时间序列分析
Time Series Analysis

Lecture 1

Instructor

Yundong Tu (涂云东)

Research Fellow/
Associate Professor

Department of Business Statistics and Econometrics

Guanghua School of Management
And
Center for Statistical Science

Peking University

- Research areas: Time series analysis; Non/semi-parametric methods; Model averaging; Financial econometrics, Network data; Air pollution.
- Research publications in: *Journal of Econometrics; Journal of Business and Economic Statistics; Computational Statistics and Data Analysis; Econometric Reviews; Statistica Sinica; Economics Letters*.
- Phone : 010-62760219
- Email : yundong.tu@gsm.pku.edu.cn
- Office: Room475, GSM #2
- Office hour : by appointment

Course Info

- Course Unit: 3
- Time: 18:40-21:30, Wednesday
- Location: R217, GSM #2
- Teaching Assistant:

林颖倩 1601211783@pku.edu.cn

王雅琼 1701110966@pku.edu.cn

Course Objective

The course aims to help you understand

- the characteristics of time series data
- the features of various building blocks of time series models
- how to model time series data in practice
- how to forecast future

Why this course?

- Time series data are **commonly observed/recorded** in Macroeconomics, Finance and related fields in Social Science.
- Time series data often present **serial dependence** across time and this dependence is often useful for understanding the underlying structure, program evaluation, forecasting and decision making.
- Time series models are not only designed for modelling time series data, but also important **building blocks** in the modeling process for other types of data.
- Time series models are also important in the development in theoretical macroeconomics and finance theory.

To Prof. Tiao

George C. Tiao (刁锦寰)

W. Allen Wallis Professor
of Econometrics and Statistics
(Emeritus)
Graduate School of Business
University of Chicago

To Prof. Yao

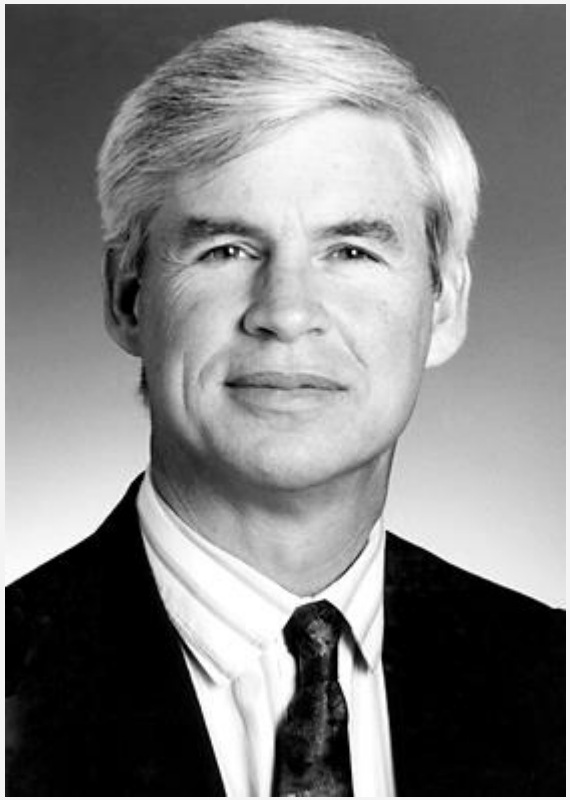
Qiwei Yao(姚琦伟)

Professor of Statistics

Department of Statistics

The London School of Economics and Political Science

Nobel Prizes in Economics (2003)



Robert F. Engle III, 1942-

"for methods of analyzing economic time series with time-varying volatility (ARCH)"

Clive W.J. Granger, 1934-2009

"for methods of analyzing economic time series with common trends (cointegration)"

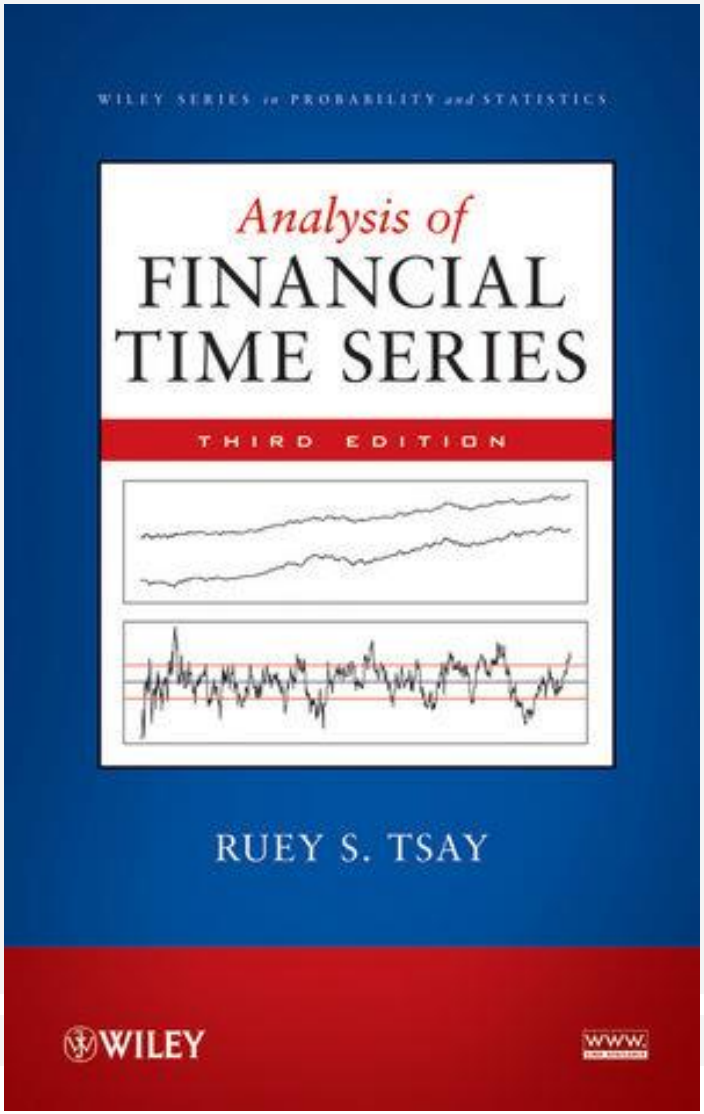
Course Grade

- Homework 20%
- Midterm Exam 40%
- Final Project 40%
  (Three in a Group)

Important Dates

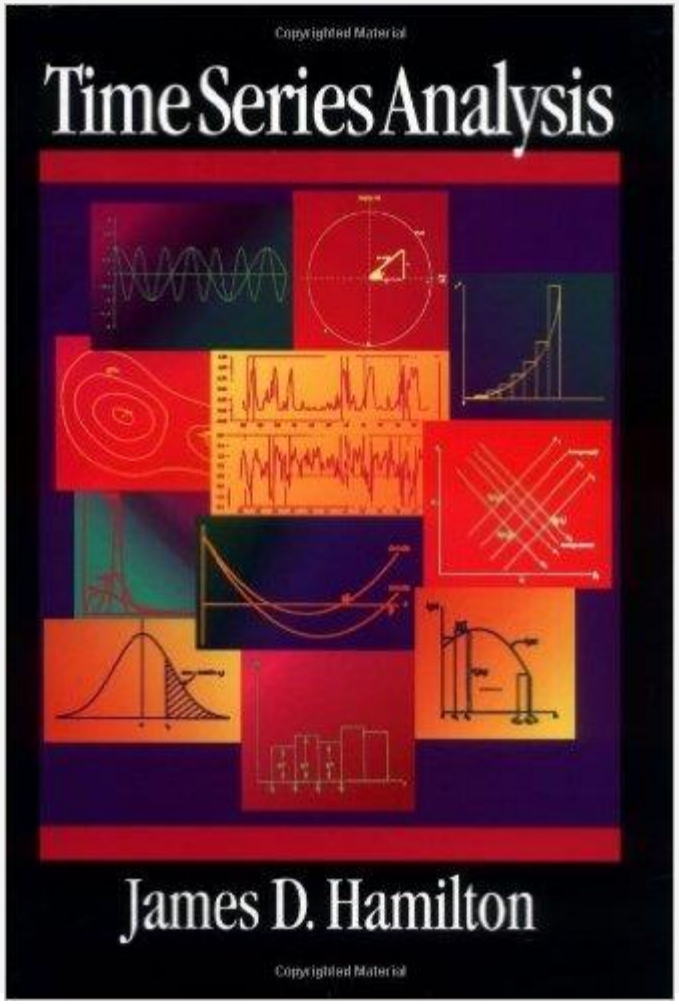
- Homework: deadlines shall be noted in each assignment.
- Midterm: Apr 18th, 2018, in class
- Project proposal: May 9th, 2018
- Presentation: Jun 6/13th, 2018
- Project report: Jun 20th, 2017

Text Recommended



- Ruey S. Tsay (2010)
- *Analysis of Financial Time Series (3rd Edition)*
- John Wiley &Sons

Text Recommended



- James D. Hamilton (1994)
- *Time Series Analysis*
- Princeton University Press
- Chapter 3,4,5,10,11,15-22

Text Recommended

- Fumio Hayashi (2000)
- *Econometrics*
- Princeton University Press
- Chapter 2,6,9,10

Software Required : R

http://www.r-project.org/

[Home]

Download

CRAN

R Project

About R
Logo
Contributors
What's New?
Reporting Bugs
Development Site
Conferences
Search

R Foundation

Foundation
Board
Members
Donors
Donate

Help With R

Getting Help

Documentation

Manuals
FAQs
The R Journal
Books
Certification
Other

Links

Bioconductor
Related Projects

The R Project for Statistical Computing

Getting Started

R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. To **download R**, please choose your preferred CRAN mirror.

If you have questions about R like how to download and install the software, or what the license terms are, please read our answers to frequently asked questions before you send an email.

News

- **R version 3.3.3 (Another Canoe) prerelease versions** will appear starting Friday 2017-02-24. Final release is scheduled for Monday 2017-03-06.
- **useR! 2017** (July 4 - 7 in Brussels) has opened registration and more at http://user2017.brussels/
- Tomas Kalibera has joined the R core team.
- The R Foundation welcomes five new ordinary members: Jennifer Bryan, Dianne Cook, Julie Josse, Tomas Kalibera, and Balasubramanian Narasimhan.
- **R version 3.3.2 (Sincere Pumpkin Patch)** has been released on Monday 2016-10-31.
- **The R Journal Volume 8/1** is available.
- The **useR! 2017** conference will take place in Brussels, July 4 - 7, 2017.
- **R version 3.3.1 (Bug in Your Hair)** has been released on Tuesday 2016-06-21.
- **R version 3.2.5 (Very, Very Secure Dishes)** has been released on 2016-04-14. This is a rebadging of the quick-fix release 3.2.4-revised.
- **Notice XQuartz users (Mac OS X)** A security issue has been detected with the Sparkle update mechanism used by XQuartz. Avoid updating over insecure channels.
- The **R Logo** is available for download in high-resolution PNG or SVG formats.
- **useR! 2016**, hase taken place at Stanford University, CA, USA, June 27 - June 30, 2016.
- **The R Journal Volume 7/2** is available.
- **R version 3.2.3 (Wooden Christmas-Tree)** has been released on 2015-12-10.
- **R version 3.1.3 (Smooth Sidewalk)** has been released on 2015-03-09.

China

https://mirrors.tuna.tsinghua.edu.cn/CRAN/	TUNA Team, Tsinghua University
http://mirrors.tuna.tsinghua.edu.cn/CRAN/	TUNA Team, Tsinghua University
https://mirrors.ustc.edu.cn/CRAN/	University of Science and Technology of China
http://mirrors.ustc.edu.cn/CRAN/	University of Science and Technology of China
http://mirrors.xmu.edu.cn/CRAN/	Xiamen University

The Comprehensive R Archive Network

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- Download R for Linux
- Download R for (Mac) OS X
- Download R for Windows

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

R for Windows

Subdirectories:

base	Binaries for base distribution (managed by Duncan Murdoch). This is what you want to **install R for the first time**.
contrib	Binaries of contributed CRAN packages (for R >= 2.11.x; managed by Uwe Ligges). There is also information on third party software available for CRAN Windows services and corresponding environment and make variables.
old contrib	Binaries of contributed CRAN packages for outdated versions of R (for R < 2.11.x; managed by Uwe Ligges).
Rtools	Tools to build R and R packages (managed by Duncan Murdoch). This is what you want to build your own packages on Windows, or to build R itself.

Please do not submit binaries to CRAN. Package developers might want to contact Duncan Murdoch or Uwe Ligges directly in case of questions / suggestions related to Windows binaries.

You may also want to read the R FAQ and R for Windows FAQ.

Note: CRAN does some checks on these binaries for viruses, but cannot give guarantees. Use the normal precautions with downloaded executables.

R-3.3.1 for Windows (32/64 bit)

Download R 3.3.1 for Windows (70 megabytes, 32/64 bit)

Installation and other instructions

New features in this version

If you want to double-check that the package you have downloaded exactly matches the package distributed by R, you can compare the md5sum of the .exe to the true fingerprint. You will need a version of md5sum for windows: both graphical and command line versions are available.

Frequently asked questions

- Does R run under my version of Windows?
- How do I update packages in my previous version of R?
- Should I run 32-bit or 64-bit R?

Please see the R FAQ for general information about R and the R Windows FAQ for Windows-specific information.

Other builds

- Patches to this release are incorporated in the r-patched snapshot build.
- A build of the development version (which will eventually become the next major release of R) is available in the r-devel snapshot build.
- Previous releases

Note to webmasters: A stable link which will redirect to the current Windows binary release is <CRAN MIRROR>/bin/windows/base/release.htm.

Last change: 2016-06-21, by Duncan Murdoch

The R Manuals

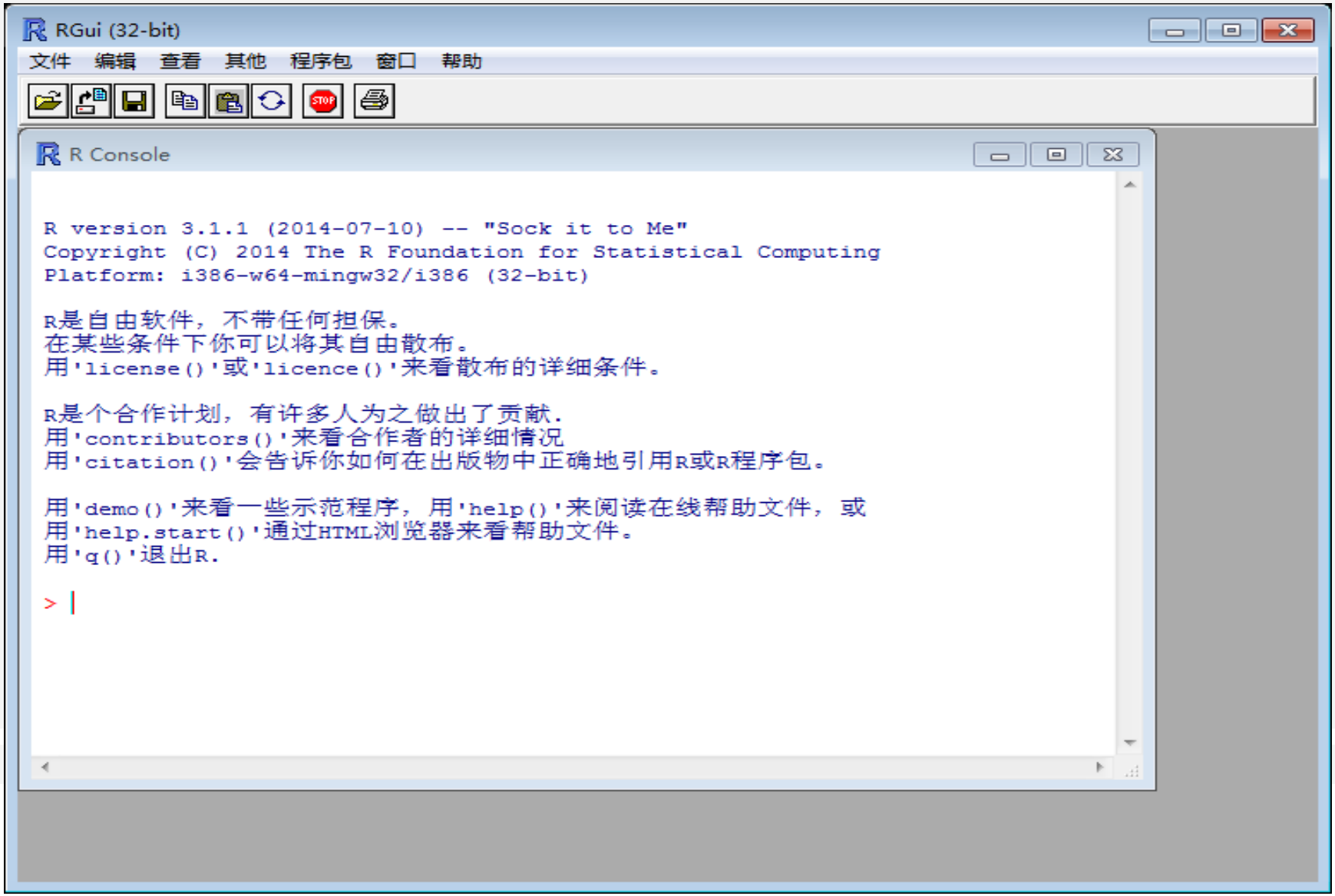
edited by the R Development Core Team.

