

PETER HALL'S CONTRIBUTIONS TO THE BOOTSTRAP

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1. Introduction. Professor Peter Hall's first publication appeared in 1977, one year after he was awarded DPhil from the University of Oxford and MSc from the Australian National University (ANU). His first paper on the bootstrap appeared in 1985 [Hall (1985)] on the block bootstrap of spatial point patterns, six years after the seminal paper [Efron (1979)] that introduced the bootstrap method. Hall (1985) was his 103rd publication and proposed resampling “tiles” of spatial data (“coverage patterns” in his words) to preserve the spatial dependence. The proposal was one year earlier than Carlstein's (1986) proposal of resampling nonoverlapping blocks of data sub-series for time series data.

The early publications of Peter were predominantly in probability theory: strong approximation and limiting distributions of various stochastic quantities. In the first ten years (1976–1985) as a publishing academic, he started as a probabilist and made a transition to Statistics. An inspection on the publications reveals that among the 102 papers published prior to his first bootstrap paper [Hall (1985)], 66 papers were published in the probability journals and 36 in the statistics journals: the *Annals*, *Biometrika*, *JRSS-B*, the *Annals of the Institute of Statistical Mathematics* (AISM), *Journal of Multivariate Analysis* and *Australian Journal of Statistics*. The first statistics paper was Hall (1980) appeared in the Japanese *Annals* AISM, which studied estimating a probability density function on the half real line with the orthogonal series. Hall (1981) was his first *The Annals of Statistics* (AoS) paper and his second statistics paper, which was on the density estimation with trigonometric series. The two works indicated that Peter's transition to Statistics started from nonparametric curve estimation, a field to which he has made enormous contributions which is surveyed by Cheng and Fan (2016) in this memorial issue.

By a search of four key words “bootstrap,” “bagging,” “resampling” and “percentile” on titles of Peter's more than 650 publications, we find 80 papers in the 30 year span from 1985 to 2015, with 50 of these papers published in the first ten years 1985–1994. See Table 1 for yearly counts on the bootstrap publications, which indicates a high intensity of output by Peter on the subject in this period. Figure 1

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