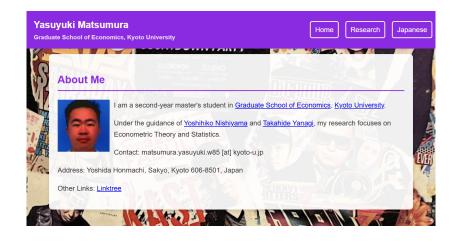
Nonparametric Density Estimation

Sections 17.1-17.8 of Hansen (2022)

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Last Updated: April 21, 2025

https://yasu0704xx.github.io



This slide is available on

https://github.com/yasu0704xx/Econometrics2025.

Introduction

- As a general rule, density functions can take any shape. They
 are inherently nonparametric and cannot be described by a
 finite set of parameters.
- That is, functional and/or distributional specifications relied on when estimating density functions may be incorrect.
- If we assume that such specifications are "true," we might obtain incorrect empirical conclusions.
- Thus, it would be disirable if we develop estimation procedures without requiring functional and/or distributional specifications.
- Nonparametric kernel methods achieve such a goal.

Setup

- Here we review Sections 17.1-17.8 of Hansen (2022) [1].
- We proceed with a discussion of how to estimate the probability density function (PDF) of a real-valued random variable X for which we have n IID observations $X_1, \dots X_n$.
- We assume that X has a continuous density f(x).
- The goal is to estimate f(x) either at a single point x or a set of points in the interior of the support of X.

References

- Excellent textbooks on nonparametric density estimation include Silverman (1986) [5] and Scott (1992) [4].
- The following textbooks are often refered:
 - Silverman (1986) [5],
 - Scott (1992) [4],
 - van der Vaart (1998, Chapter 24) [6],
 - Pagan and Ullah (1999, Chapter 2) [3], and
 - Li and Racine (2007, Chapter 1) [2].
- 日本語の文献:
 - 西山・人見 (2023, 第1章) [3]
 - 末石 (2015, 第9章) [2]
 - 清水 (2023, 第5章) [1]

Histogram

Kernel Density Estimator

Bias

Variance

Variance Estimation and Standard Errors

Integrated Mean Squared Error (IMSE)

Optimal Kernel

Refernces

Histogram

Kernel Density Estimator

Bias

Variance

Variance Estimation and Standard Errors

Integrated Mean Squared Error (IMSE)

Optimal Kernel

Refernces

References i

- Hansen, B. E. (2022). *Probability and Statistics for Economists*. Princeton.
- Li, Q. and J. S. Racine (2007). *Nonparametric Econometrics:* Theory and Practice. Princeton.
- Pagan, A. and A. Ullah (1999). *Nonparametric Econometrics*. Cambridge.
- Scott, D. W. (1992). Multivariate Density Estimation: Theory, Practice, and Visualization. Wiley.
- Silverman, B. W. (1986). Density Estimation for Statistics and Data Analysis. Chapman and Hall.

References ii



an der Vaart, A. W. (1998). Asymptotic Statistics. Cambridge.

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- 清水泰隆 (2023)『統計学への漸近論, その先は』内田老鶴圃.
- 末石直也 (2015) 『計量経済学:ミクロデータ分析へのいざない』日本評論社.
- 西山慶彦, 人見光太郎 (2023) 『ノン・セミパラメトリック統計解析』共立出版.