The following manuals for R were created on Debian Linux and may differ from the manuals for Mac or Windows on platform-specific pages, but most parts will be i
manuals change with R, hence we provide versions for the most recent released R version (R-release), a very current version for the patched release version (R-patche

Here they can be downloaded as PDF files, EPUB files, or directly browsed as HTML:

Manual	R-release	R-patched	R-devel
An Introduction to R is based on the former "Notes on R", gives an introduction to the language and how to use R for doing statistical analysis and graphics.	HTML | PDF | EPUB	HTML | PDF | EPUB	HTML | PDF | EPUB

R Console


RGui (32-bit)
文件 编辑 查看 其他 程序包 窗口 帮助
R Console
R version 3.1.1 (2014-07-10) -- "Sock it to Me"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: i386-w64-mingw32/i386 (32-bit)
R是自由软件，不带任何担保。
在某些条件下你可以将其自由散布。
用'license()'或'licence()'来看散布的详细条件。
R是个合作计划，有许多人为之做出了贡献.
用'contributors()'来看合作者的详细情况
用'citation()'会告诉你如何在出版物中正确地引用R或R程序包。
用'demo()'来看一些示范程序，用'help()'来阅读在线帮助文件，或
用'help.start()'通过HTML浏览器来看帮助文件。
用'q()'退出R.
>

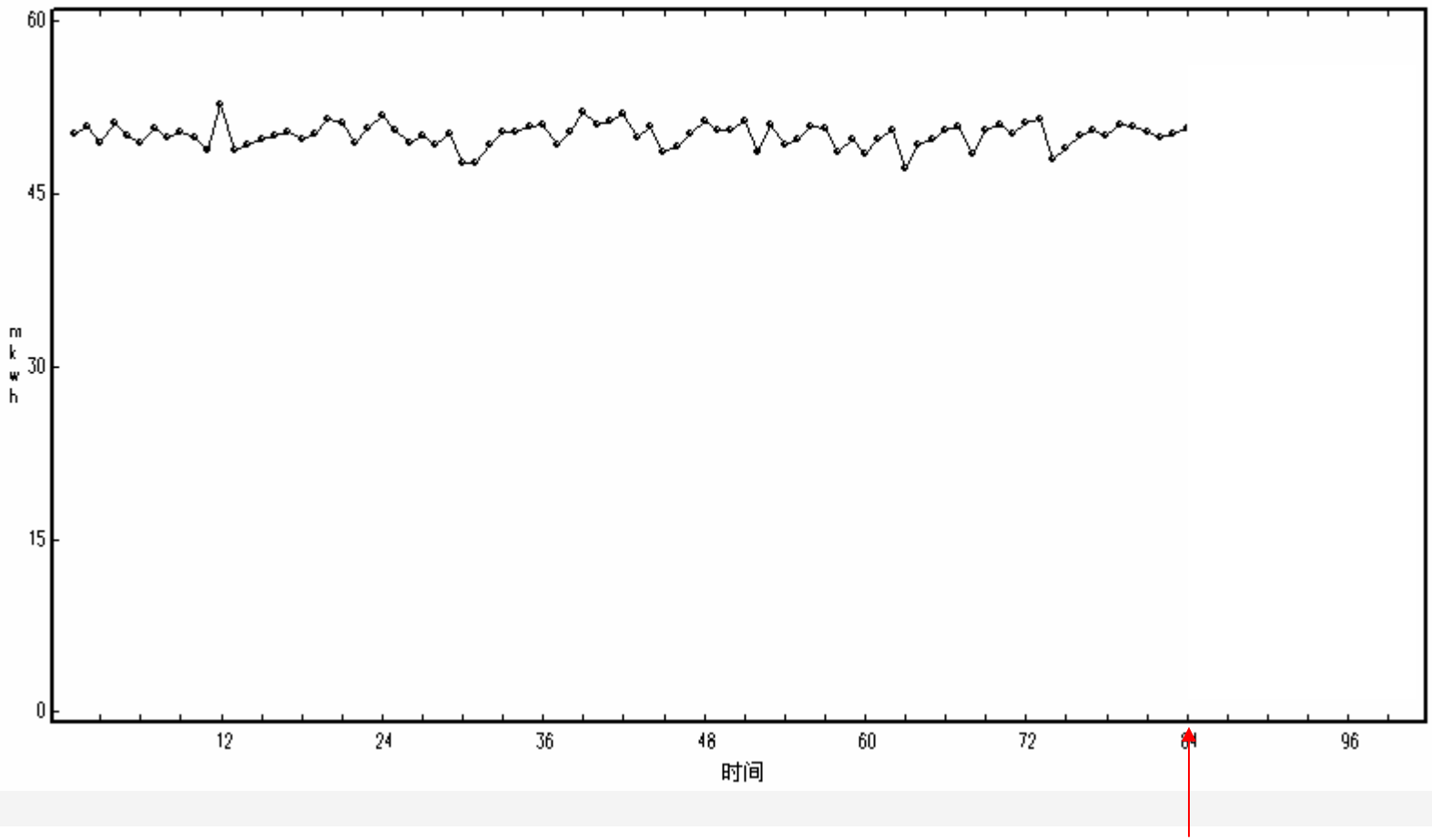
Course Requirement

- Pre-requisite
  - Mathematical Statistics
  - Regression
- After-class
  - At least 6 hours weekly study on course related materials

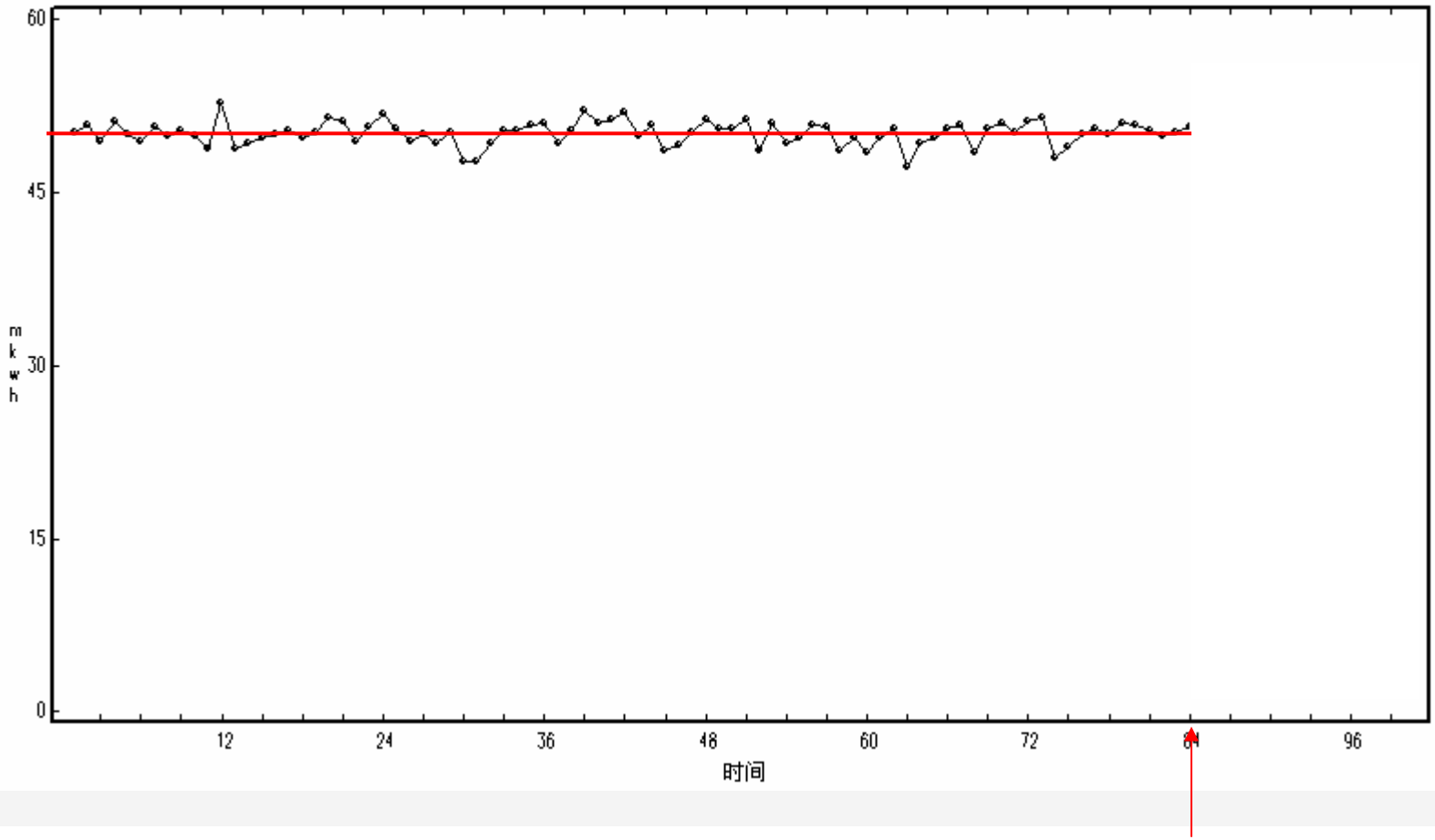
电力公司市场需求预测

- 预测时间长度
  - 短期 (周)
  - 中期 (季)
  - 长期 (年)
- 怎么预测？
  - 从过去的数据中获取信息！

电力公司市场需求预测



电力公司市场需求预测



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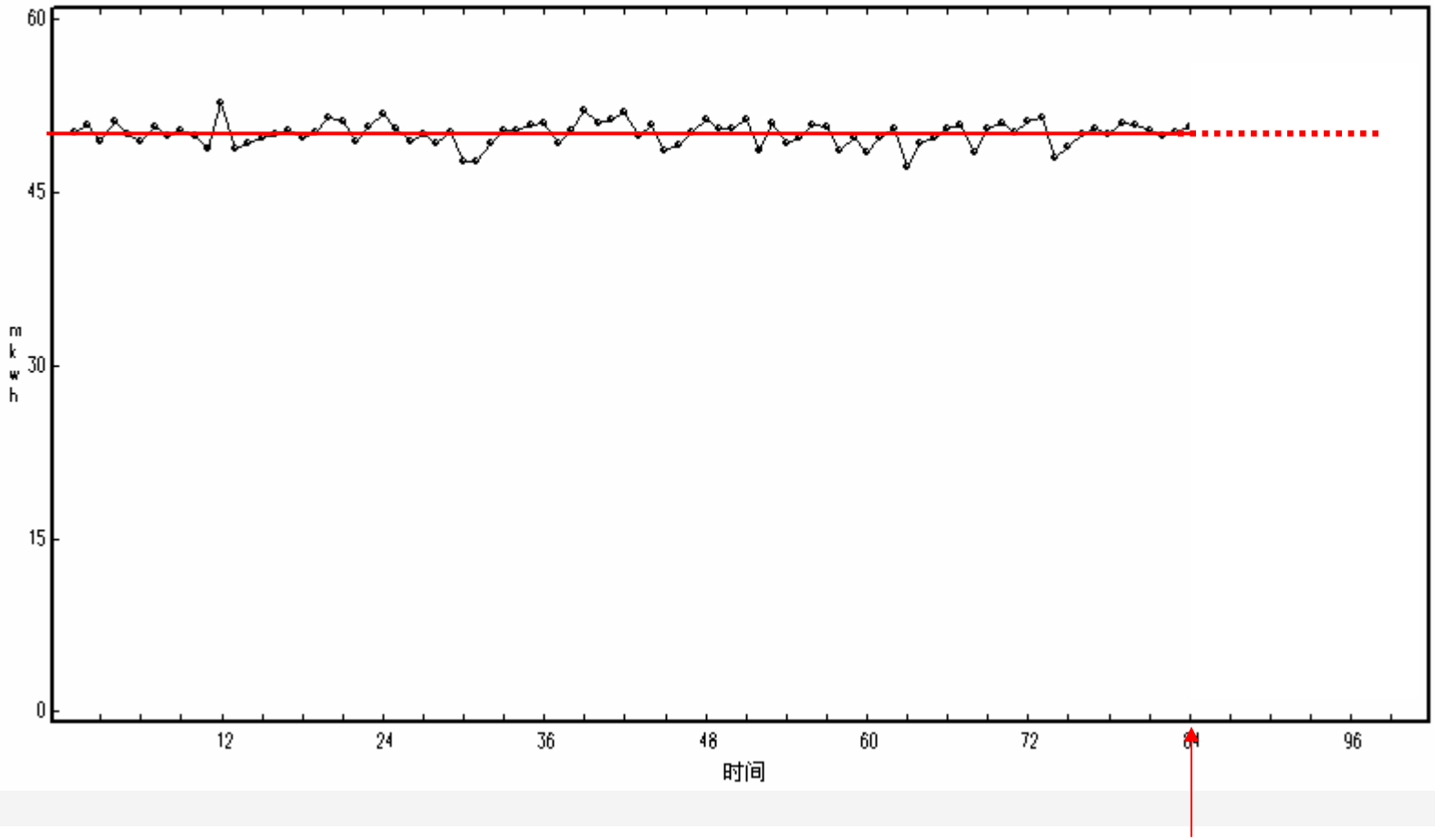

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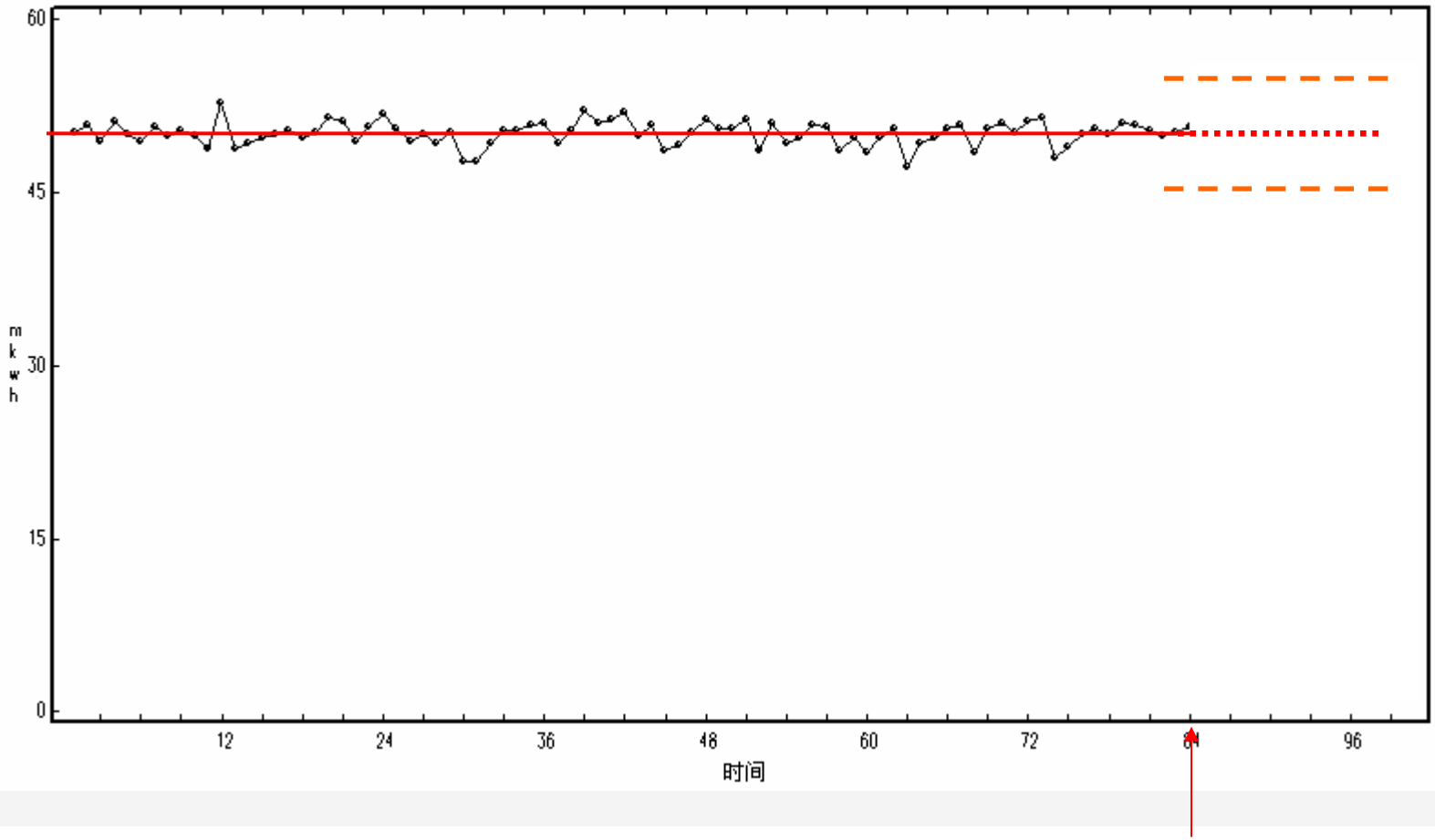
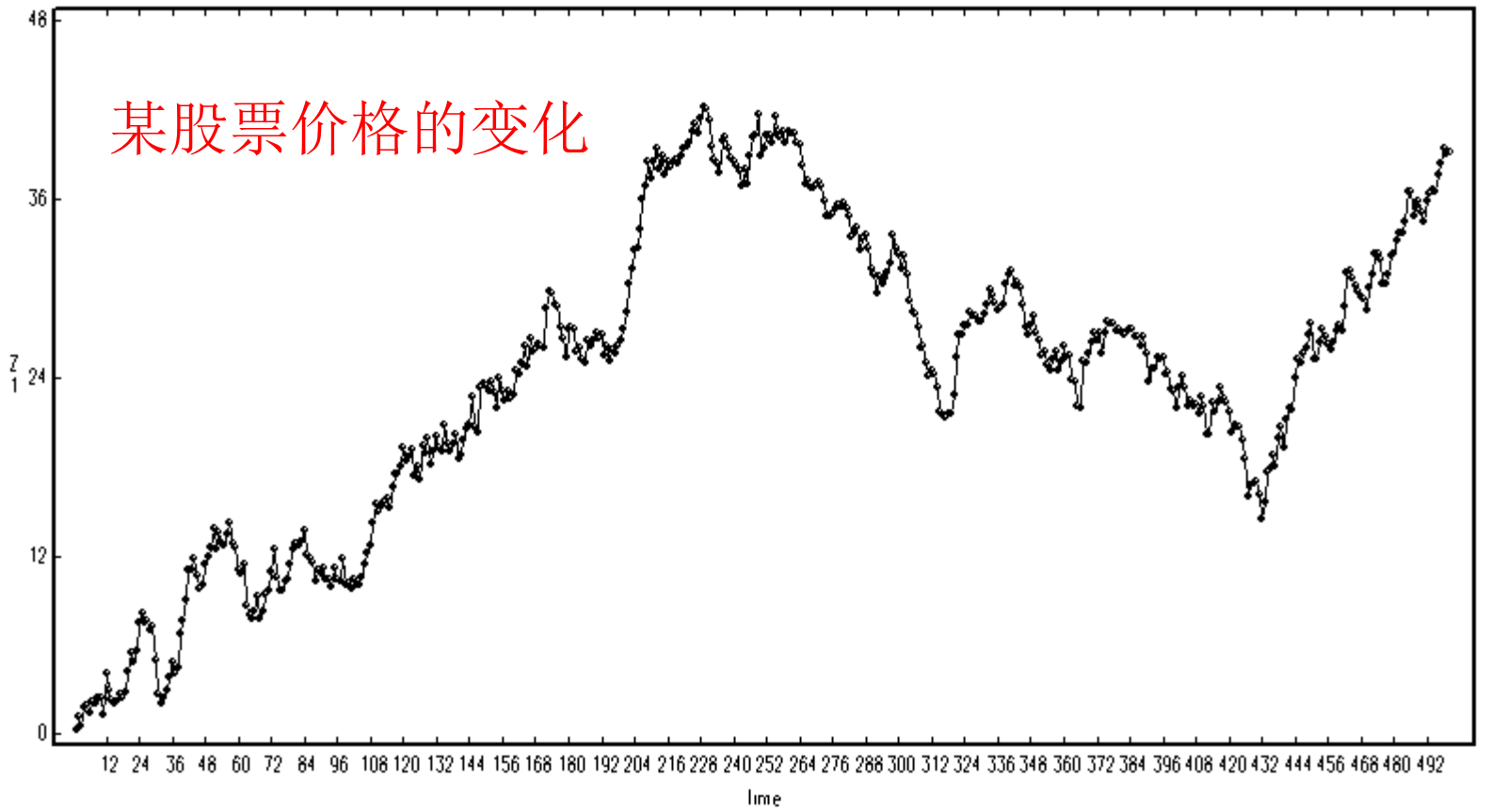
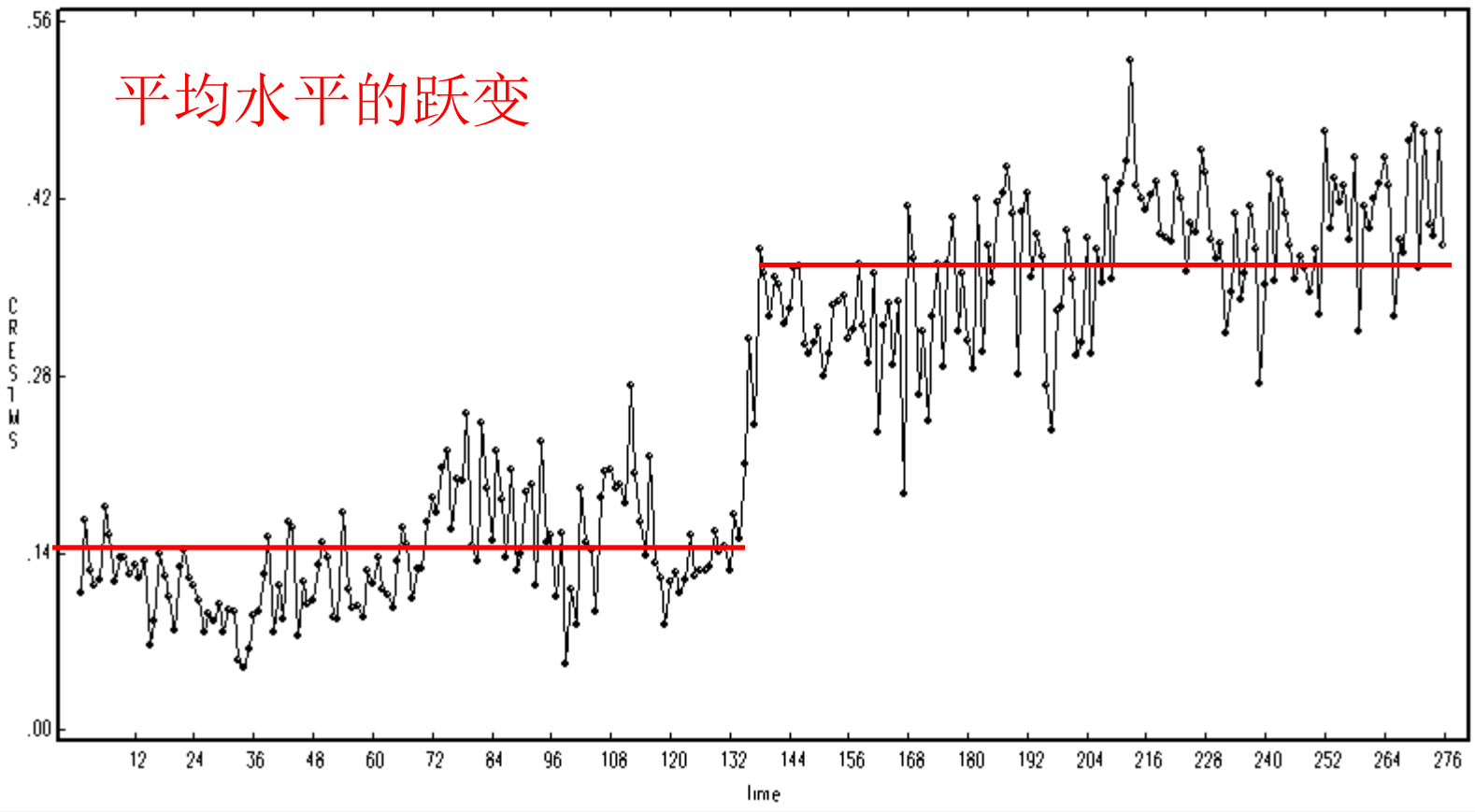


