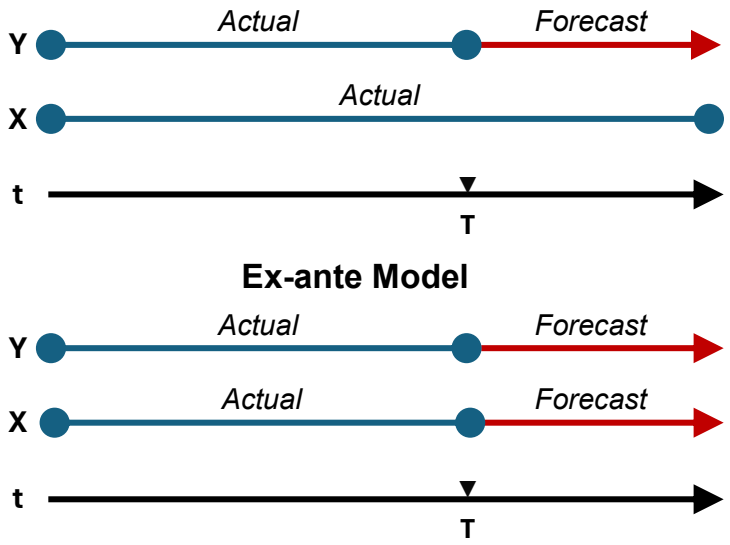
EX-POST AND EX-ANTE VALIDATION OF STATISTICAL MODELS

VALIDATION DESIGN

We evaluate model performance using a pseudo out-of-sample holdout framework. For each specification, the model is estimated using data available up to a fixed forecast origin (training window of 5–20 years). Let Y_t denote the dependent variable and X_t the vector of independent variables. The model is estimated using observations $\{Y_t, X_t\}$ for $t \le T$, and forecasts are generated for $t = T+1, \ldots, T+H$ (H = e.g., 5 years horizon in our application).

VALIDATION SCHEMATIC



Importantly, forecasts over the holdout period are constructed conditional on the realized values of the independent variables. That is, forecasts take the form $\hat{Y}$ where X_t are the actual observed values in the holdout period, rather than forecasts of X_t that would have been available at time T.

Forecast accuracy is assessed using symmetric Mean Absolute Percentage Error (MAPE) over the holdout period, using a Möbius[1,0,1,2] transformation.

INTERPRETATION

This evaluation corresponds to a conditional ex-post forecast (conditional on X being known) rather than a fully operational ex-ante forecast. As such, it measures the model's ability to map predictors X_t to outcomes Y_t assuming perfect knowledge of future X_t.

The resulting accuracy metrics therefore isolate the contribution of model specification and parameter estimation, and the structural relationship between *X* and *Y*, while avoiding errors arising from forecasting X_t themselves.

This distinction is standard in the forecasting literature, where conditional (ex-post) forecasts are used to assess the intrinsic predictive power of a model separately from upstream predictor forecasts (Hyndman & Athanasopoulos, 2021).

LIMITATIONS

Because the evaluation assumes knowledge of future X_t, reported accuracy should not be interpreted as directly representative of real-time forecasting performance. In practical applications where X_t must themselves be forecast, total forecast error will generally be larger.

To complement this, an operational ex-ante analysis should be conducted, if feasible, using only information available at time T, including forecasted independent variables X_t

SUMMARY

The conditional holdout approach provides a diagnostic of whether the model $Y_t = f(X_t)$ is well-specified. When paired with ex-ante validation, it enables decomposition of forecast error into model error (structure/fit) and input error (forecast error in X_t). This dual evaluation framework is widely used in empirical forecasting applications, including settings where forecasts are conditioned on realized predictors (Ferraro, Rogoff, and Rossi, 2015).

REFERENCES

Tashman, L.J. (2000*). Out-of-Sample Tests of Forecasting Accuracy: An Analysis and Review*. International Journal of Forecasting.

Ferraro, D., K. Rogoff, and B. Rossi (2015). *Can Oil Prices Forecast Exchange Rates?* NBER Working Paper.

Hynman, R.J., & G. Athanasopoulos (2021). Forecasting: Principles and Practice (3rd ed.).