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**Weak Consistent Moving Block Bootstrap Estimator for the Variance of CLS Estimators in a Class of Bilinear Models**

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Abstract

Grahn (1995) introduced the Conditional Least Squares estimators for the class (I) of bilinear models. These estimators have a variance which is difficult to derive analytically. In this paper we derive the conditions for the Moving Block Bootstrap estimator of the variance and we show its weak consistency.
1 Introduction

The framework of non-linear time series models offers many statistics of interest for which is difficult to derive sample distributions and variance estimators. In these cases the use of a general methodology such as Bootstrap is often recommended.

We focus our attention on a class (I) of bilinear models introduced by Grahn (1995). The stochastic process \( \{X_t, t \in \mathbb{N}\} \), belonging to the class (I), is defined as:

\[
X_t = \sum_{i=1}^{p} a_i X_{t-i} + \sum_{i=1}^{q} c_i \varepsilon_{t-i} + \sum_{i=1}^{k} \sum_{j=w}^{r} b_{ij} \varepsilon_{t-i} X_{t-j} + \varepsilon_t \tag{1}
\]

where \( w = \max(k, q) + 1 \) and \( \varepsilon_t \) is i.i.d. White Noise with zero mean and variance \( \sigma^2 > 0 \). Without loss of generality, we can assume that \( \{\varepsilon_t\} \) is Normally distributed. Suppose that the parameters in model (1) are not all equal to zero.

Grahn (1995) introduced the Conditional Least Squares (CLS) estimators for the parameters of (1) whereas the variance of the CLS estimators is not known yet.

In this paper we propose to use the Moving Block Bootstrap (MBB) (Kunsch, 1989) to estimate the variance of the CLS estimators when they are strongly consistent and converge weakly to the Normal distribution (Grahn, 1995). The latter happens under mild conditions. In particular we analyze two problems: the first is concerned with the weak consistency of MBB distribution for CLS estimators; the second problem is related to the MBB variance estimator.

In section 2, we introduce the notations, definitions, assumptions and properties of CLS estimators. Other definitions for MBB estimators and some results for CLS estimators are reported in section 3. In section 4 we show a useful representation of a MBB CLS estimator which leads to the main result about the weak consistency for a MBB estimator of sampling distribution and variance of CLS estimators. Finally, we report a simulation experiment in section 5.
2 Definitions and properties of the Moving Block Bootstrap and CLS estimators

In this section we introduce briefly the MBB procedure and we report the main results about the CLS estimators of the parameters in model (1). It is known that \(\{X_t\}\), in model (1), is a strictly stationary, causal and ergodic process under some conditions on the coefficients \(\{a_i\}, i = 1, \ldots, p\), and \(\{b_{ij}\}, i = 1, \ldots, k, j = w, \ldots, r\). Notice that the MA component does not affect these properties. (Grahn, 1995); (Tong, 1990).

We assume that

A1) the process \(\{X_t\}\) is driven by a Normal White Noise innovation sequence \(\{\varepsilon_t\}\) such that \(\rho(\Gamma_8) < 1\), where the matrix \(\Gamma_8\) is defined in Grahn (1995) and \(\rho(\cdot)\) is the maximum eigenvalue of \(\Gamma_8\).

A2) the matrix \(C_{p,w'\cdot-1} := \{c(w' - 1 + i - j)\}\) is invertible, with \(1 \leq i, j \leq p, c(k) := \text{Cov}(X_{t}, X_{t+k})\) and \(w' := \max(q + 1, k)\).

A3) The MA component of the bilinear model (1), defined by the MA coefficients \(c_1, \ldots, c_q\), is invertible.

\(T_n := T_n(X_1, \ldots, X_n)\) is a CLS estimator for a parameter of model (1), where \(n\) is the length of the observed time series. The aim of the present paper is to estimate the variance of \(T_n\) via MBB.

We consider the MBB procedure with blocks of length \(l\) from the original data. This parameter \(l\) is related to the dependence structure of the observed data. From each bootstrap replication \(X_1^*, \ldots, X_n^*\), we have \(T_n^* := T_n(X_1^*, \ldots, X_n^*)\), the bootstrap statistic. Instead, the bootstrap variance is \(\text{Var}^*(T_n^*)\), where \(\text{Var}^*\) denotes the variance of \(T_n^*\) conditional on \(X_1, \ldots, X_n\) (Kunsch, 1989).