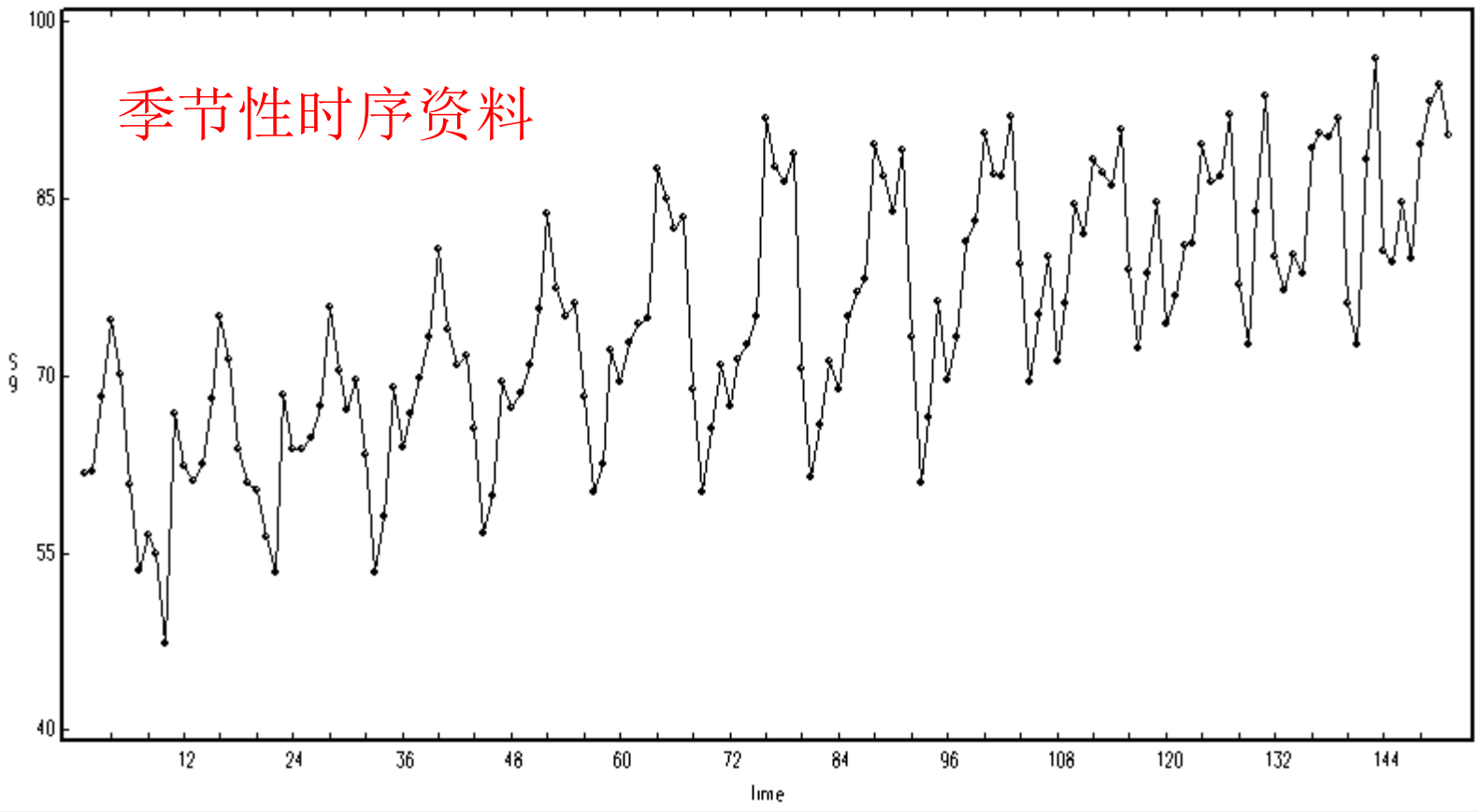
other patterns - 1



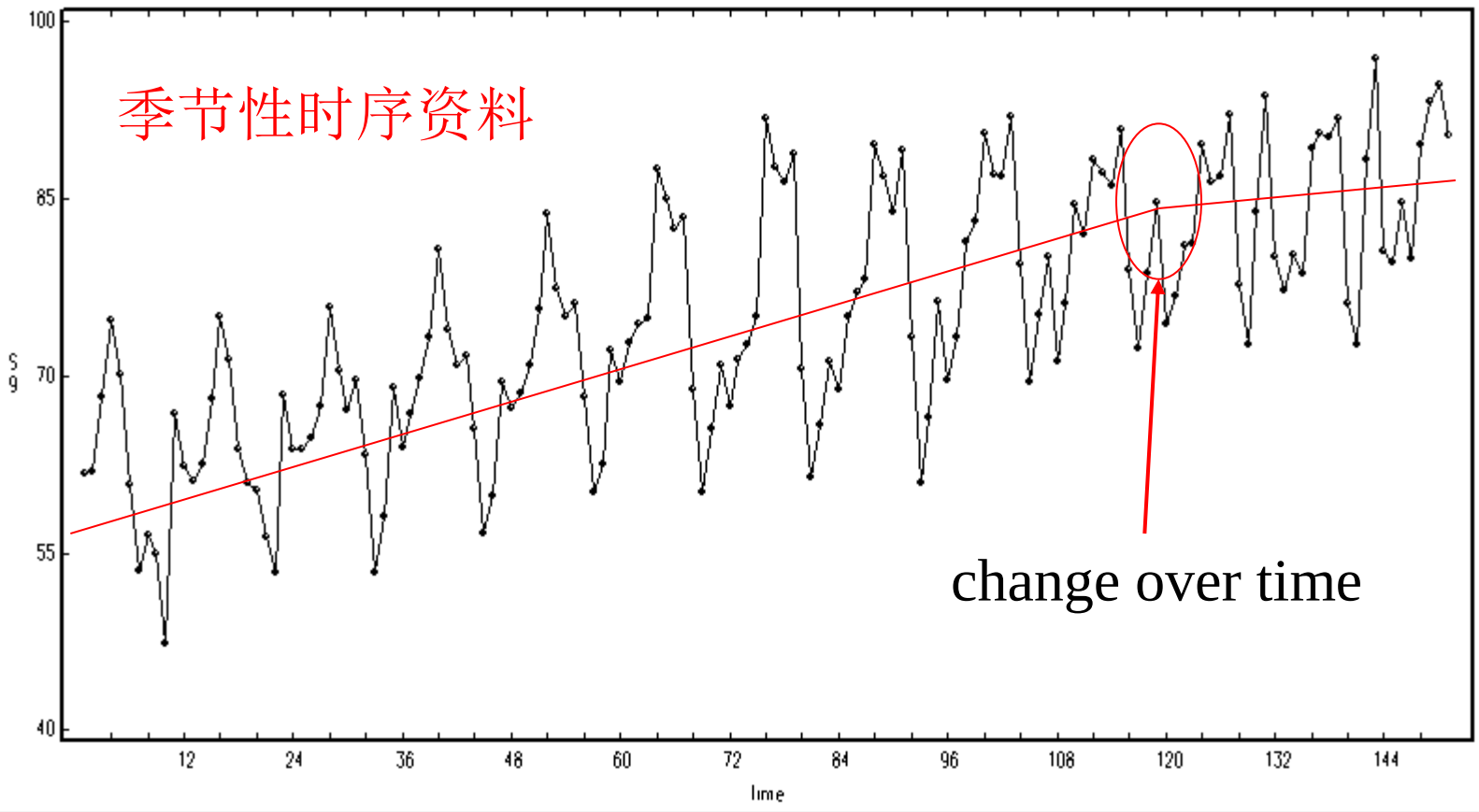
other patterns – 2



other patterns – 3



other patterns – 3



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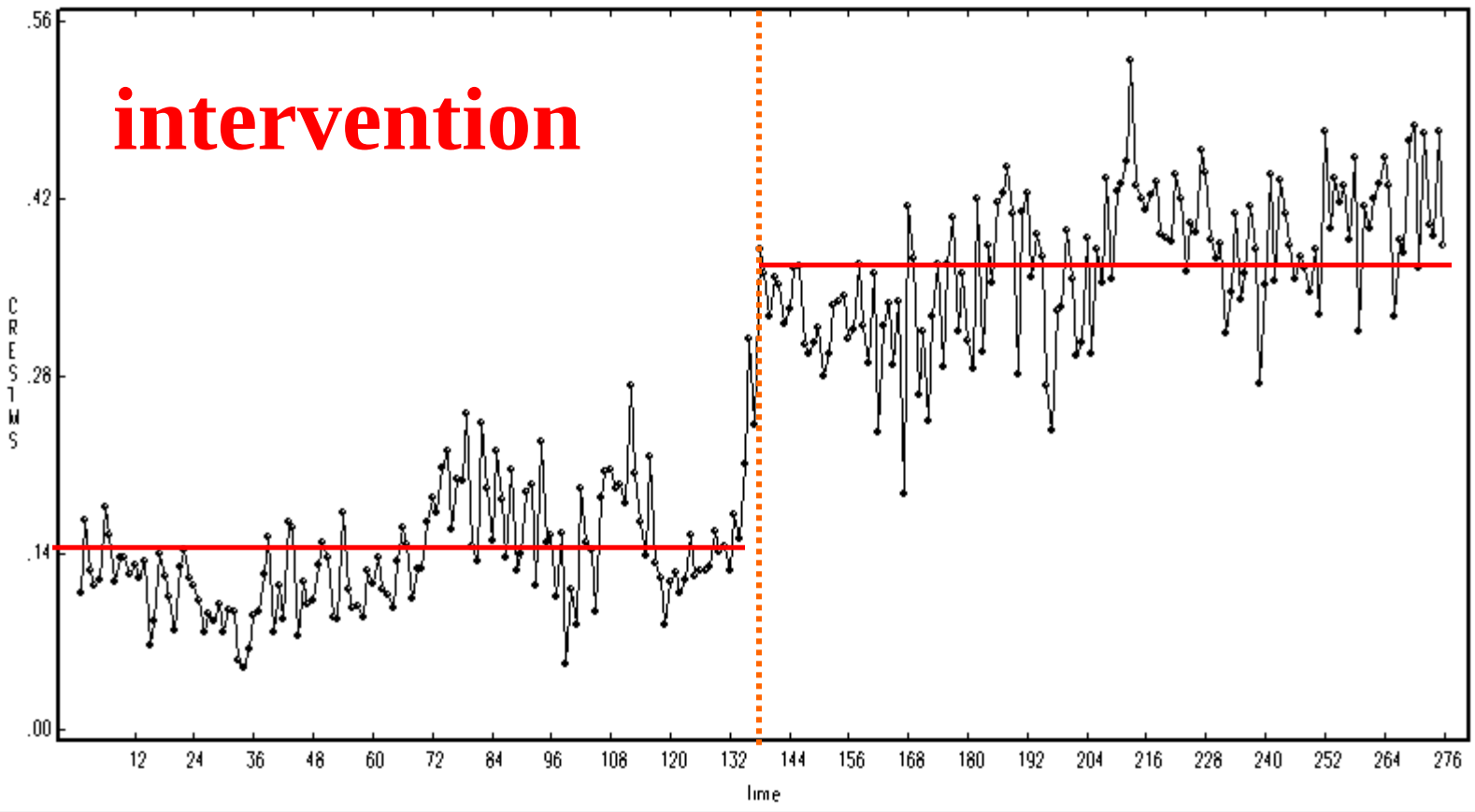
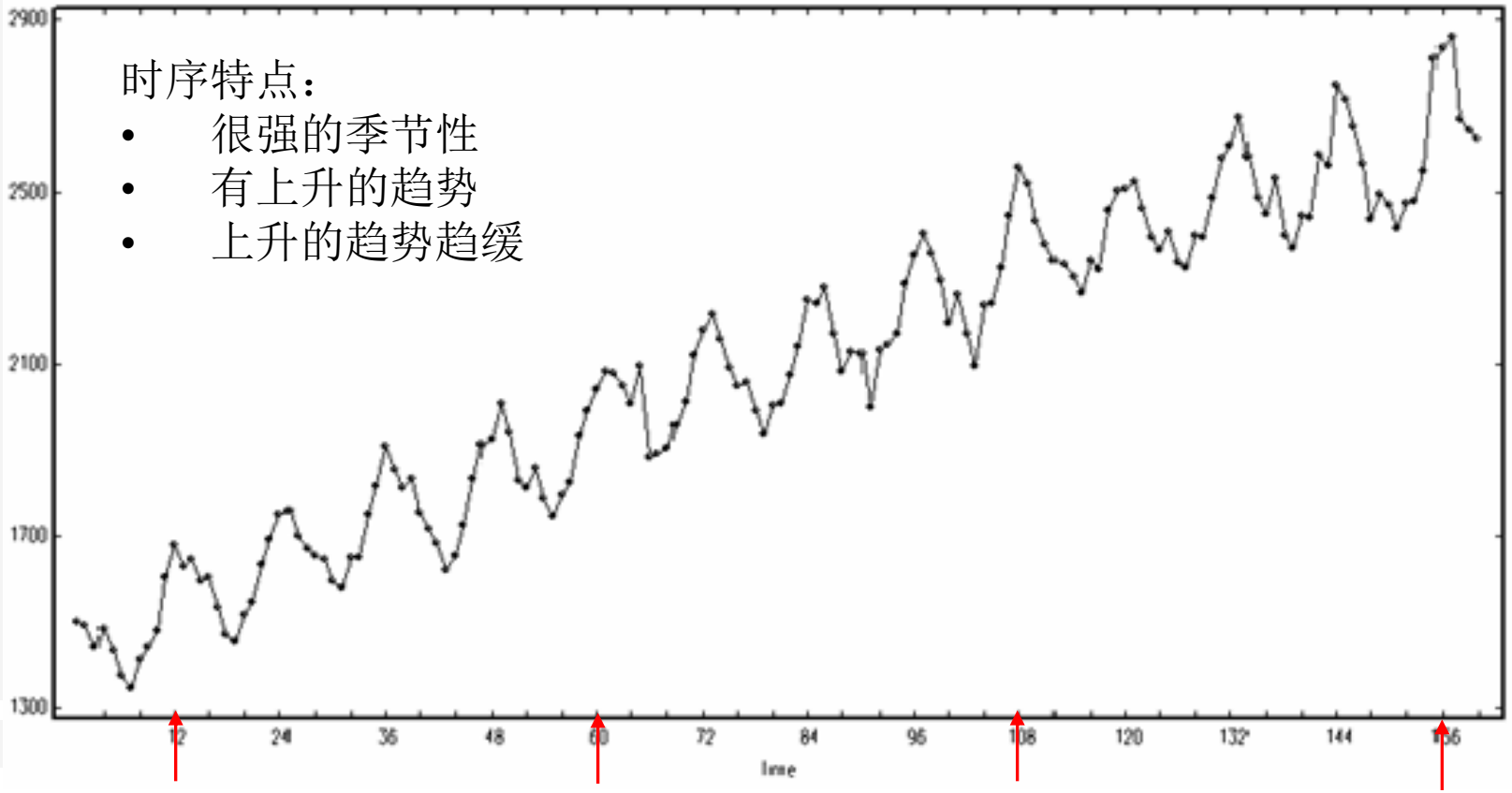


