<div style="border: 1px solid black; padding: 10px;">

wntestq — Portmanteau (Q) test for white noise

</div>

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Description

wntestq performs the portmanteau (or Q) test for white noise.

Quick start

Perform Portmanteau's test for white noise on series y using tsset data

    wntestq y

Same as above, but calculate 10 autocorrelations

    wntestq y, lags(10)

Menu

Statistics > Time series > Tests > Portmanteau white-noise test

Syntax

    wntestq *varname* [*if*] [*in*] [, <u>lags</u>(#)]

You must tsset your data before using wntestq; see [TS] **tsset**. Also the time series must be dense (nonmissing with no gaps in the time variable) in the specified sample.

varname may contain time-series operators; see **[U] 11.4.4 Time-series varlists**.

collect is allowed; see **[U] 11.1.10 Prefix commands**.

Option

<u>lags</u>(#) specifies the number of autocorrelations to calculate. The default is to use $\min(\lfloor n/2 \rfloor - 2, 40)$, where $\lfloor n/2 \rfloor$ is the greatest integer less than or equal to $n/2$.

Remarks and examples

Box and Pierce (1970) developed a portmanteau test of white noise that was refined by Ljung and Box (1978). See also Diggle (1990, sec. 2.5).

▷ Example 1

In the example shown in [TS] **wntestb**, we generated two time series. One (x1) was a white-noise process, and the other (x2) was a white-noise process with an embedded cosine curve. Here we compare the output of the two tests.

1

```
. drop _all

. set seed 12393

. set obs 100
Number of observations (_N) was 0, now 100.

. generate x1 = rnormal()

. generate x2 = rnormal() + cos(2*_pi*(_n-1)/10)

. generate time = _n

. tsset time
Time variable: time, 1 to 100
        Delta: 1 unit

. wntestb x1, table

Cumulative periodogram white-noise test
─────────────────────────────────────────
 Bartlett's (B) statistic  =      0.8038
 Prob > B                   =      0.5380

. wntestq x1

Portmanteau test for white noise
─────────────────────────────────────────
 Portmanteau (Q) statistic =     31.0396
 Prob > chi2(40)            =      0.8443

. wntestb x2, table

Cumulative periodogram white-noise test
─────────────────────────────────────────
 Bartlett's (B) statistic  =      2.1653
 Prob > B                   =      0.0002

. wntestq x2

Portmanteau test for white noise
─────────────────────────────────────────
 Portmanteau (Q) statistic =    225.6211
 Prob > chi2(40)            =      0.0000
```

This example shows that both tests agree. For the first process, the Bartlett and portmanteau tests result in nonsignificant test statistics: a p-value of 0.5380 for wntestb and one of 0.8443 for wntestq.

For the second process, each test has a significant result to less than 0.0005.

◁

Stored results

wntestq stores the following in r():

Scalars
   r(stat) Q statistic
   r(df)   degrees of freedom
   r(p)   probability value

Methods and formulas

The portmanteau test relies on the fact that if $x(1), \ldots, x(n)$ is a realization from a white-noise process. Then

$$Q = n(n+2) \sum_{j=1}^{m} \frac{1}{n-j} \, \hat{\rho}^2(j) \longrightarrow \chi_m^2$$

where m is the number of autocorrelations calculated (equal to the number of lags specified) and $\longrightarrow$ indicates convergence in distribution to a χ^2 distribution with m degrees of freedom. $\hat{\rho}_j$ is the estimated autocorrelation for lag j; see [TS] **corrgram** for details.

References

Box, G. E. P., and D. A. Pierce. 1970. Distribution of residual autocorrelations in autoregressive-integrated moving average time series models. *Journal of the American Statistical Association* 65: 1509–1526. https://doi.org/10.2307/2284333.

Diggle, P. J. 1990. *Time Series: A Biostatistical Introduction.* Oxford: Oxford University Press.

Ljung, G. M., and G. E. P. Box. 1978. On a measure of lack of fit in time series models. *Biometrika* 65: 297–303. https://doi.org/10.2307/2335207.

Zhu, G., Z. Du, and J. C. Escanciano. 2017. Automatic portmanteau tests with applications to market risk management. *Stata Journal* 17: 901–915.

Also see

[TS] **corrgram** — Tabulate and graph autocorrelations

[TS] **cumsp** — Graph cumulative spectral distribution

[TS] **pergram** — Periodogram

[TS] **tsset** — Declare data to be time-series data

[TS] **wntestb** — Bartlett's periodogram-based test for white noise