If (A1) holds then \(E(X_8^*) < \infty\) and the following results are valid for CLS estimators (Grahn, 1995):

B1) \(T_n \overset{a.s.}{\rightarrow} T\), with \(T\) a parameter in model (1);

B2) \(n^{1/2}(T_n - T) \overset{d}{\rightarrow} N(0, V^2)\) with \(V^2\) the variance of the limit distribution.
3 Preliminary results

In this section we introduce some preliminary results. By Grahn (1995) we can write any CLS estimators in model (1) as follows:

\[ T_n = f(\hat{M}_4) + o_p\left(n^{-1/2}\right), \tag{2} \]

with \(M_4 := \{(M_4)_i\}, \) and \(\hat{M}_4 := \{(\hat{M}_4)_i\}, i = 1, \ldots, \nu;\) where \((M_4)_i\) and \((\hat{M}_4)_i\) denote generic mixed moments of order up to 4. The first is the true moment, the second is its sample analog.

In other words, \((M_4)_i\) can be considered the theoretical moment of a product \(X_tX_{t+k_1}X_{t+k_2}X_{t+k_3}, \) with \(0 \leq k_{1i} \leq k_{2i} \leq k_{3i}.\)

The function \(f(\cdot)\) has \(\nu\) continuous first partial derivatives in a neighborhood of \(M_4.\)

Let \(\nu\) be the number of moments in vectors \(\hat{M}_4\) and \(M_4.\) The dimension \(\nu\) depends on the CLS estimator \(T_n.\)

Let us denote \(A(\cdot) := \{f'(\cdot)\}, i = 1, \ldots, \nu,\) that is the column vector of the first partial derivatives of the function \(f(\cdot).\)

Let \(\Sigma_{M_4}\) be the true variance-covariance matrix for \(n^{1/2}\hat{M}_4.\) \(\Sigma_{M_4}\) is a positive-definite matrix by Proposition (4.3) in Grahn (1995).

**Lemma 1** Let \(\{X_t\} \) be the process defined in (1) and let (A1), (A2) and (A3) hold, then the variance of the limit distribution of \(n^{1/2}(\hat{T}_n - T),\) is

\[ V^2 = A'(\hat{M}_4)\Sigma_{M_4}A(M_4). \]

**Proof.**

By (2) and condition (A1) the variance of \(n^{1/2}\left(f(\hat{M}_4) - f(M_4)\right)\) converges to \(V^2\) which is also the variance of the limit distribution of \(n^{1/2}(\hat{T}_n - T).\)

By Taylor’s expansion we have:

\[ f(\hat{M}_4) = f(M_4) + A'(\hat{M}_4)(\hat{M}_4 - M_4) + R_n. \]

There exists a random vector \(\tilde{z}\) in a neighborhood of \(\hat{M}_4\) such that \(\|\tilde{z} - \hat{M}_4\| \leq \|\hat{M}_4 - M_4\|.\) Hence \(f(\hat{M}_4) = f(M_4) + A'(\tilde{z})(\hat{M}_4 - M_4),\)

where \(\|\cdot\|\) is the Euclidean norm.

Since all sample moments in \(\hat{M}_4\) converge in \(L^2\) norm to its corresponding component in \(M_4\) (Theorem 3.1 in Grahn (1995)), then \(\hat{M}_4 \xrightarrow{p} M_4\) and
\[ \hat{z} \overset{p}{\rightarrow} M_4. \] The remainder term, \( R_n \), can be written as
\[ \sqrt{n}R_n = \sqrt{n} \left( (A' (\hat{z}) - A' (M_4)) \left( M_4 - \hat{M}_4 \right) \right). \]

By Theorem 3.1 in Grahn (1995), \( \sqrt{n} \left( \hat{M}_4 - M_4 \right) \) converges in law to a Multivariate Normal distribution with asymptotic variance-covariance matrix \( \Sigma M_4 \). The latter has full rank because of condition (C2) of Proposition (4.3) in Grahn (1995). By continuity, it follows that \( A' (\hat{z}) \overset{p}{\rightarrow} A' (M_4) \). So we can conclude that \( \sqrt{n}R_n \overset{p}{\rightarrow} 0 \) by Slutsky’s theorem.