电力公司市场需求预测

Monthly Electricity Demand (logged), 1/64 to 4/77



时序特点：

- 很强的季节性
- 有上升的趋势
- 上升的趋势趋缓

Dec.,1964　　1968　　1972　　1976

电力公司市场需求预测

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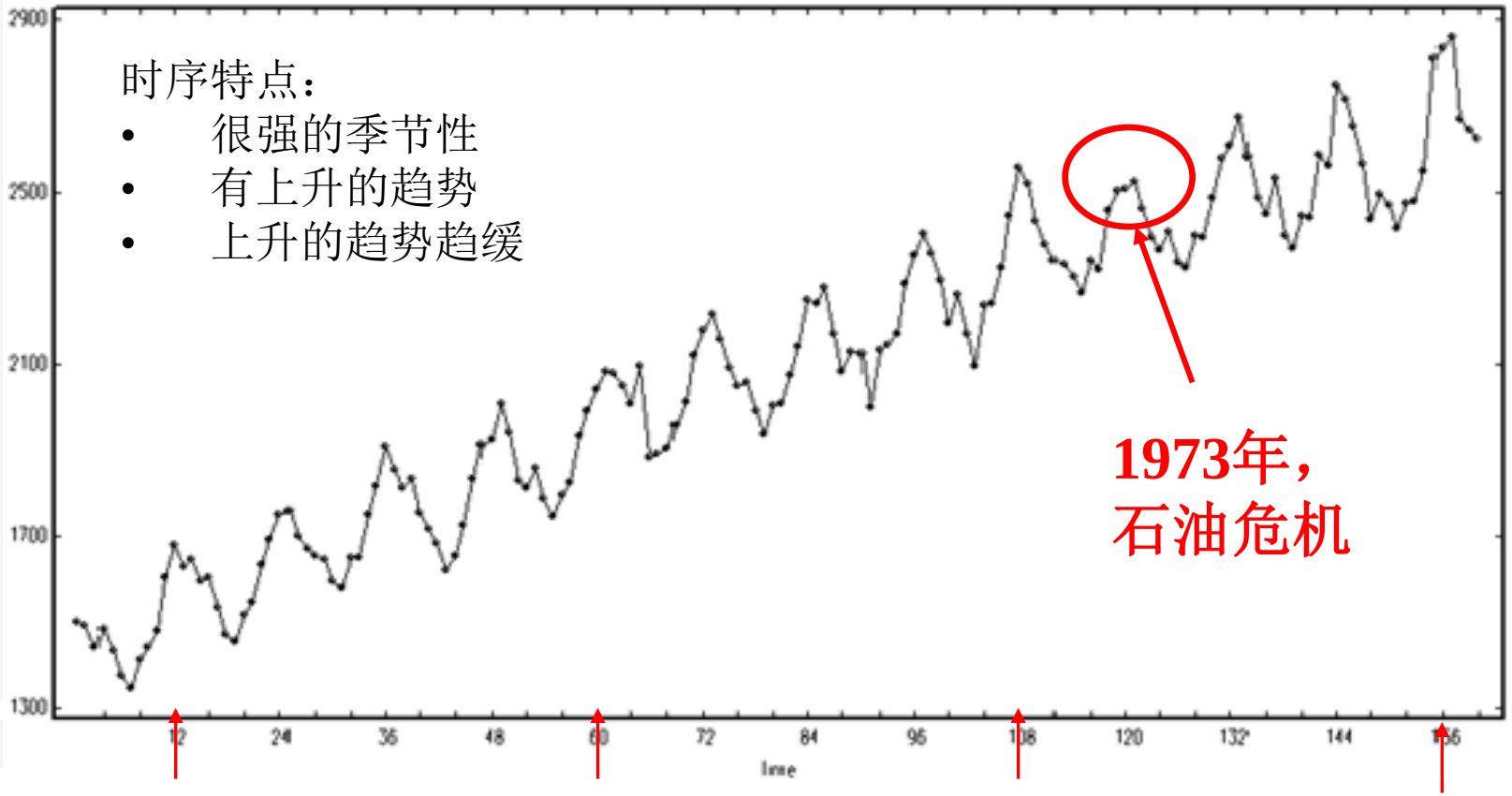

时序特点：

- 很强的季节性
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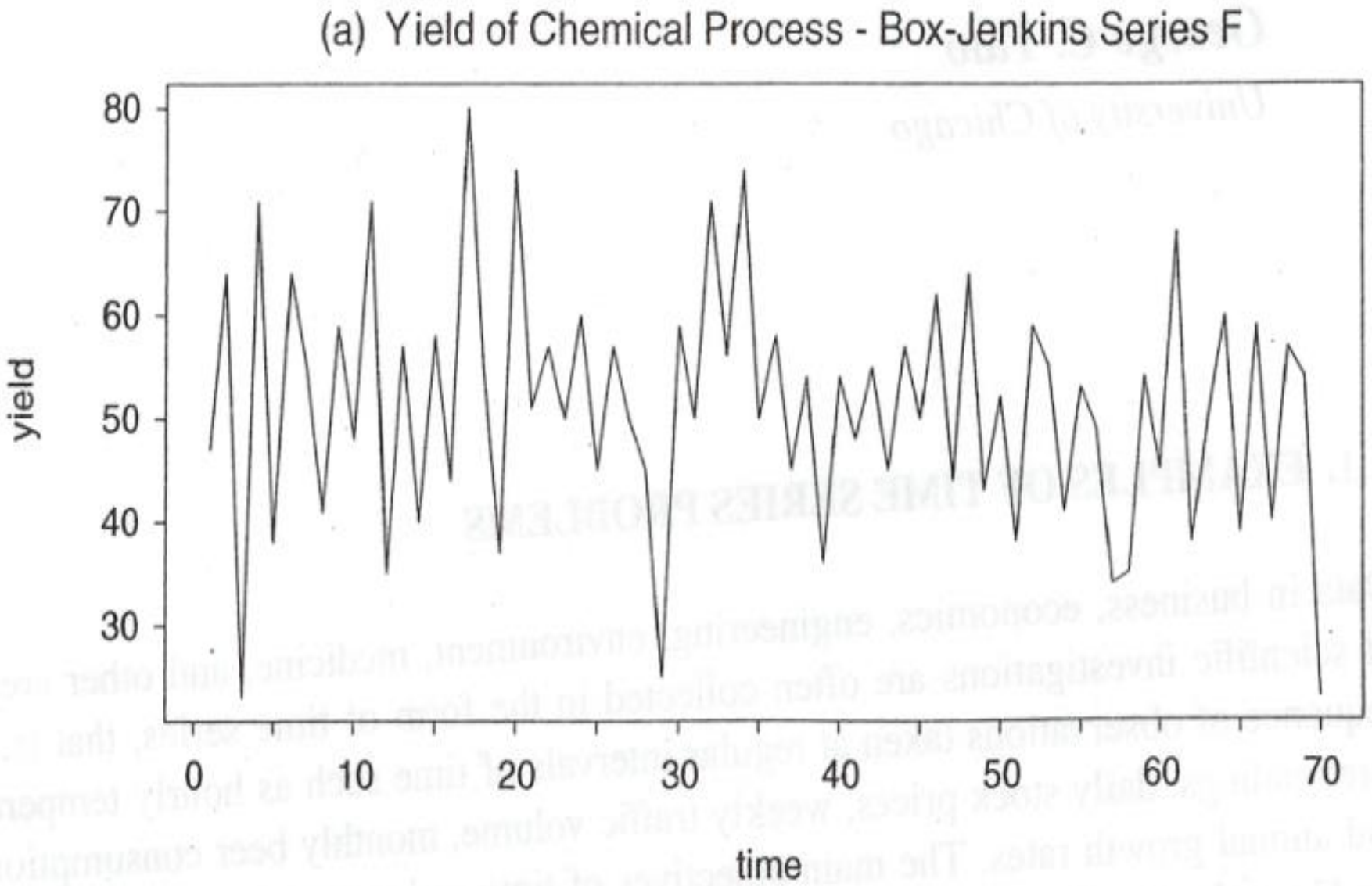
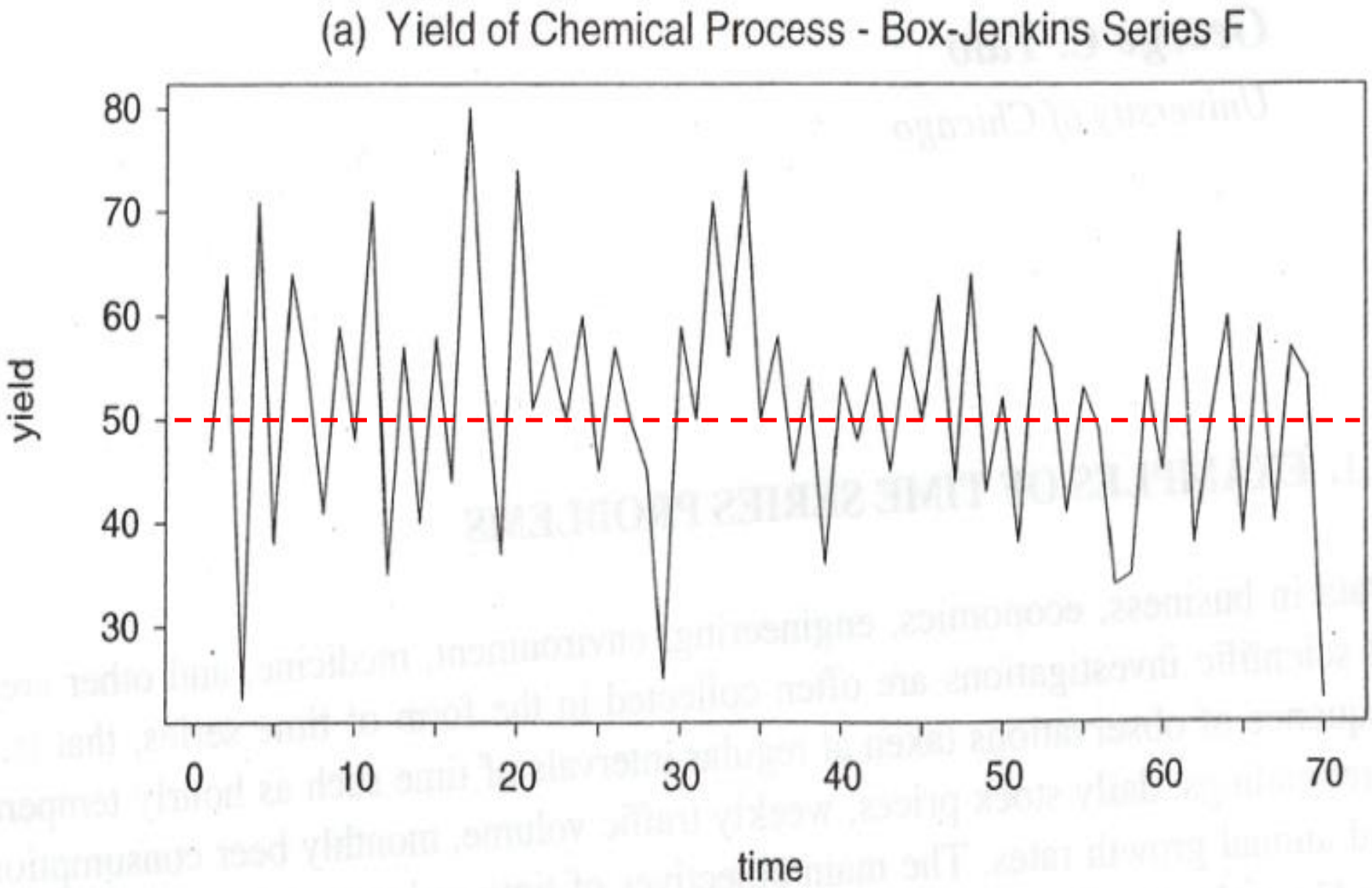
1973年，石油危机

Dec.,1964　　1968　　1972　　1976

平稳时间序列 (1)


(a) Yield of Chemical Process - Box-Jenkins Series F
yield
80
70
60
50
40
30
0
10
20
30
40
50
60
70
time

