

School of Mathematics and Statistics. The University of Sydney.  
Information on graduate-Ph.D course. Lecturer: Dr Marc Raimondo <sup>1</sup>.

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## Smoothing Data

*Goal:* The aim of the course is to present an overview of the state-of-the-art smoothing methods in nonparametric statistics as well as to give some insight into theoretical considerations which allow a deeper understanding of the reviewed methodologies.

*Outline:* A rather recent approach to analysing data is to fit a curve to the data points 'locally' so that at any point the curve at that point depends only on neighbouring observations. The technique for producing such fits is called 'Smoothing'. In this lecture, we will present the main smoothing methods and study their properties in the context of nonparametric regression and density estimation. Particular attention is given to the choice of the smoothing parameter. The following topics will be covered: §1. Introduction to smoothing. Motivations. Standard non parametric problems. Criteria for comparing non parametric estimators. §2. Survey of existing methods. Kernel methods. Orthogonal series methods. Polynomial methods. §3. Optimal non parametric estimation. Minimax lower bound. Assouad lemma. §4. On global performances of kernel smoothers. Bias and variance trade-off. Asymptotic properties. Choosing the kernel function. Choosing the smoothing parameter. Automatic bandwidth choice. §5. Adaptive estimation. Spatial adaptation to inhomogeneous curves. Variable bandwidth methods in local polynomial regression. Introduction to Wavelet thresholding methods.

*References:*

- W. Härdle, SMOOTHING TECHNIQUES, 1990.
- B.L.S. Prakasa Rao, NONPARAMETRIC FUNCTIONAL ESTIMATION, 1983.
- B.W. Silverman, DENSITY ESTIMATION, 1986.
- M.P. Wand and M.C. Jones, KERNEL SMOOTHING, 1995.

*Schedule:* 3 to 4 hours a week of lecture per week, an hour computer practical session per week, an hour of exercises. A short exam during the last week will be also organized.

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