Hence \( n^{1/2} \left[ f (\hat{M}_4) - f (M_4) \right] \) has the same limit distribution as \( W_n := n^{1/2} A' (M_4) \left( \hat{M}_4 - M_4 \right) \). The latter completes the proof.

This lemma gives the functional form of the asymptotic variance for the CLS estimators, \( T_n \). More precisely, it is a linear combination of variances and covariances of some sample mixed moments.

Now we introduce the MBB estimates of the parameters in model (1). Given a bootstrap replication \( X_1^*, \ldots, X_n^* \) we can define the following quantities in bootstrap version. Let \( \hat{a}^*_i \), with \( i = 1, \ldots, p \), be the MBB estimators of parameters \( a_i \). Let \( a := \{ a_i \} \), \( i = 1, \ldots, p \).

Let \( \hat{Q}^*_n (\hat{\beta}^*_s) := \sum_{t \geq 0} \left[ \hat{v}^*_t \hat{v}^*_t - \hat{E}_{\hat{\beta}^*_s} \left( v^*_t v^*_t | t - w \right) \right]^2 \),

where \( \hat{E}_{\hat{\beta}^*_s} \left( v^*_t v^*_t | t - w \right) := L \left( \hat{\beta}^*_s ; 1, X^*_t, X^*_t X^*_t \right) \);
\( \hat{v}^*_t := X^*_t - \hat{a}^*_1 X^*_t - \ldots - \hat{a}^*_p X^*_t \); with \( L(\cdot;\ldots) \) the linear combination of its arguments as reported by (2.2) in Grahn (1995), \( s \geq 0 \) is an integer.

Finally, we define the vector \( \hat{\beta}^*_s \) such that \( \nabla \hat{Q}^*_n (\hat{\beta}^*_s) = 0 \), with \( \nabla \) the first order derivatives.

Any CLS estimator \( T_n \) and its bootstrap version, \( T^*_n \) can be written as a linear transform of the components in the vectors \( \{ \hat{a}, \hat{\beta}_s \} \) and \( \{ \hat{a}^*, \hat{\beta}^*_s \} \), respectively (Grahn, 1995). Such a linear transform depends on the right estimators of parameters \( \{ c_i \} \), \( i = 1, \ldots, q \) in model (1).

We use the following symbols to denote the bootstrap convergence. If \( Y^*_n = o_p^* (n^{-1/2}) \), it means that \( P^* (n^{1/2} | Y^*_n | > \epsilon) := P \left( n^{1/2} | Y^*_n | > \epsilon | Y_1, \ldots, Y_n \right) \rightarrow 0 \) in probability when \( n \rightarrow \infty \), \( \forall \epsilon > 0 \).
Let $CA^*(m)$ denote the bootstrap version of the $CA(m)$ condition reported in Grahn (1995). Now we define the $CA^*(m)$ condition for the pair $(\theta, \hat{\theta}^*)$, where $\theta$ is an unknown parameter and $\hat{\theta}^*$ is its bootstrap estimator. $CA^*(m)$ is defined as:

i) the same as the $CA(m)$, part (i).

ii) $\left|\hat{\theta}^* - f\left(\hat{M}_m^*\right)\right| = o_p(n^{-1/2})$, where $\hat{M}_m^*$ is the vector of the corresponding bootstrap estimates of the theoretical moments $M_m$.

4 Weak consistency

The first step is to prove a suitable representation of a MBB CLS estimator, $T_n^*$.

**Lemma 2** Let $T_n^*$ be a MBB CLS estimator, let assumptions (A1)-(A3) hold, $E|X_t|^{8+\delta} < \infty$ with $\delta > 0$ and the block length $l$ is such that $l \to \infty$, $\frac{l}{n} \to 0$ for $n \to \infty$, then $T_n^* - f\left(\hat{M}_m^*\right) = o_p(n^{-1/2})$

**Proof.**

To prove this lemma it is sufficient to show that the pair $\{\theta, \hat{\theta}^*\}$ fulfills the $CA^*(2)$ condition and the pair $\{\beta_s, \hat{\beta}_s^*\}$ fulfills the $CA^*(4)$ condition. Along the same line of Proposition 4.2 in Grahn (1995) it is easy to verify that the pair $\{\theta, \hat{\theta}^*\}$ fulfills the $CA^*(2)$ condition. By assumptions the process $X_t$ is geometrically $\alpha$-mixing (Doukhan, 1994). The sample vector $\hat{M}_4$ is defined by mixed moments of $X_t$ up to order 4. Let $\hat{M}_4$ and $\hat{M}_4^*$ be a generic sample moment of order 4 and its bootstrap version, respectively.