平稳时间序列 (1)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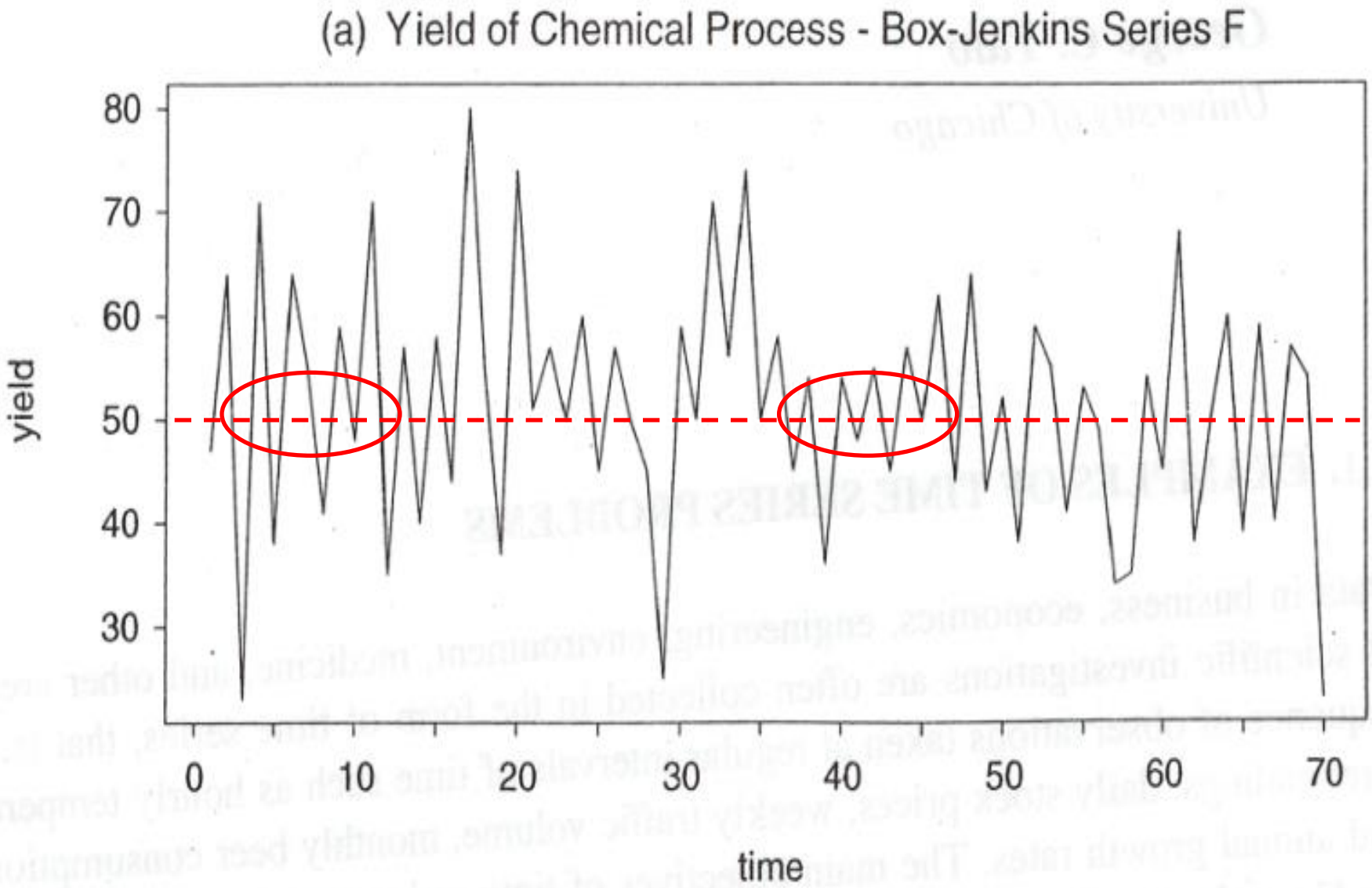
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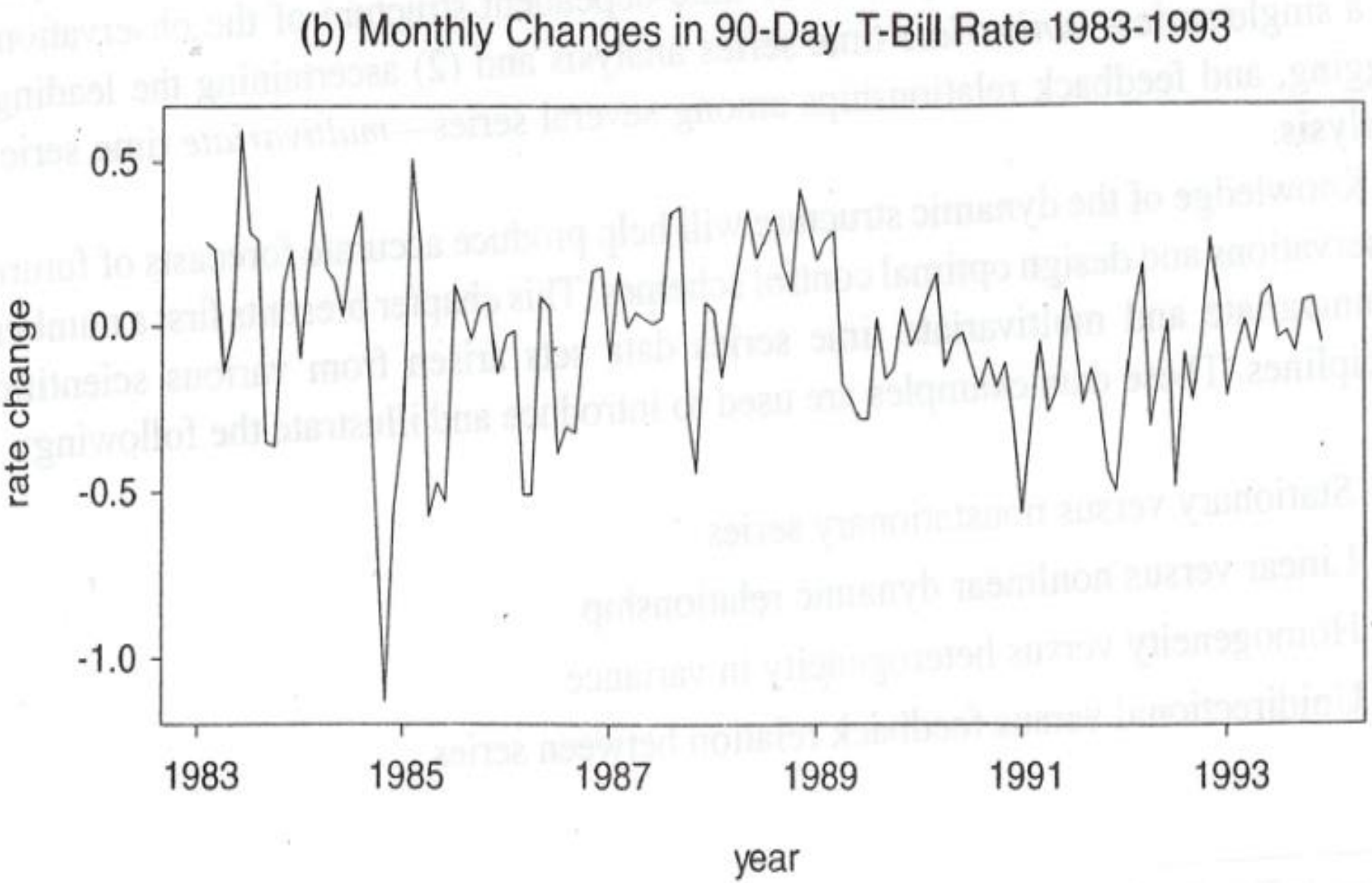
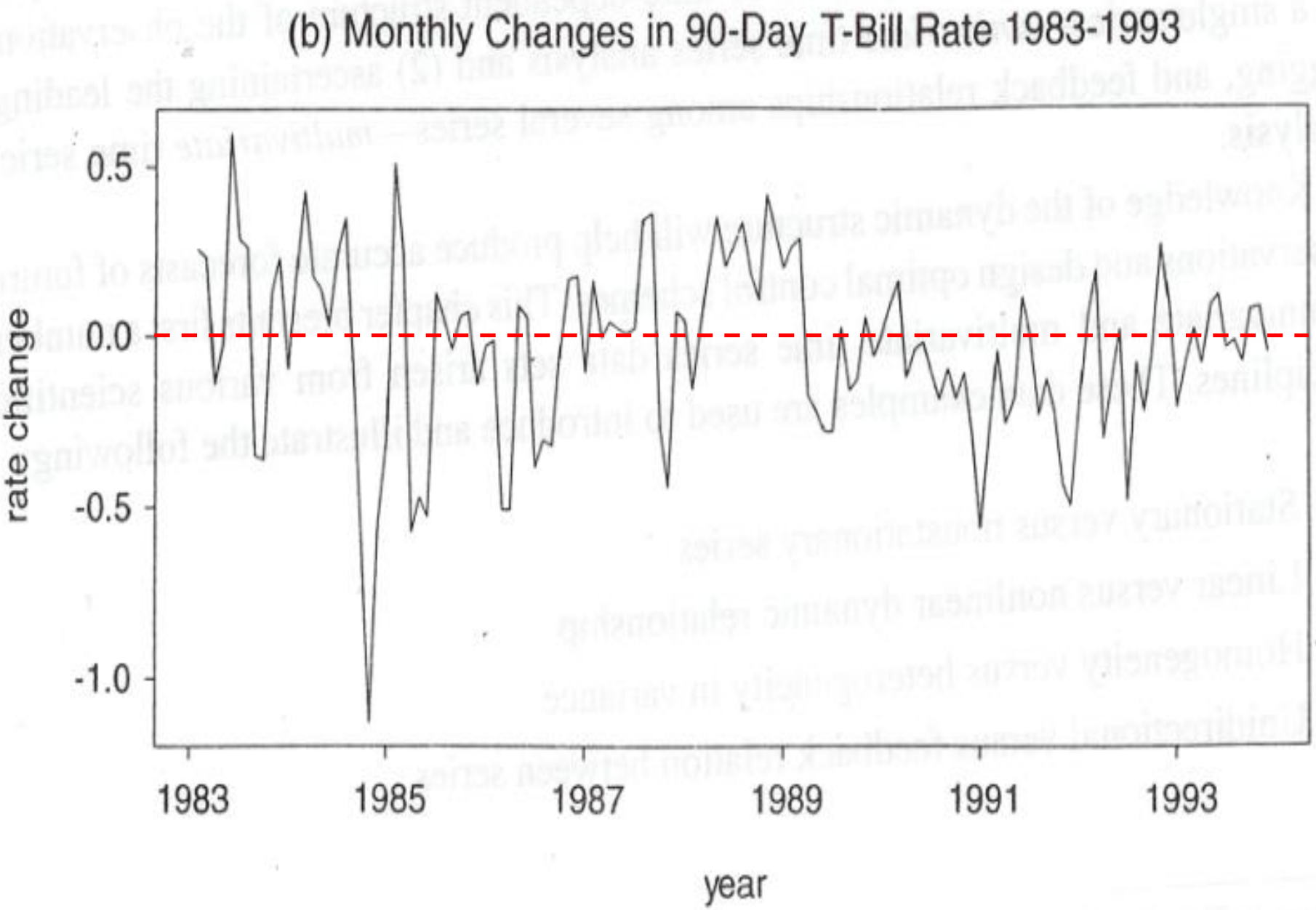
time

平稳时间序列 (2)


(b) Monthly Changes in 90-Day T-Bill Rate 1983-1993
rate change
0.5
0.0
-0.5
-1.0
1983
1985
1987
1989
1991
1993
year

平稳时间序列 (2)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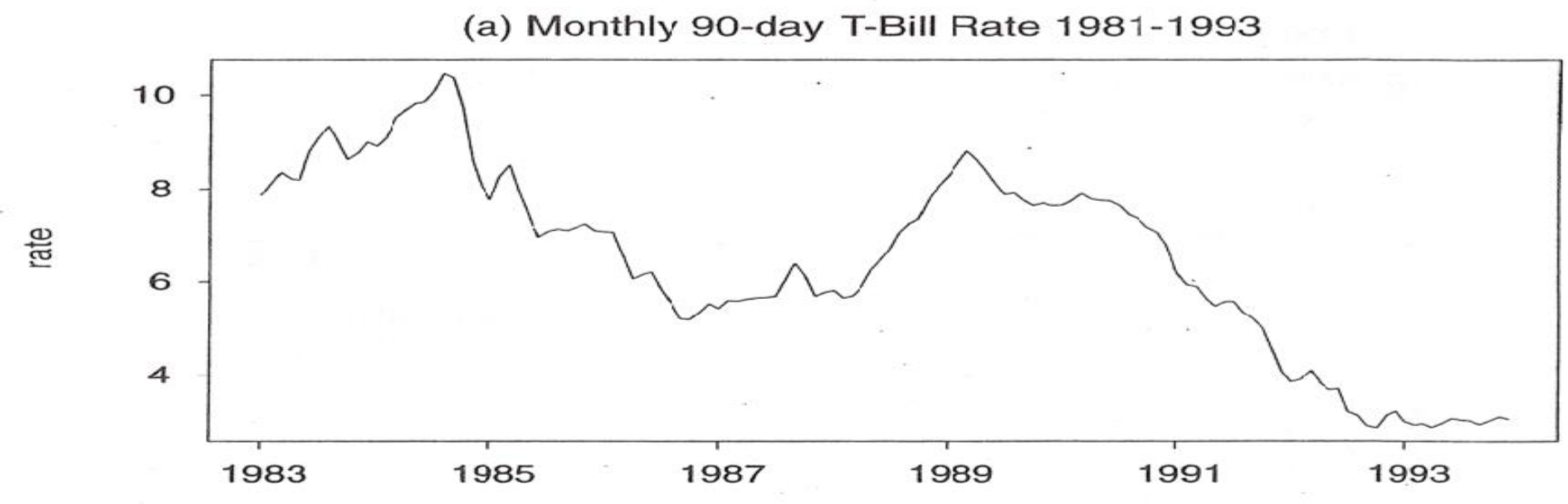
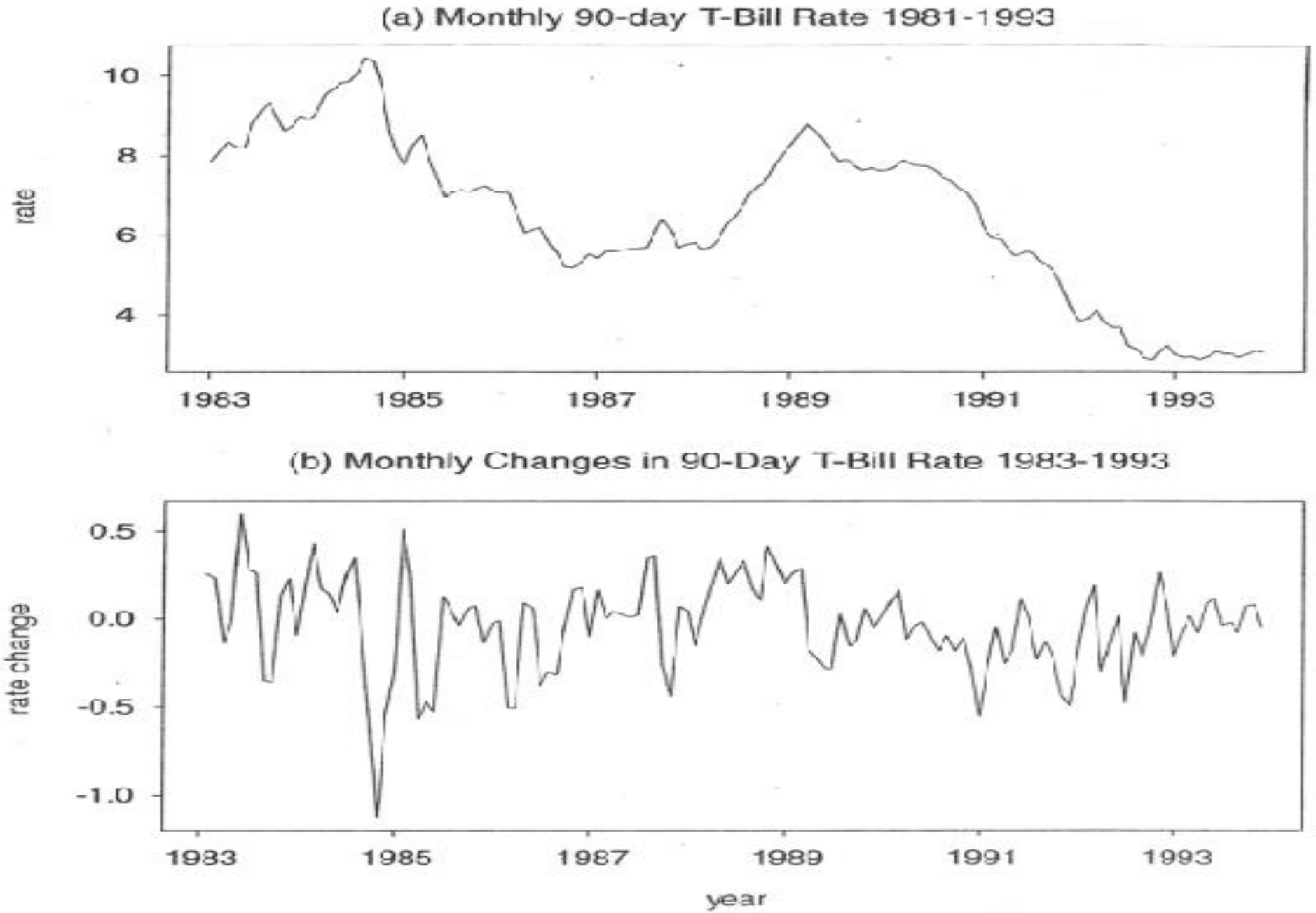
非平稳时间序列 (1)


(a) Monthly 90-day T-Bill Rate 1981-1993
rate
10
8
6
4
1983
1985
1987
1989
1991
1993

非平稳时间序列 (1)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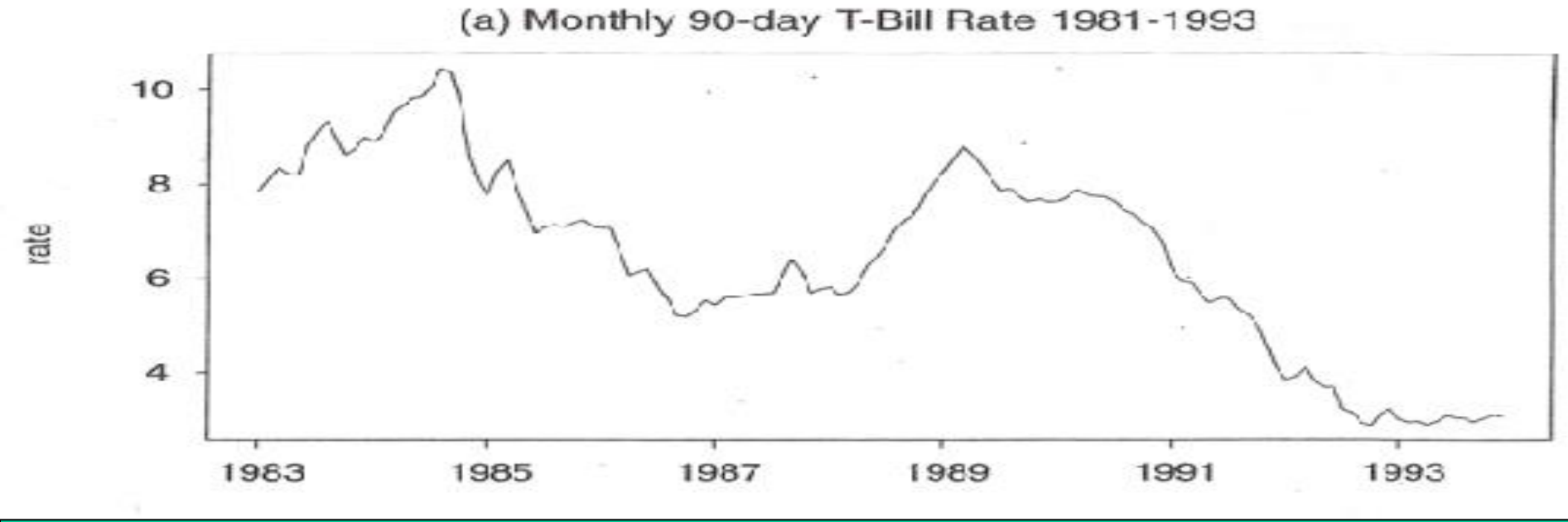
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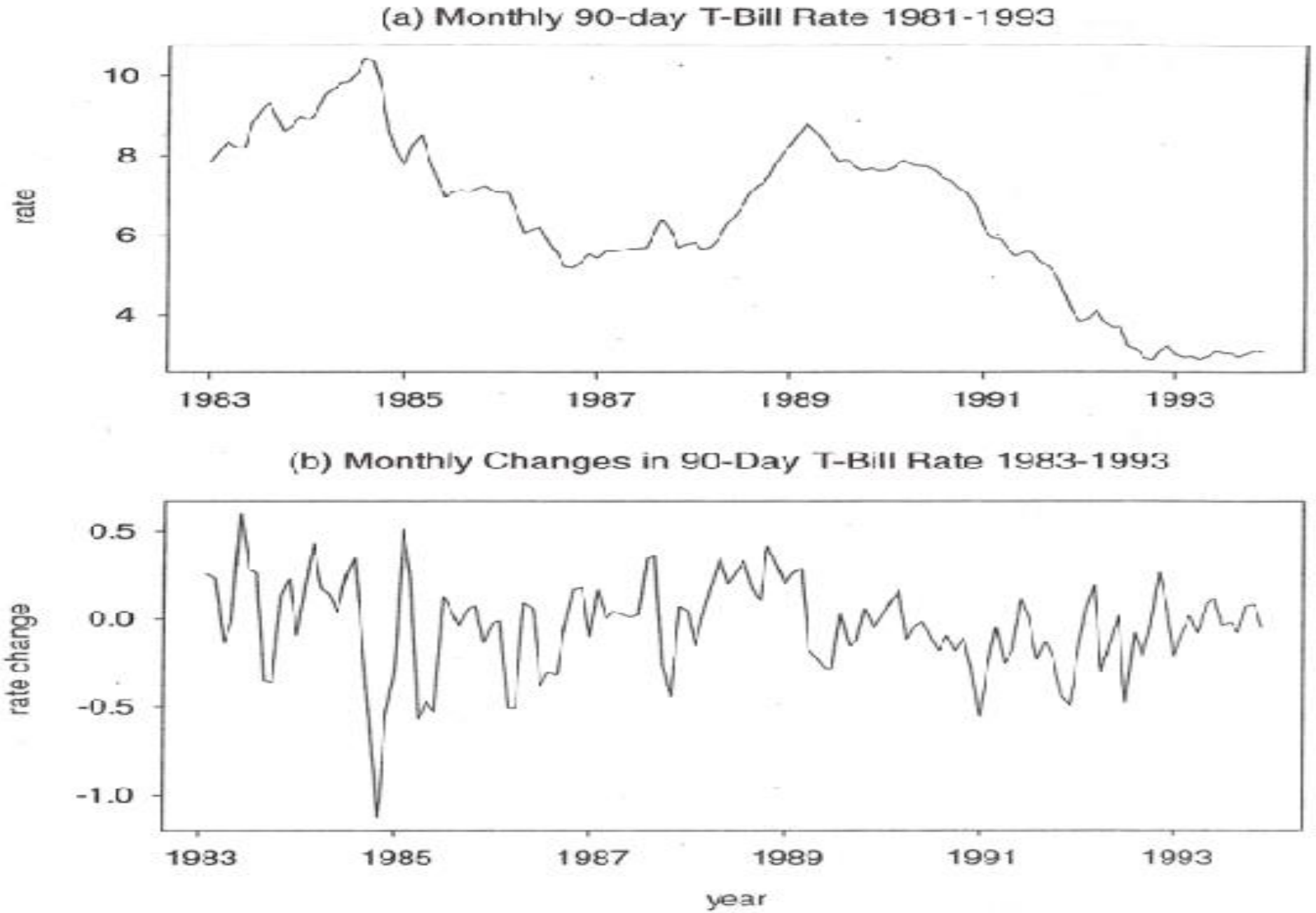
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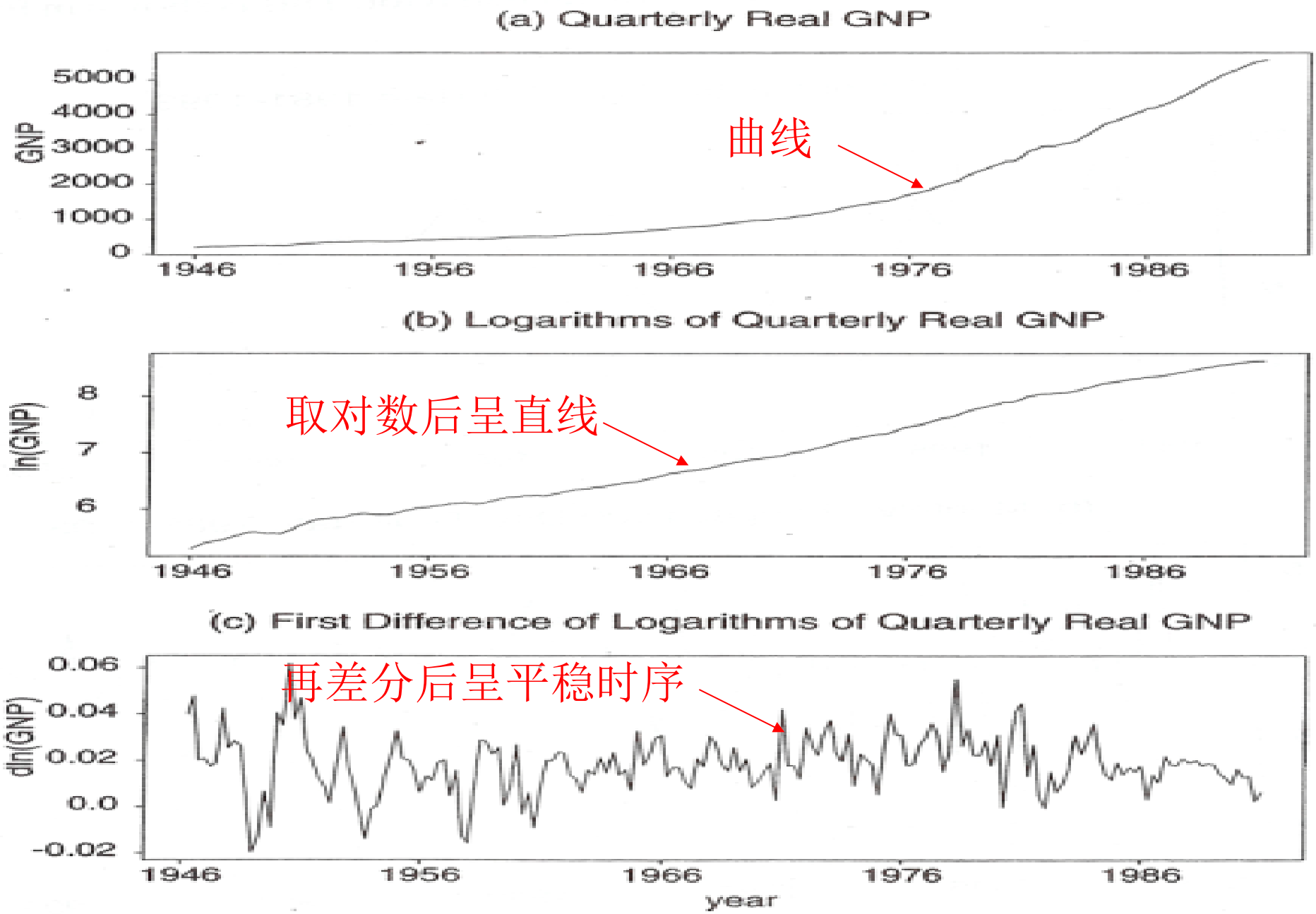

