A Technical Note on a Direct Estimate of the Significance of Bias in Forecasts

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Abstract

This paper provides direct test for forecast bias using the Thiel equation. In this test the constant term is simple the difference between the mean of the forecast and the mean of the actual date. A simple data transformation leads to this specification of the constant term. The approach is expanded to include a function with additional independent variables where one is interest in the constant tern being simple the difference of the means of the dependent and any one of the independent variables.

Key Words: forecast bias, test for bias

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Thiel (1966) suggested that the bias an efficiency of a forecast could be tested by the function

$$\hat{F}_t = \alpha + \beta F_t + \varepsilon_t$$

Bias is a significant difference in the means of the two series. That is, if a forecast is biased, its means will be above or below the mean of the original data and the difference would be significant at some statistical level. Inefficiency means that the forecast error systematically depends upon the level of the original variable. If the slope coefficient is greater than 1.0, it would mean that the underlying forecasting model would over estimate when the value of the original data is high, i.e., above the mean of the actual data. The model would under forecast when the actual data are beneath the mean of the actual data. The reverse holds if the slope coefficient is less than 1.0

In the Thiel test, bias (difference in the means of the two series) is captured as part of the constant term and efficiency is captured in the slope coefficient. However, the constant term is also affected by the slope coefficient; hence, for a forecast to be unbiased and efficient, it must satisfy the joint test that a=0 and B=1.

In dealing with non-technical audiences this joint test is often confusing and detracts from the importance of the basic findings. To deal with this, I have found it convenient to estimate the basic Thiel equation by subtracting the mean of the independent variable from both sides of the regression. Thus, the constant term becomes simply the difference in the means.

$$\alpha = \overline{\hat{F}_t} - \overline{F}_t - \beta(F_t - \overline{F}_t)$$

and

$$a = \overline{\hat{F}_t} - \overline{F_t}$$

Additionally, the data transformation does not affect the slope coefficient, since the transformation is simply a parallel shift of the regression line.

In this way, a joint test is no longer necessary. The magnitude and significance of bias can be directly measured by the magnitude and significance of the constant term. The level of efficiency and its significance can be directed measured by the difference between the slope coefficient and 1.0.

This basic approach can be expanded to any other problem in which there is a joint test of the constant term =0.0 and the slope coefficient =1.

More importantly, this can be expanded to any number of independent variables in which one desires to show that in which one wants to test, within the regression, if the means of the dependent variable and any one of the independent variables are equal. To see this, consider the following

$$Y_t = \alpha + \beta X_t + \lambda Z_t .$$

Suppose one wishes t test the null hypothesis that

$$\overline{Y} = \overline{X} .$$

By testing that the constant term is zero. This can be achieved by the following transformation

$$Y_t - \overline{X} = \alpha + \beta(X_t - \overline{X}) + \gamma(Z_t - \overline{Z}) .$$

In this case,

$$\alpha = \overline{Y} - \overline{X} - \beta(\overline{X} - \overline{X}) - \gamma(\overline{Z} - \overline{Z})$$
and
$$a = \overline{Y} - \overline{X}$$

Again, this transformation has no effect on the slope coefficients.

Selected Reference

Thiel, Henri, 1966. Applied Economic Forecasting. North Holland Publishing Company. Amesterdam.