By theorem 3.1 in Lahiri (2003), $n \text{Var}^*\left(\hat{M}_4^*\right) \xrightarrow{P} \sigma^2_{\hat{M}_4}$, where $\sigma^2_{\hat{M}_4}$ is a generic component of the matrix $\Sigma_{\hat{M}_4}$.

As in Proposition (4.3) in Grahn (1995) we have that

$$0 = \nabla \hat{Q}_n^*\left(\hat{\beta}_a^*\right) = \nabla \hat{Q}_n^*\left(\beta_a\right) + \left(\hat{\beta}_a^* - \beta_a\right)' \nabla^2 \hat{Q}_n^*\left(\beta_a\right)$$

(3)

because of the linearity of $\nabla \hat{Q}_n^*\left(\cdot\right)$. Let $\nabla^2$ denote the second order derivatives.

Now we have to show that
(I) $\frac{1}{n} \nabla \hat{Q}_n^* \left( \beta_s \right) = o_p^*(1)$.

(II) $\frac{1}{n} \nabla^2 \hat{Q}_n^* \left( \beta_s \right) - \Sigma_{M_4} = o_p^*(1)$

(III) the pair $\left( 0, \frac{1}{n} \nabla \hat{Q}_n^* \left( \beta_s \right) \right)$ fulfills $CA^*(4)$.

Condition (III) implies the condition (I). Now by the linearity of $\nabla \hat{Q}_n^* (\cdot)$, Proposition (4.3) in Grahn (1995) and theorem 3.1 in Lahiri (2003) it follows that conditions (II) and (III) hold.

By conditions (I) and (II) $\hat{\beta}_s^* - \beta_s = o_p^*(1)$. By expression (3) and condition (II) we can write

$$\Sigma_{M_4}^{-1} \nabla \hat{Q}_n^* \left( \beta_s \right) = \left( \hat{\beta}_s^* - \beta_s \right)' \left( 1 + o_p^*(1) \right).$$

Using condition (III) and theorem 3.2 in Lahiri (2003) we have that $\left( \hat{\beta}_s^* - \beta_s \right)'^T o_p^*(n^{-1/2})$.

Finally, using again condition (III), there exists a continuously differentiable function $f(\cdot)$ which satisfies $CA^*(4)$ condition for the estimator $\hat{\beta}_s^*$ and the result follows.

Remark 1 This lemma gives a useful representation of a MBB CLS estimator in term of a function of a finite set of mixed moments of $X_t^*$.

Remark 2 By condition (III) in lemma 2, the function $f(\cdot)$ is a linear transform of elements in the vector $\frac{1}{n} \nabla \hat{Q}_n^* (\cdot)$.

Theorem 1 Let $T_n^*$ be a MBB CLS estimator, let (A1)-(A3) hold, $E |X_t|^{8+\delta} < \infty$ with $\delta > 0$ and the block length $l$ is such that $l \to \infty$, $\frac{1}{n} \to 0$ for $n \to \infty$, then

$$\sup_{x \in \mathbb{R}} P^{*} \left( n^{1/2} \left( T_n^* - \tilde{T}_n \right) \leq x \right) - P \left( n^{1/2} \left( T_n - T \right) \leq x \right) \to 0,$$

where $\tilde{T}_n := f \left( E^{*} \left( \tilde{M}_4^* \right) \right) + o_p^* (n^{-1/2})$.

Proof.

By lemma 2 $n^{1/2} \left( T_n^* - \tilde{T}_n \right)$ and $n^{1/2} \left( f \left( \tilde{M}_4^* \right) - f \left( E^* \left( \tilde{M}_4^* \right) \right) \right)$ have the same limit distribution in probability.