(a) Quarterly Real GNP
GNP
5000
4000
3000
2000
1000
0
1946
1956
1966
1976
1986
曲线
(b) Logarithms of Quarterly Real GNP
ln(GNP)
8
7
6
1946
1956
1966
1976
1986
取对数后呈直线
(c) First Difference of Logarithms of Quarterly Real GNP
dln(GNP)
0.06
0.04
0.02
0.0
-0.02
1946
1956
1966
1976
1986
year
再差分后呈平稳时序

平稳时序？非平稳时序？

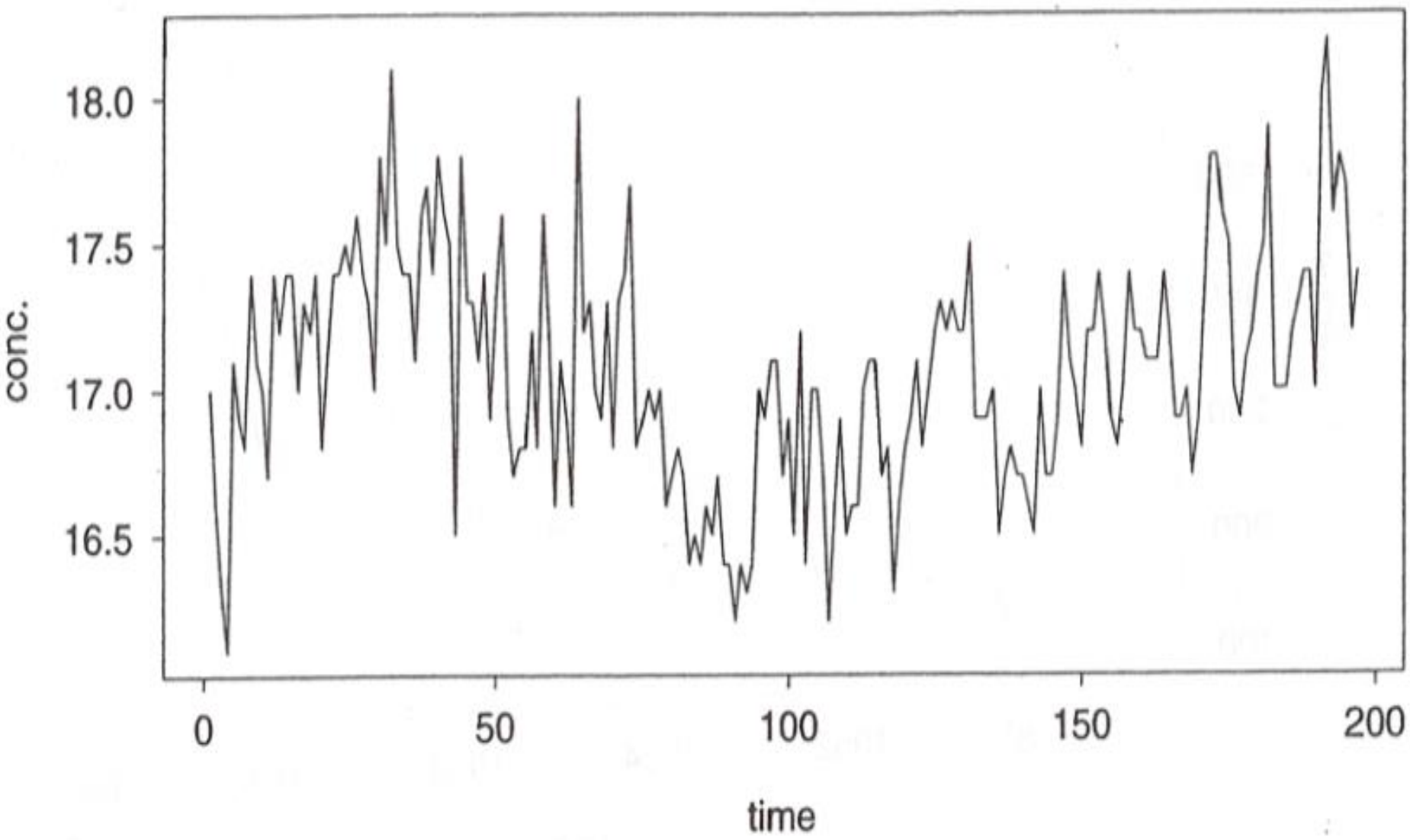


FIGURE 1.4 Concentration readings of a chemical process: Box–Jenkins series A.

平稳时序？非平稳时序？

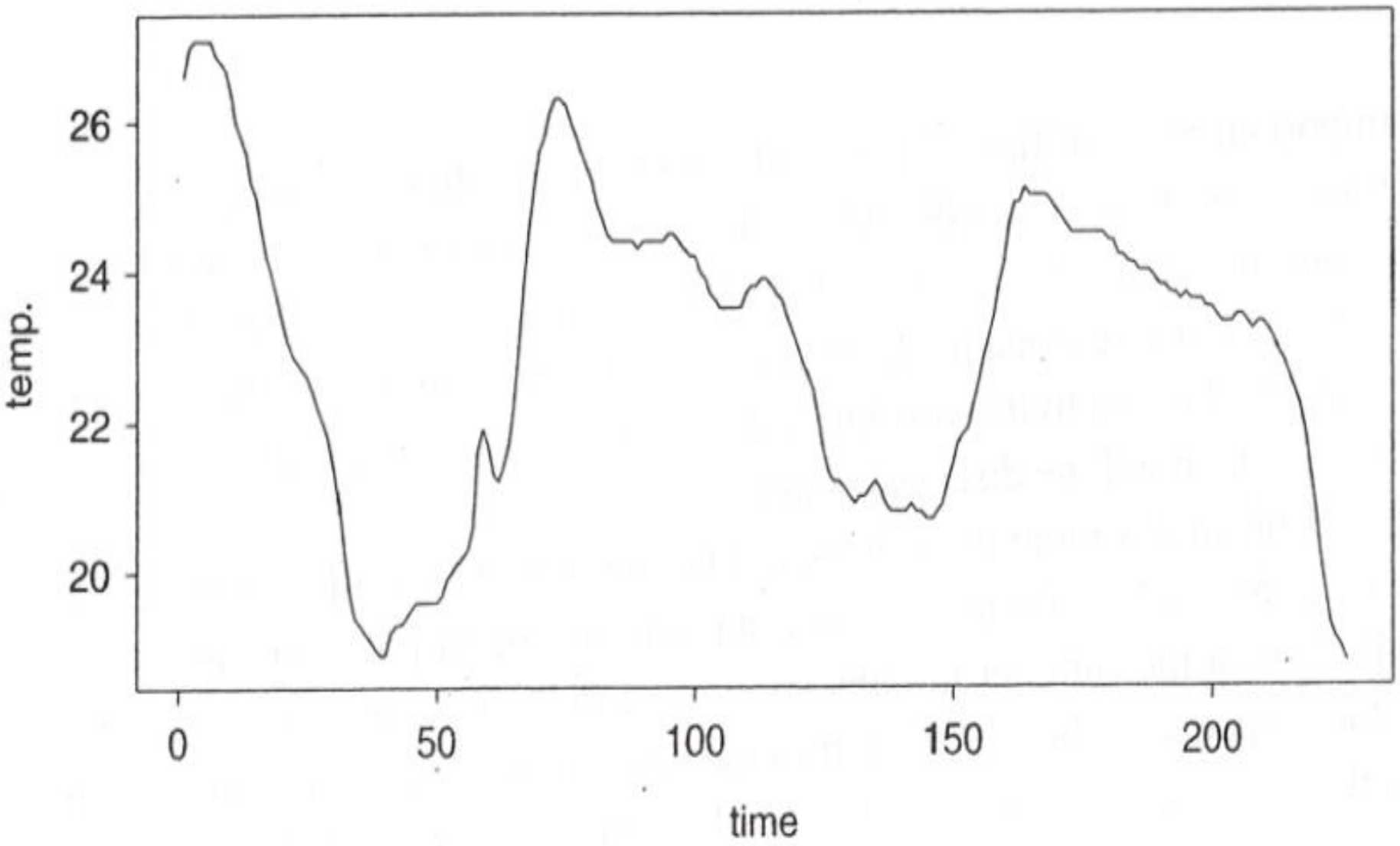


FIGURE 1.5 Temperature readings: Box–Jenkins series C.

季节性时间序列 (1)

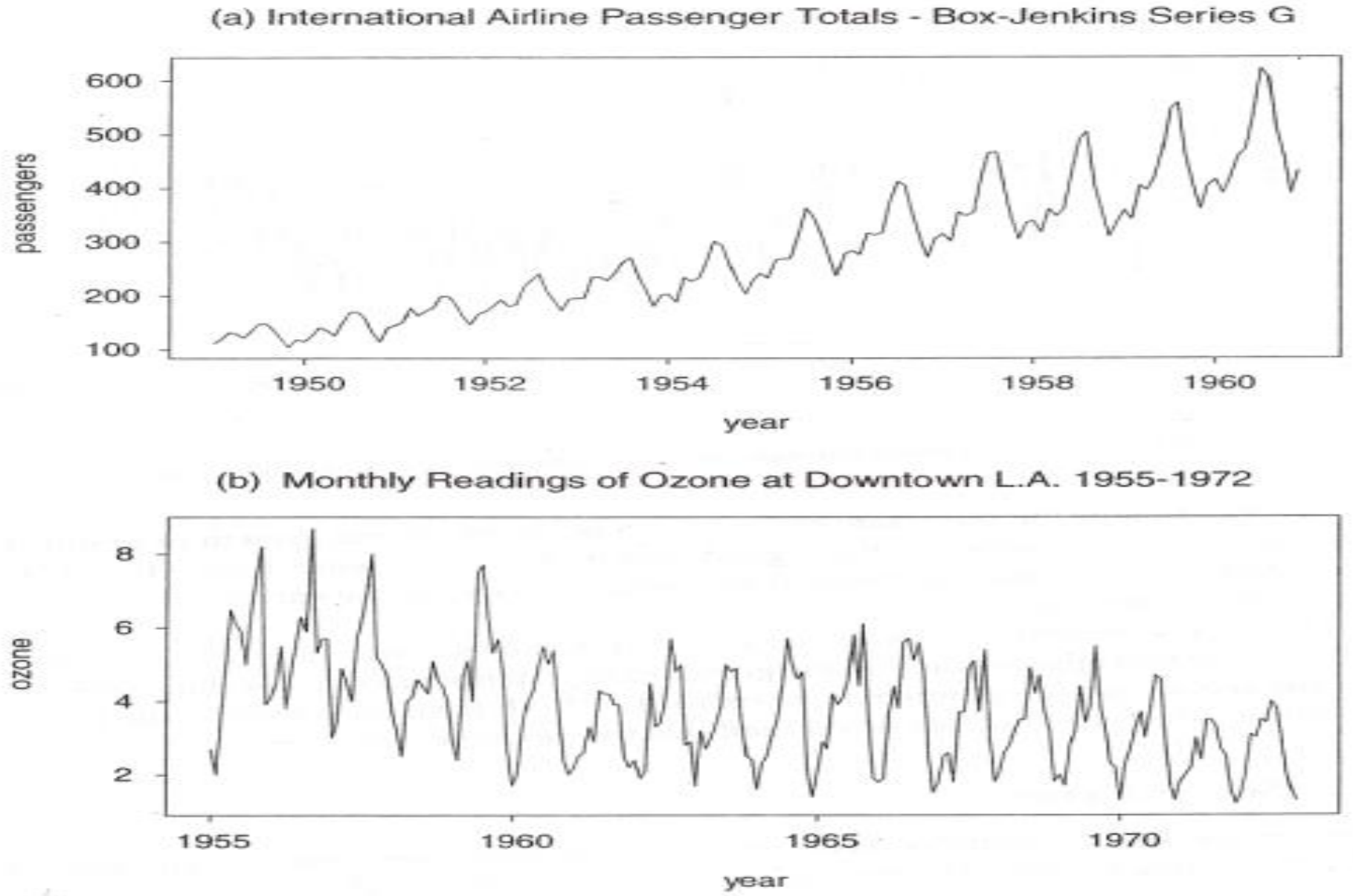


FIGURE 1.6 Two examples of seasonal series.

