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Impulse saturation break tests ☆

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Abstract

We develop a new class of tests for breaks at unknown dates based on impulse saturation. Theoretical Power is derived for mean and variance shifts. Empirical power is close to theory results. The test performs well in both cases.
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JEL classification: C12; C15; C22; C52

1. Introduction

Impulse saturation (see Hendry et al., 2007) is a key major development in model selection. The authors have established that a general-to-specific strategy is feasible to select from a set of T candidate indicator variables, one for each observation. Such an initial model cannot be estimated from the outset, so subset selection is used (where the subsets are sample partitions either in halves, thirds, etc.), followed by searches across the union of the terminal models. For a split of $T/2$, this entails saturating half the sample and storing the significant indicators, and then examining the other half. Under the null hypothesis that no indicator matters, the impulse saturation procedure is shown to have the correct null

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rejection frequencies (NRFs) precluding overfitting, independently of the number of splits used for the subsets. For individual tests conducted on each indicator at a significance level α, the average retention rate is αT, matching exactly the binomial result and showing low costs of search for low α (see Hendry, 2000). The asymptotic distribution of the post-selection estimators of the mean and variance, in a location-scale model with IID errors is derived, and extensive Monte Carlo evidence confirms the theoretical results.

In this paper, we show that when there are breaks in the location-scale model (either in the mean or in the variance), impulse saturation has good power to detect them. What under the null was described as a model selection problem (Hendry et al., 2007), under the alternative may be thought of as a test for breaks at unknown dates. From a practitioner's point of view, the ability to detect breaks with such an easy to implement procedure would be the most appealing side of impulse saturation. Castle (2005) provides a first example of this.

This paper is organized as follows: in Section 2 we derive theoretical power for a break (either in the mean or in the variance) in one side of the sample split only. We assume the break occurs for the last rT observations in the sample, $0<r<1$. Section 3 presents extensive Monte Carlo evidence on empirical power of the suggested test. Section 4 concludes.

2. Dummy saturation under the alternative

Consider the existence of a break in the location-scale DGP. This might be a break in the mean or a break in the variance (although not both simultaneously). In the next two subsections, we will derive the theoretical power of the impulse saturation procedure under both these alternatives.

2.1. Changes in the mean of z_t

We consider the DGP:

$$z_{\mathrm{t}} \sim IN[\delta_{\mathrm{t}}, \sigma_{\mathrm{zz}}] \tag{1}$$

where

$$\delta_{\mathrm{t}} = \left\{ \begin{array}{l} 0 \Leftarrow t < T_1 \\ d \Leftarrow t \geq T_1 \end{array} \right\}$$

$\sigma_{\mathrm{zz}} \in R_{+}$, $d \neq 0$.

The 'power' to retain each dummy in the model, given in its simplest form by:

$$z_{\mathrm{t}} = \sum_{i \varepsilon S\alpha} \hat{\rho}_{\mathrm{i},(\alpha)} \, 1_{\{t=t_{\mathrm{i}}\}} + \upsilon^{*}_{\mathrm{z,t}} \tag{2}$$

where S_α is the set of retained dummies, when the process is Eq. (3), namely:

$$z_{\mathrm{t}} = \delta_{\mathrm{t}} 1_{\{t \geq T_1\}} + \upsilon_{\mathrm{z,t}} \tag{3}$$

depends on the probability of rejecting the null for the associated estimated coefficient in Eq. (2):

$$\widehat{\rho}_{\mathrm{i},(\alpha)} = \delta_{\mathrm{t}} + \upsilon_{\mathrm{z},t_{\mathrm{i}}}$$

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