Using the first term Taylor’s expansion of $f \left( \tilde{M}_4^* \right)$ around $M_4$ we can write

$$f \left( \tilde{M}_4^* \right) = f \left( \tilde{M}_4 \right) + A' \left( \tilde{M}_4 \right) \left( \tilde{M}_4^* - \tilde{M}_4 \right) + R_{1n}^t,$$

where the row vector

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\[ A'(M_4) \] contains the first partial derivatives of \( f(\cdot) \) evaluated at \( M_4 \) and \( R_{1n}^* \) is the remainder term.

As before we can write \( f\left( E^* \left( \hat{M}_4 \right) \right) \) based on the first term Taylor’s expansion around \( M_4 \), that is \( f\left( E^* \left( \hat{M}_4 \right) \right) = f(M_4) + A'(M_4) \left( E^* \left( \hat{M}_4 \right) - M_4 \right) + R_{1n}^*, \) with \( R_{1n}^* \), the remainder term.

Now we can show that all the first partial derivatives must not be equal to zero at \( M_4 \). By proposition 4.3 in Grahn (1995) if all the partial derivatives are equal to zero at \( M_4 \) then the parameters of model (1) must be zero.

This is impossible otherwise the bilinear model in (1) would disappear.

Now, we show that \( n^{1/2}R_{1n}^* = o_p(1) \) and \( n^{1/2}R_{2n}^* = o_p(1) \).

In a suitable neighborhood of \( M_4 \), we can choose a \( \hat{z}_1^* \) such that \( \| \hat{z}_1^* - M_4 \| \leq \left\| \hat{M}_4 - M_4 \right\| \) and we can write \( n^{1/2}R_{1n}^* = n^{1/2} \left( A'(\hat{z}_1^*) - A'(M_4) \right) \left( \hat{M}_4 - M_4 \right) \),

where \( \|\cdot\| \) is the Euclidean norm.

Again, there exists another suitable neighborhood of \( M_4 \) in which we can choose a \( \hat{z}_2^* \) such that \( \| \hat{z}_2^* - M_4 \| \leq \left\| E^* \left( \hat{M}_4 \right) - M_4 \right\| \) and we can write \( n^{1/2}R_{2n}^* = n^{1/2} \left( A'(\hat{z}_2^*) - A'(M_4) \right) \left( E^* \left( \hat{M}_4 \right) - M_4 \right) \).

By Assumptions \( n^{1/2} \left( \hat{M}_4 - E^* \left( \hat{M}_4 \right) \right) \) converges to a Multivariate Normal distribution in probability by theorem (3.2) in Lahiri (2003).

By theorem (3.1) in Lahiri (2003) \( n\text{Var}^* \left( \hat{M}_4 \right) \xrightarrow{P} \Sigma_{\hat{M}_4} \) and \( nE \left\| E^* \left( \hat{M}_4 \right) - M_4 \right\|^2 = O(1/n) \). Using theorem (3.1) in Grahn (1995) and theorem (3.1) in Lahiri (2003) we have that \( \left\| \hat{M}_4 - M_4 \right\| = o_p(1) \) and also \( \left\| E^* \left( \hat{M}_4 \right) - M_4 \right\| = o_p(1) \).

Then \( \| \hat{z}_1^* - M_4 \| = o_p(1) \) and \( \| \hat{z}_2^* - M_4 \| = o_p(1) \).

The row vector \( A'(\cdot) \) is a vector of continuous functions so \( P^* \left( \left\| A'(\hat{z}_1^*) - A'(\hat{M}_4) \right\| > \epsilon \right) \xrightarrow{P} 0 \), \( \forall \epsilon > 0 \). Applying the Conditional Slutsky Theorem, as in Lahiri (2003), we have that \( P^* \left( n^{1/2} |R_{1n}^*| > \epsilon \right) \xrightarrow{P} 0 \).

Using the same technique we can show that \( P^* \left( n^{1/2} |R_{2n}^*| > \epsilon \right) \xrightarrow{P} 0 \).

Then the limit distribution of \( n^{1/2} \left( f\left( \hat{M}_4 \right) - f\left( E^* \left( \hat{M}_4 \right) \right) \right) \) is the same.
as \( n^{1/2} \left( A' \left( \hat{M}_4 \right) \left( \hat{M}_4^* - E^* \left( \hat{M}_4^* \right) \right) \right) \).

