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Tests for Normality Table

When you specify the NORMAL option in the PROC UNIVARIATE statement, you obtain the Tests for Normality table.

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.96493	**Pr < W**	0.0006
Kolmogorov-Smirnov	**D**	0.077469	**Pr > D**	0.0230
Cramer-von Mises	**W-Sq**	0.2275	**Pr > W-Sq**	<0.0050
Anderson-Darling	**A-Sq**	1.298736	**Pr > A-Sq**	<0.0050

The table contains all three empirical distribution functions' (EDF) goodness-of-fit tests, plus the Shapiro-Wilk *W* statistic and test. The *W* statistic is the ratio of the best estimator of the variance (based on the square of a linear combination of the order statistics) to the usual corrected sum of squares estimator of the variance (Shapiro and Wilk 1965). When *n* is greater than three, the coefficients to compute the linear combination of the order statistics are approximated by the method of Royston (1992). The *W* statistic is always greater than zero and less than or equal to one ($0 < W \leq 1$). Small values of *W* lead to the rejection of the null hypothesis of normality. The distribution of *W* is highly skewed. Seemingly large values of *W* (such as 0.90) might be considered small and lead you to reject the null hypothesis. The method for computing the *p*-value (the probability of obtaining a *W* statistic less than or equal to the observed value) depends on *n*.

The Kolmogorov-Smirnov *D* statistic, the Cramér-von Mises W^2 statistic, and the Anderson-Darling A^2 statistic are based on the EDF. The EDF tests offer advantages over the traditional chi-square goodness-of-fit test, including improved power and invariance with respect to the histogram midpoints. For detailed information about the computation of each statistic, refer to the SAS online documentation. A thorough discussion about the EDF tests can be found from D'Agostino and Stephens (1986). Here are some highlights.

Kolmogorov-Smirnov D Statistic and Test

- It is the most well-known EDF statistic, but it is often less powerful than W^2 and A^2 statistics.
- It does not depend on the underlying cumulative distribution function being tested.
- It is an exact test. (The chi-square goodness-of-fit test depends on an adequate sample size for the approximations to be valid.)
- It tends to be more sensitive near the center of the distribution than at the tails.

Cramér-von Mises W^2 Statistic and Test

- It is a modification of the Kolmogorov-Smirnov (K-S) test.
- It allows a more sensitive and powerful test.

Anderson-Darling A^2 Statistic and Test

- It is a modification of the Kolmogorov-Smirnov (K-S) test. It uses the specific distribution in calculating critical values and gives more weight to the tails than does the K-S test.
- It behaves similarly to theCramér-von Mises W^2 statistic statistic. However, it is more powerful when departures from the true distribution are in the tails, especially when there appear to be too many outlying values from the data for the specified distribution.
- It is a recommended statistic when departures in the tails are important to detect.

The results of these tests should be considered in conjunction with the distribution of the variable, the histogram, and the normal probability plot to evaluate the normality.

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