 M>
DATASET ACTIVATE GQ_RAW.
1119  0 M>  DATASET ACTIVATE GQ_RAW.

1120  0 M>
* ------------------------------------------------------------.
1121  0 M>  * ------------------------------------------------------------.
* 8. Save final working file and export SPSS output to PDF.
1122  0 M>  * 8. Save final working file and export SPSS output to PDF.
* ------------------------------------------------------------.
1123  0 M>  * ------------------------------------------------------------.

1124  0 M>
SAVE OUTFILE='D:\low kda score priority basis posts\first post\Goldfeld Quandt
 Test\SPSS\goldfeld_quandt_spss_working_file.sav'
1125  0 M>  SAVE OUTFILE='D:\low kda score priority basis posts\first post\Gol
dfeld Quandt Test\SPSS\goldfeld_quandt_spss_working_fi
              le.sav'
 /COMPRESSED.
1126  0 M>   /COMPRESSED.
```

```
1127  0 M>
OUTPUT EXPORT
1128  0 M>  OUTPUT EXPORT
 /CONTENTS EXPORT=ALL
1129  0 M>   /CONTENTS EXPORT=ALL
```