季节性时间序列 (1)

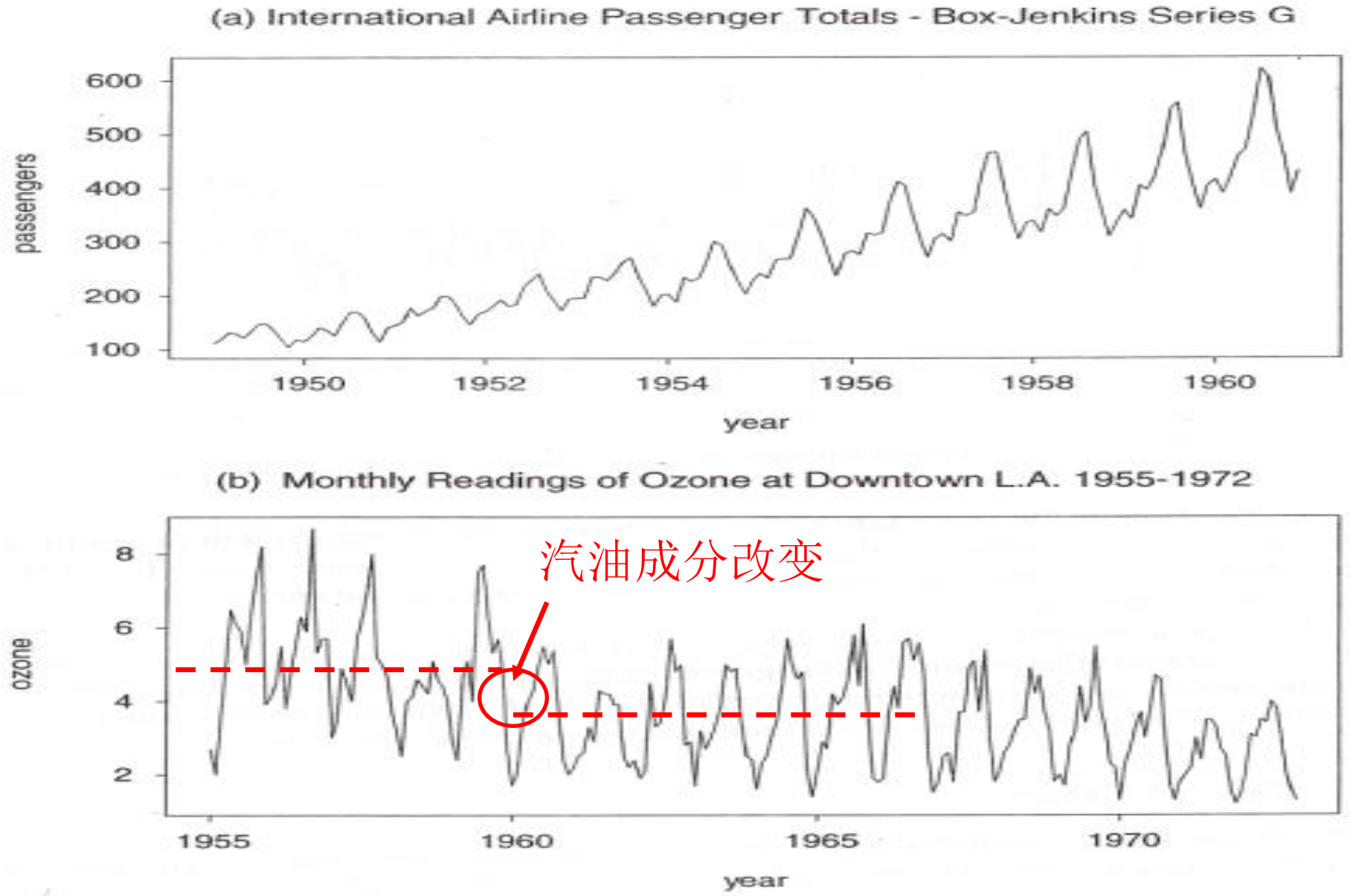


FIGURE 1.6 Two examples of seasonal series.

季节性时间序列 (1)

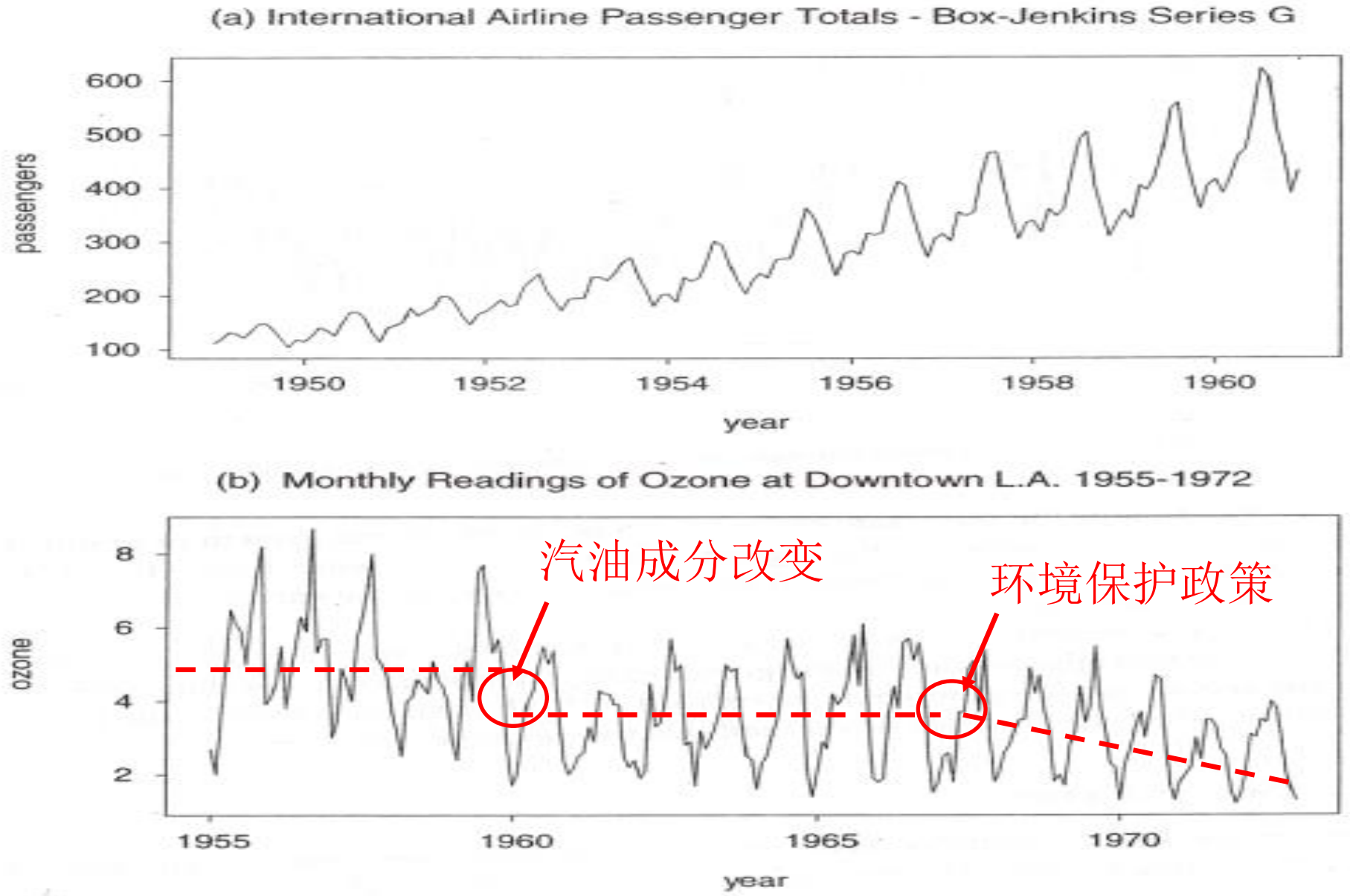


FIGURE 1.6 Two examples of seasonal series.

季节性时间序列 (2)

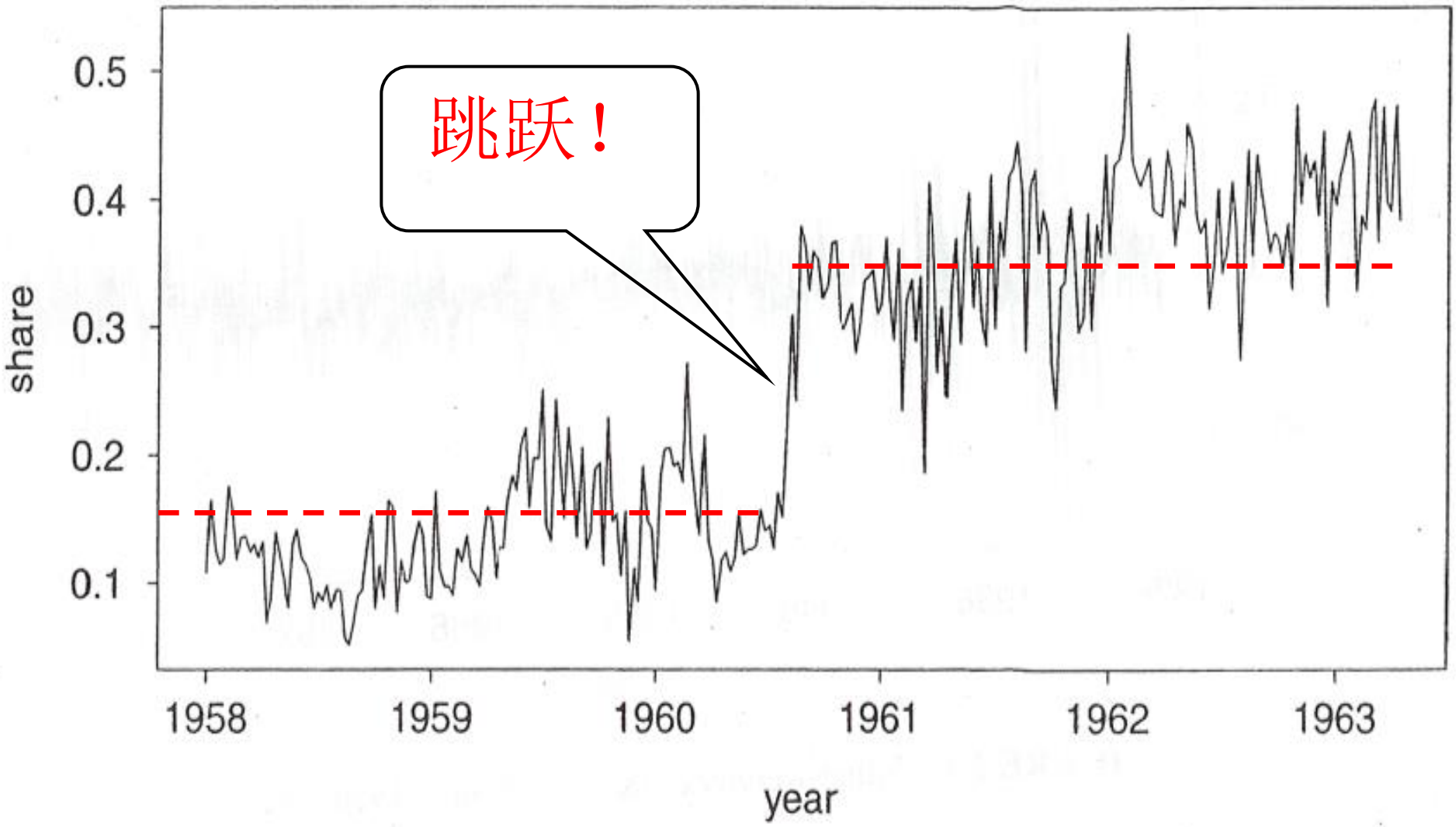


FIGURE 1.7 The Crest market share weekly data 1958–1963.

Variance Change

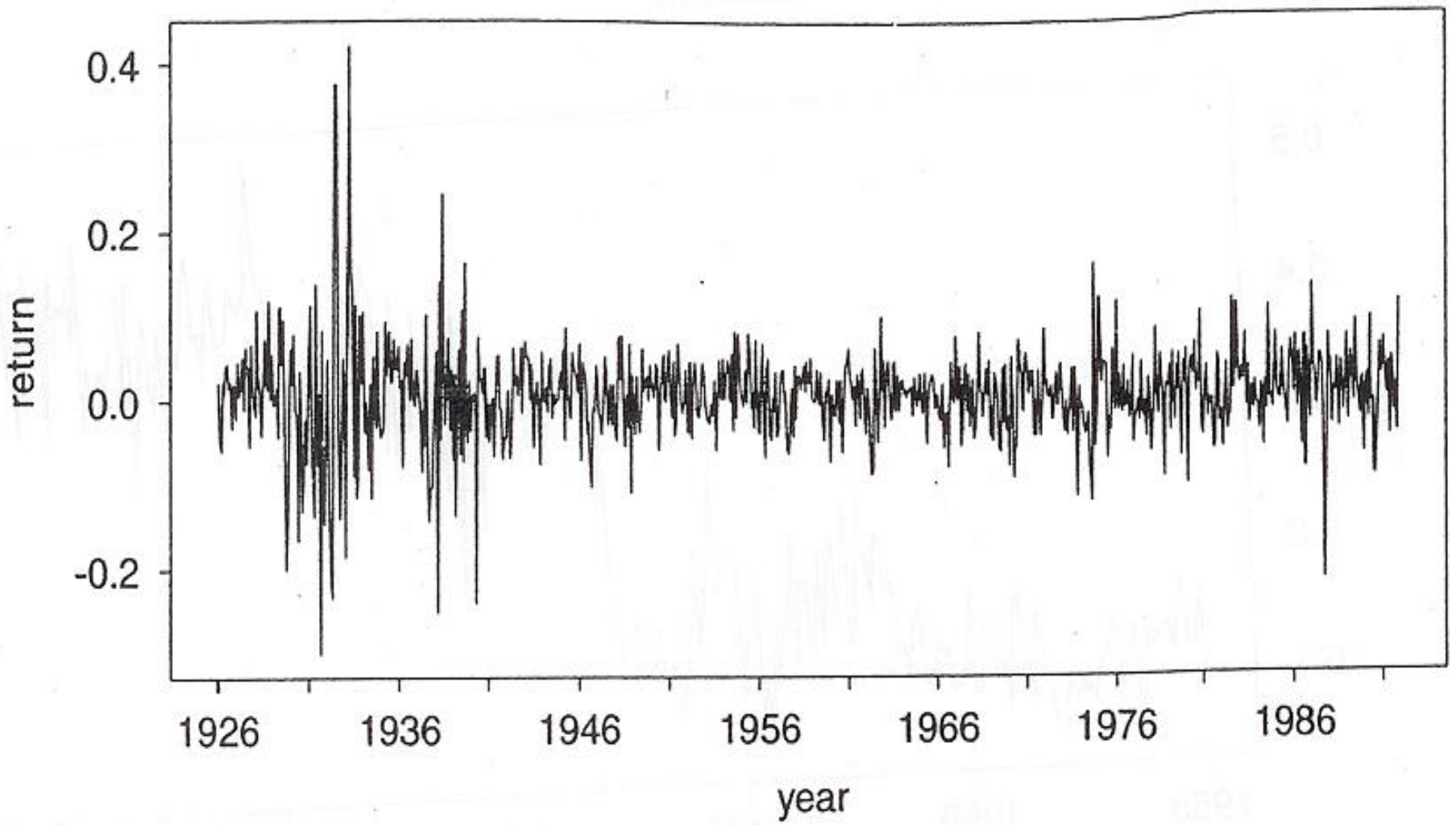


FIGURE 1.8 Value-weighted S&P 500 returns 1926–1991.

Variance Change

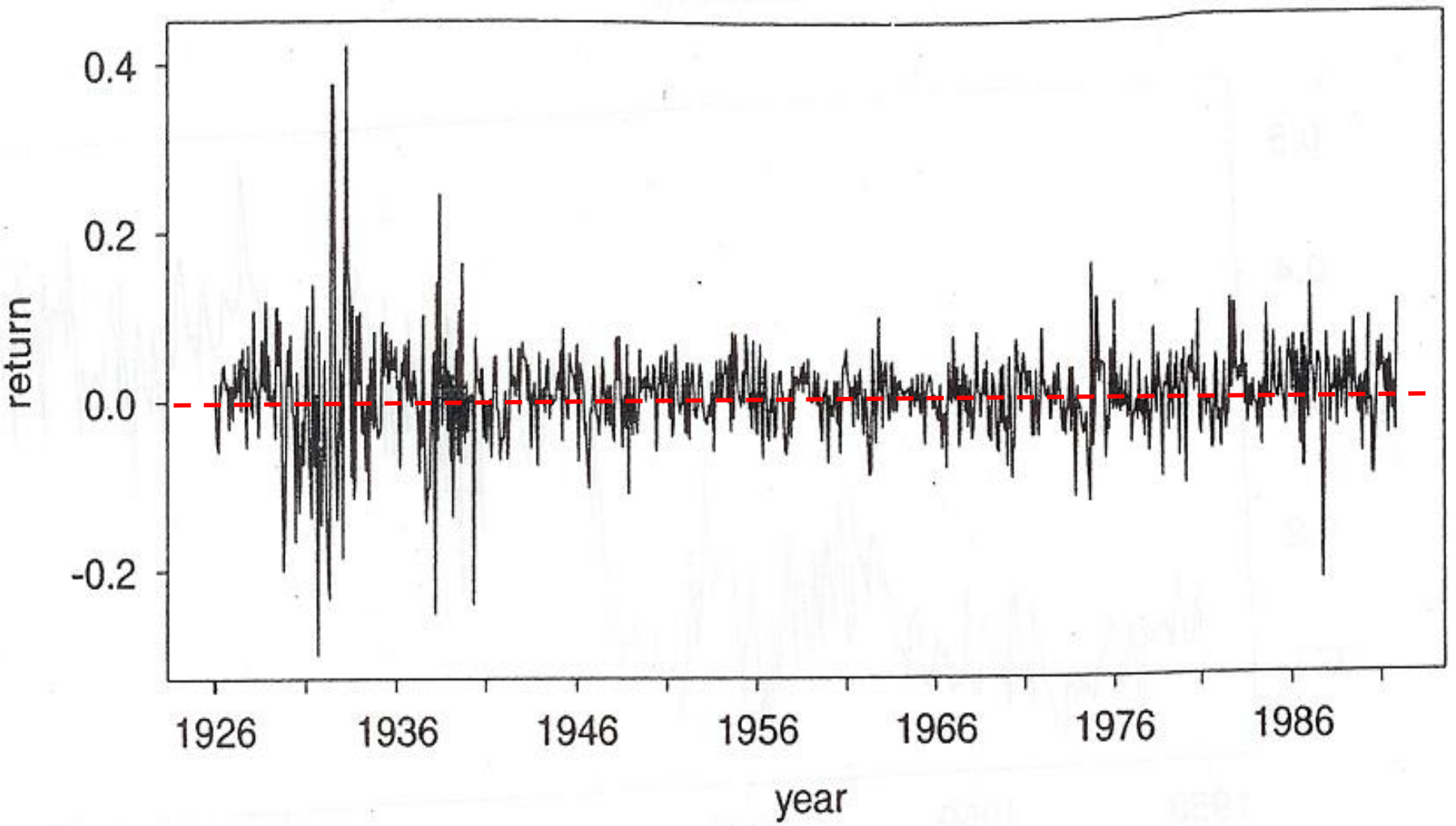


FIGURE 1.8 Value-weighted S&P 500 returns 1926–1991.