Using again theorem (3.2) in Lahiri (2003) we have that 
\( P^* \left( n^{1/2} \left( A' \left( \hat{M}_4 \right) \left( \hat{M}_4^* - E^* \left( \hat{M}_4^* \right) \right) \right) \leq x \) converges in probability to a Normal distribution with zero mean and variance \( V^2 \) which is the same limit distribution as \( P \left( n^{1/2} (T_n^* - T) \leq x \right) \). This convergence result holds uniformly with respect to \( x \in \mathbb{R} \) since the continuity of the Normal distribution. This proves the theorem.

The previous theorem gives the conditions for the weak consistency of the MBB estimator of the sampling distribution for CLS estimators with respect to the sup norm. Moreover, this theorem gives a type of linearization of MBB CLS estimator \( T_n^* \) which is \( W_n^* := n^{1/2} A' \left( \hat{M}_4 \right) \left( \hat{M}_4^* - E^* \left( \hat{M}_4^* \right) \right) \), and we can use the following statistic \( \hat{W}_n^* := n^{1/2} \left( A' \left( \hat{M}_4 \right) \left( \hat{M}_4^* - E^* \left( \hat{M}_4^* \right) \right) \right) \) which has the same limit distribution as \( n^{1/2} \left( T_n^* - \hat{T}_n \right) \).

This statistic is also important to write a sequence to approximate the variance of limit distribution, \( V^2 \).

In fact \( \hat{V}_n^2 := \text{Var}^* \left( \hat{W}_n^* \right) = n \text{Var}^* \left( A' \left( \hat{M}_4 \right) \left( \hat{M}_4^* - E^* \left( \hat{M}_4^* \right) \right) \right) = A' \left( \hat{M}_4 \right) n \text{Var}^* \left( \hat{M}_4^* \right) A \left( \hat{M}_4 \right) \).

By theorem (3.1) in Lahiri (2003) and lemma 1 we have that \( \hat{V}_n^2 \xrightarrow{p} V^2 \).

5 Empirical results

In this section we report a Monte Carlo simulation experiment to verify the consistency of the estimator for \( V^2 \) using the Moving Block Bootstrap. We consider the estimator \( \hat{W}_n^* \) and its MBB variance estimator \( \hat{V}_n^2 \).

We take into account the simplest representation of model (1) as 
\[ X_t = b \varepsilon_{t-1} X_{t-2} + \varepsilon_t. \]
with $\varepsilon_t \sim N(0, \sigma^2)$, i.i.d.
If we fix $\sigma^2 = 1$ and $b = 0.3$ in model (4), all the conditions of theorem 1 are satisfied. The CLS estimator of parameter $b$ in model (4) is $\hat{b} = f\left(M_4\right)$ where $M_4 = \left(M_3, M_2\right)$, $M_3 = 1/n \sum_t X_t X_{t-1} X_{t-2}$ and $M_2 = 1/n \sum_t X_t^2$. Let us denote with $\hat{M}_4^*$ the same vector for bootstrap estimators. In order to apply the MBB variance estimator, $\tilde{V}_n^2$, we compute the block length, $l$, using the procedure of Bühlmann and Kunsch (1999). We consider 1000 Monte Carlo runs, 500 bootstrap replicates and two time series lengths, i.e. 500 and 1000. The true value $V^2$ is computed over 10000 Monte Carlo runs. Let $V_E = \sqrt{E\left(\left(\tilde{V}_n^2 - V^2\right)^2\right)}$, $V_V = \left[V\text{ar}\left(\left(\tilde{V}_n^2 - V^2\right)^2\right)\right]^{1/4}$, the mean and variance are taken over all Monte Carlo iterations. The quantity $\tilde{V}_n^2$ is derived for each Monte Carlo run.

In table 1 we note that $V_E$ and $V_V$ decrease as the sample size increases.

<table>
<thead>
<tr>
<th>$n$</th>
<th>$V_E$ (Mean)</th>
<th>$V_V$ (Variance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>3.72</td>
<td>10.31</td>
</tr>
<tr>
<td>1000</td>
<td>2.91</td>
<td>6.40</td>
</tr>
</tbody>
</table>

$V_E$ can be considered the Root Mean Square Error for $\tilde{V}_n^2$. Since $\tilde{V}_n^2$ is a random variable which is multiplied by $n$ then the quantities $V_E$ and $V_V$ must be read in the same way.

References


WORKING PAPERS DEL DIPARTIMENTO

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