

Asymptotic theory of least squares estimator of a particular nonlinear regression model

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Abstract: The consistency and asymptotic normality of the least squares estimator are derived for a particular non-linear regression model, which does not satisfy the standard sufficient conditions of Jennrich (1969) or Wu (1981), under the assumption of normal errors.

Keywords: Consistency; least squares estimator; non-linear regression.

1. Introduction

The least squares method plays an important role in drawing inferences about the parameters in the non-linear regression model. Jennrich (1969) first rigorously proved the existence of the least squares estimator and showed its consistency of the following non-linear model:

$$y_t = f_t(\theta_0) + \varepsilon_t, \quad t = 1, 2, \dots \quad (1.1)$$

Jennrich proved the strong consistency of the least squares estimator $\hat{\theta}_n$ under the following assumption: $F_n(\theta_1, \theta_2)$ converges uniformly to a continuous function $F(\theta_1, \theta_2)$ for all θ_1 and θ_2 and $F(\theta_1, \theta_2) = 0$ if and only if $\theta_1 = \theta_2$, where

$$F_n(\theta_1, \theta_2) = \frac{1}{n} \sum_{t=1}^n (f_t(\theta_1) - f_t(\theta_2))^2. \quad (1.2)$$

Under some stronger assumptions, asymptotic normality was proved in the same paper. Wu (1981) gave some sufficient conditions under which the least squares estimator converges to θ_0 almost surely, when the growth rate requirement of F_n is replaced by a Lipschitz type condition on the sequence f_t .

We consider the non-linear regression model

$$y_t = \cos(2\pi t\theta_0) + \varepsilon_t, \quad t = 1, 2, \dots, \quad (1.3)$$

where $\{\varepsilon_t\}$ are i.i.d. normal random variables with mean zero and finite positive variance σ^2 . θ_0 is an

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Table of Contents Problems Of The Asymptotic Theory Of Non

1. Understanding the eBook Problems Of The Asymptotic Theory Of Non
 - The Rise of Digital Reading Problems Of The Asymptotic Theory Of Non
 - Advantages of eBooks Over Traditional Books
2. Identifying Problems Of The Asymptotic Theory Of Non
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Problems Of The Asymptotic Theory Of Non
 - User-Friendly Interface
4. Exploring eBook Recommendations from Problems Of The Asymptotic Theory Of Non
 - Personalized Recommendations
 - Problems Of The Asymptotic Theory Of Non User Reviews and Ratings
 - Problems Of The Asymptotic Theory Of Non and Bestseller Lists
5. Accessing Problems Of The Asymptotic Theory Of Non Free and Paid eBooks
 - Problems Of The Asymptotic Theory Of Non Public Domain eBooks
 - Problems Of The Asymptotic Theory Of Non eBook Subscription Services
 - Problems Of The Asymptotic Theory Of Non Budget-Friendly Options
6. Navigating Problems Of The Asymptotic Theory Of Non eBook Formats
 - ePub, PDF, MOBI, and More
 - Problems Of The Asymptotic Theory Of Non Compatibility with Devices
 - Problems Of The Asymptotic Theory Of Non Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Problems Of The Asymptotic Theory Of Non
 - Highlighting and Note-Taking Problems Of The Asymptotic Theory Of Non
 - Interactive Elements Problems Of The Asymptotic Theory Of Non
8. Staying Engaged with Problems Of The Asymptotic Theory Of Non

- Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Problems Of The Asymptotic Theory Of Non
9. Balancing eBooks and Physical Books Problems Of The Asymptotic Theory Of Non
- Benefits of a Digital Library
 - Creating a Diverse Reading Collection Problems Of The Asymptotic Theory Of Non
10. Overcoming Reading Challenges
- Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Problems Of The Asymptotic Theory Of Non
- Setting Reading Goals Problems Of The Asymptotic Theory Of Non
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Problems Of The Asymptotic Theory Of Non
- Fact-Checking eBook Content of Problems Of The Asymptotic Theory Of Non
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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