Variance Change

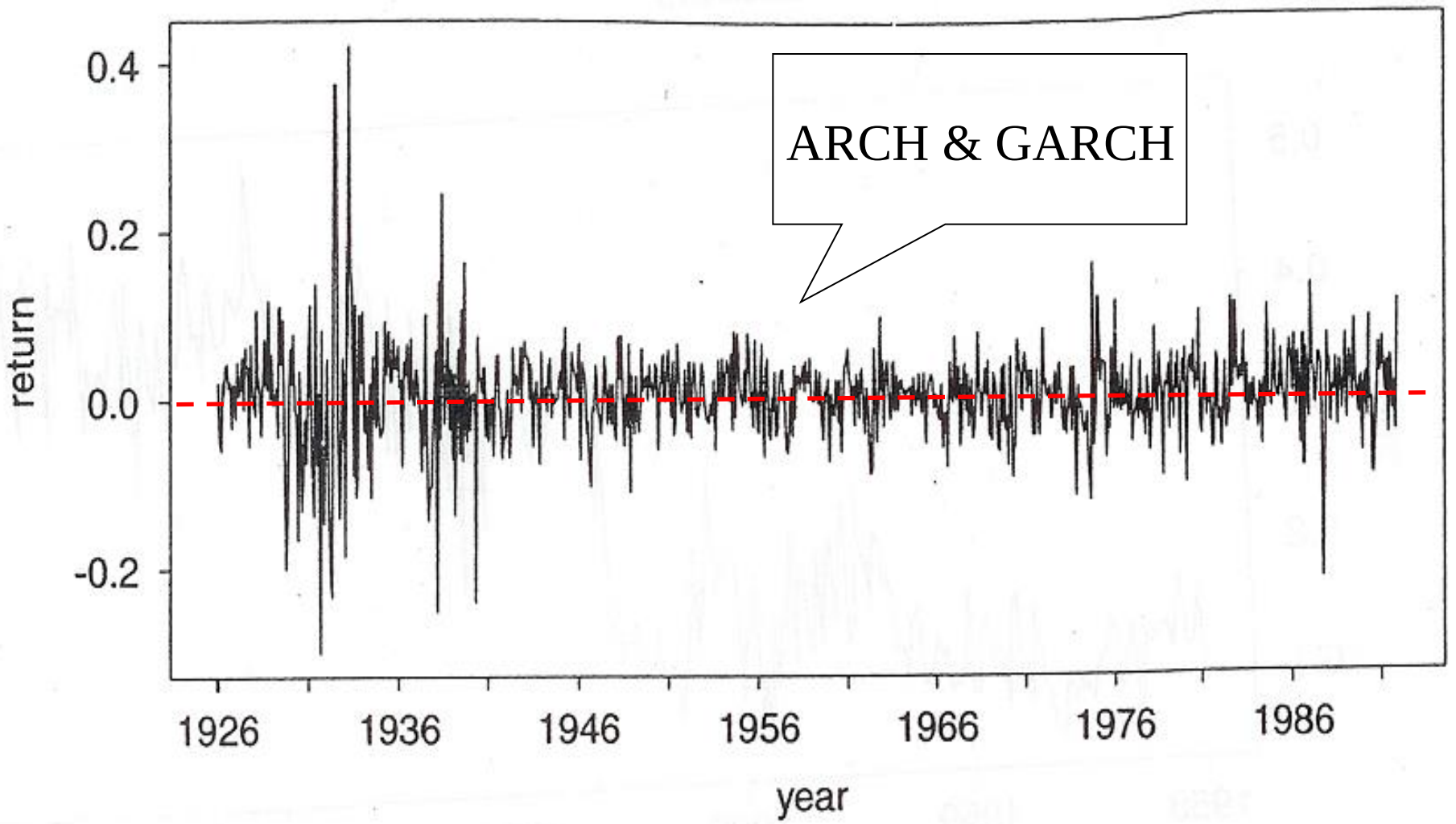
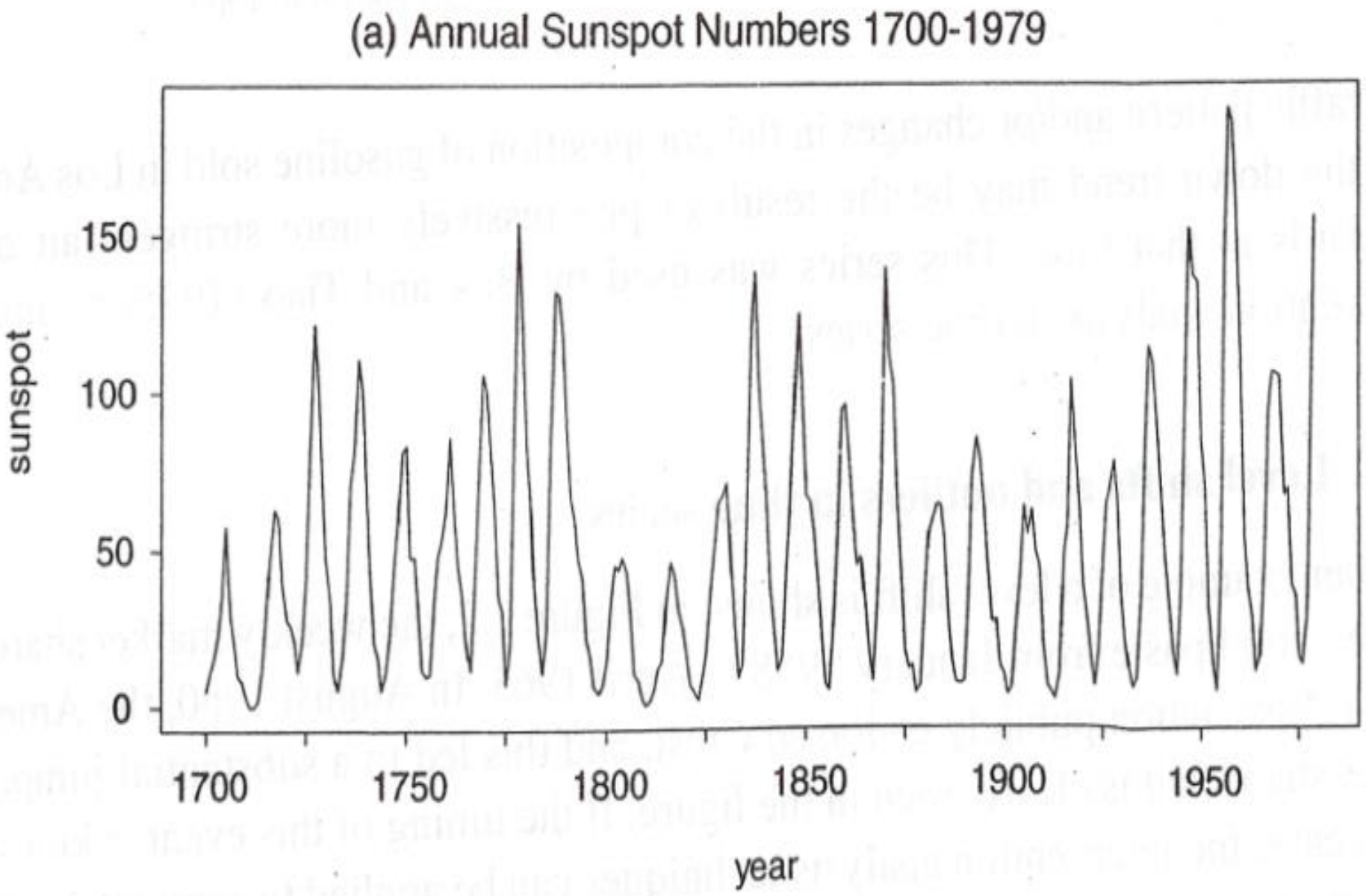


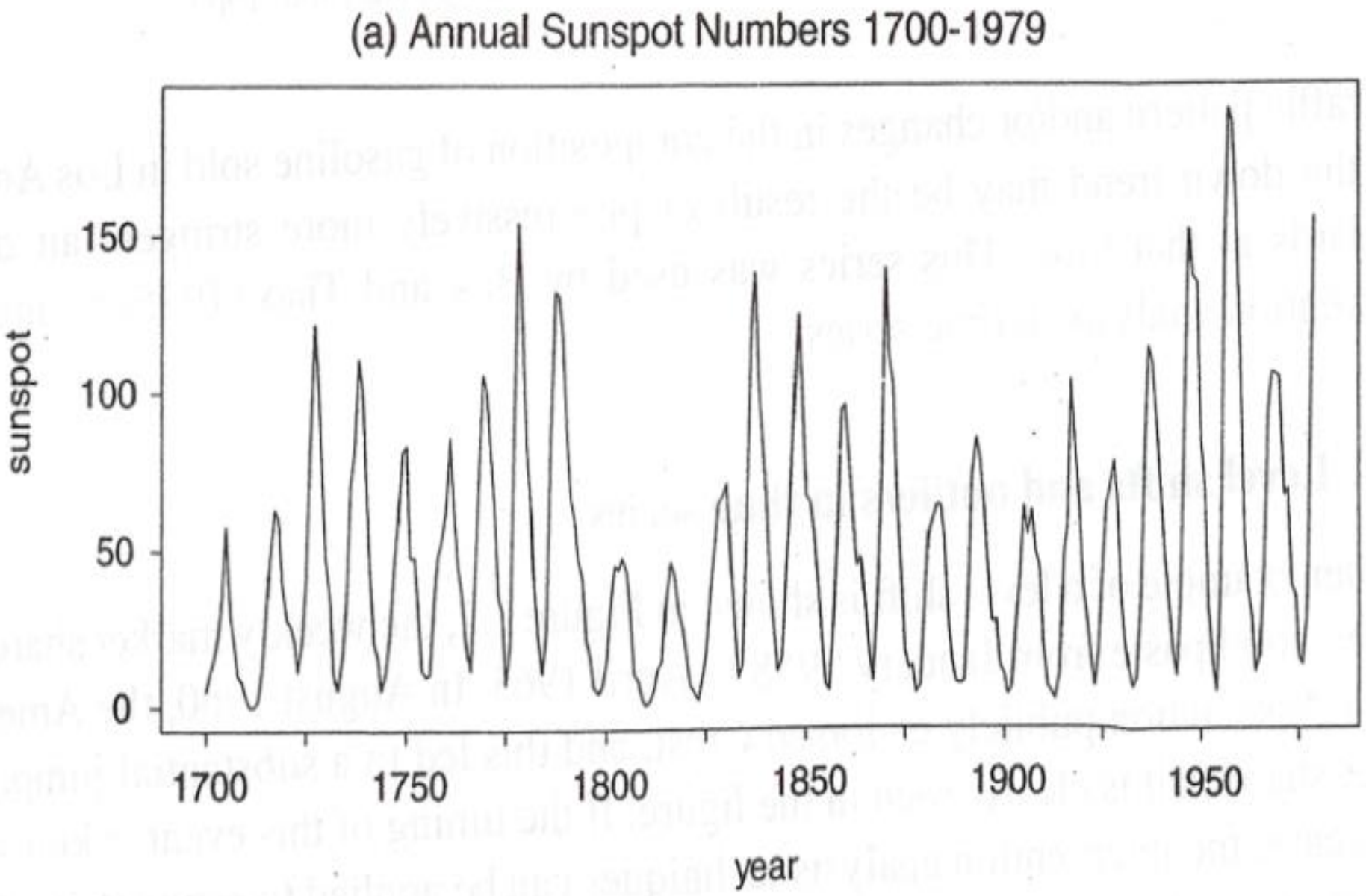
FIGURE 1.8 Value-weighted S&P 500 returns 1926–1991.

Asymmetric time series (1)

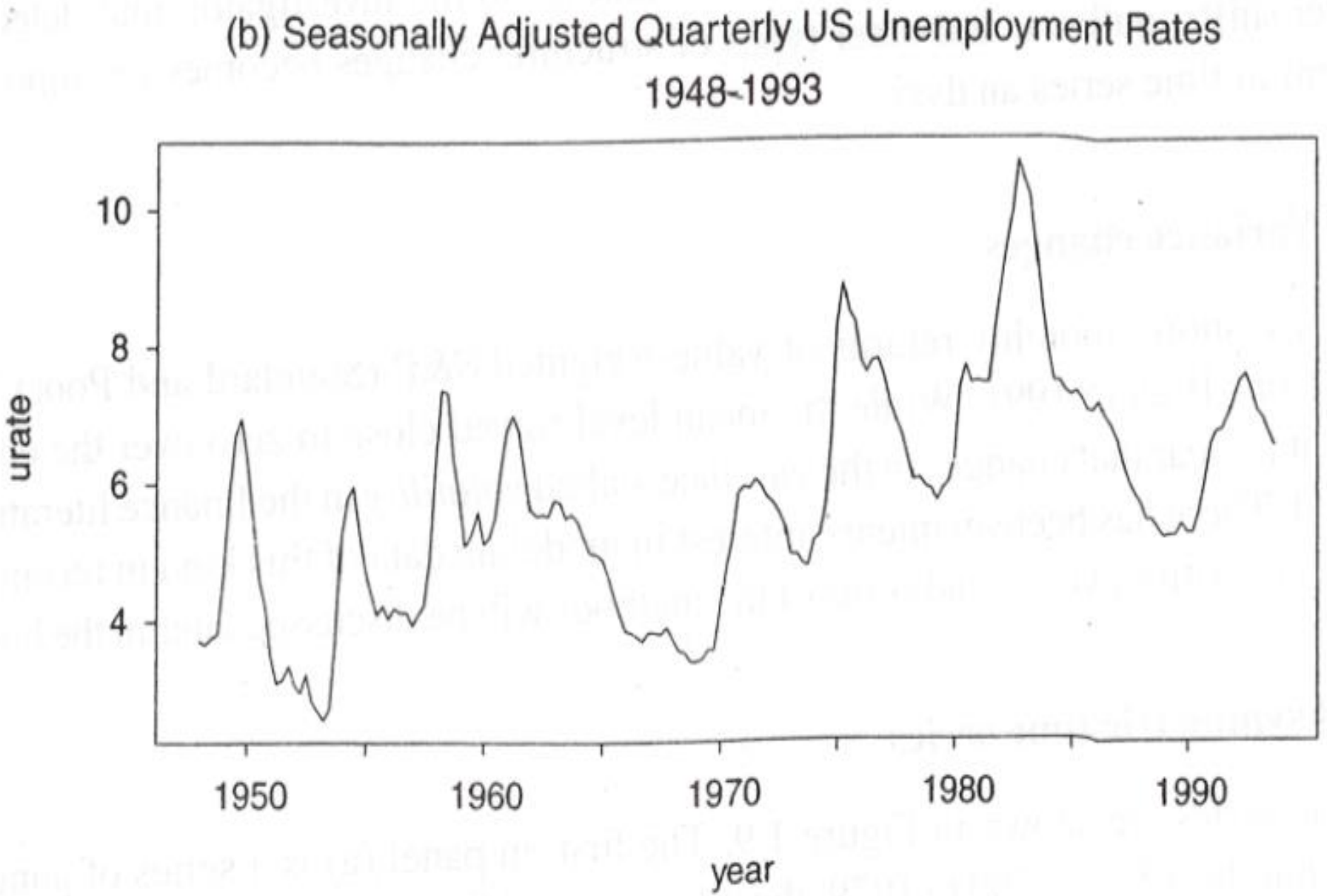


Asymmetric time series (1)

Asymmetric time series (1)



Asymmetric time series (2)



Unidirectional Relation between Series

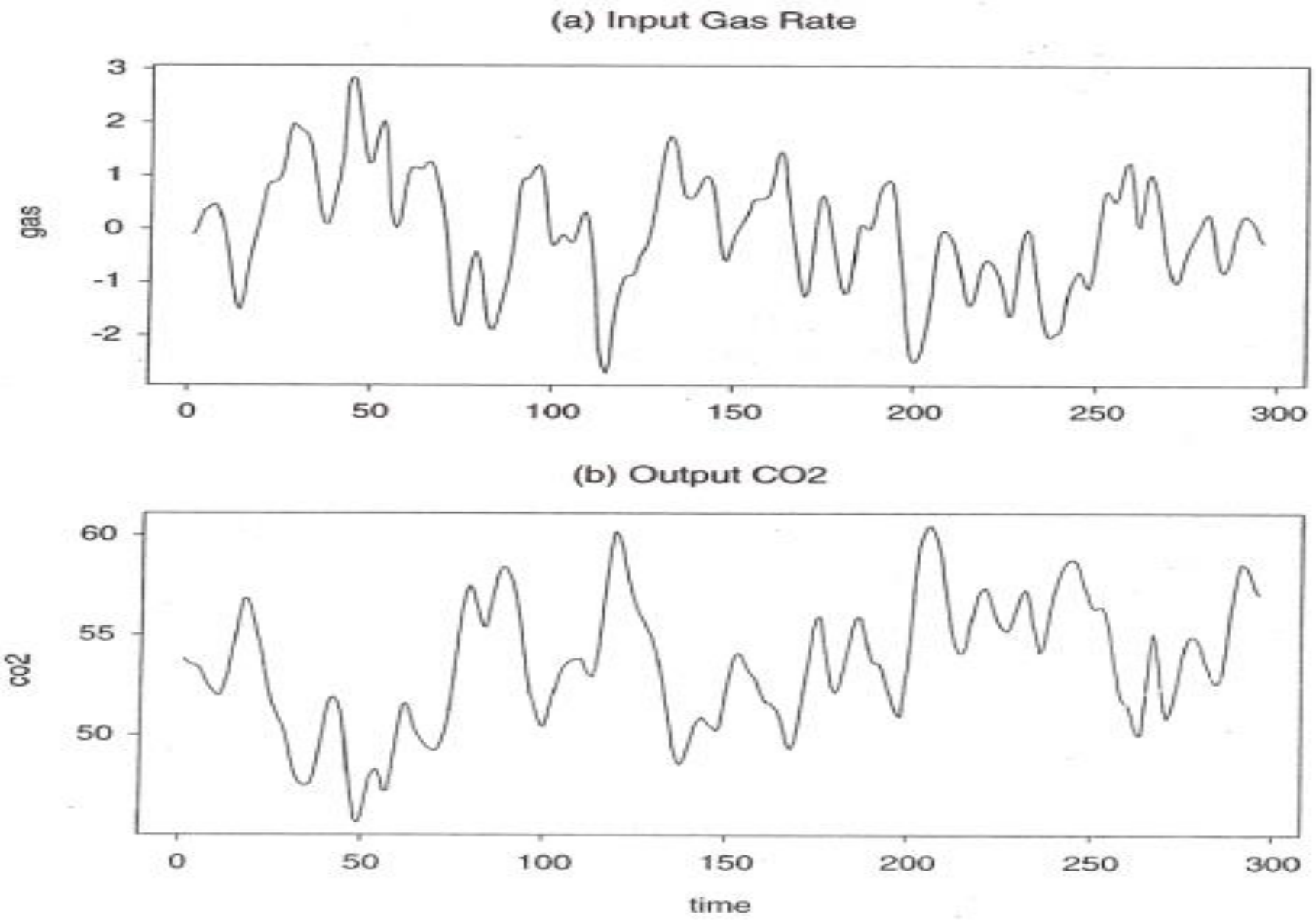


FIGURE 1.10 The gas furnace data: Box–Jenkins series J.

Course Outlines

- See the course outline document