Tests for white noise

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Introduction

- After fitting a model, one needs to verify different aspects of the assumption. This is done by both graphical tools and statistical tests. A good statistical model is one that at least the residuals from the fitting, behave like a white noise process. So it is important to develop formal procedures for testing whether a series is white noise or not. For this we have some simple and powerful nonparametric tests.

Assumptions

- Time series $\{x_t\}$ is stationary.
- $g(\omega)$ be its spectral density.

- $\{x_t\}$ will be white noise iff its spectral density is constant. We need to test the hypothesis
- H_o : $g(\omega)=\sigma^2/2\pi$ H_1 : $g(\omega)\neq\sigma^2/2\pi$

- One important thing is that the observed significance level depends on sample size.

Fisher's Test

- Fisher's test is based on the fact that under H_o the max. of spectral density and its average should be same. Based on available data, Fisher's test statistic is

$$T_{n,F} = \frac{max_{1 \leq k \leq n} I(W_k)}{n^{-1} \sum_{k=1}^{n} I(W_k)}$$

We will reject null hypothesis when test statistic is too large.

Generalized Likelihood test

$$Y_k = m(\omega_k) + Z_k + R_k \quad \text{where } k = 1,2,3,\ldots,n$$

The basic idea of generalized likelihood ratio test statistic is to find a suitable estimate for m(ω) in the given eq. Under both hypothesis.
The generalized likelihood ratio statistic is

$$\lambda n = \log L(H_1) - \log L(H_0)$$
$$= \sum_{k=1}^{n} \{\exp(Y_k - m_0) - \exp(Y_k - m_{lk}(\hat{\omega}_k)) + m_o - m_{lk}(\omega_k)\}$$

Adaptive Neyman Test

- Neyman test is adaptively optimal test in the sense that it achieves adaptively the optimal rate of convergence for non parametric hypothesis testing with unknown degree of smoothness.
- Adaptive Neyman test statistic is as follows:

$$T_{AN*} = \frac{\max_{1 \le m \le aT} T_m - m}{\sqrt{2m}}$$

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THANKS FOR ATTENTION