

# MATH 180A. INTRODUCTION TO PROBABILITY

## LECTURE 3

David A. Meyer

*Project in Geometry and Physics, Department of Mathematics  
University of California/San Diego, La Jolla, CA 92093-0112  
<http://math.ucsd.edu/~dmeyer/>; [dmeyer@math.ucsd.edu](mailto:dmeyer@math.ucsd.edu)*

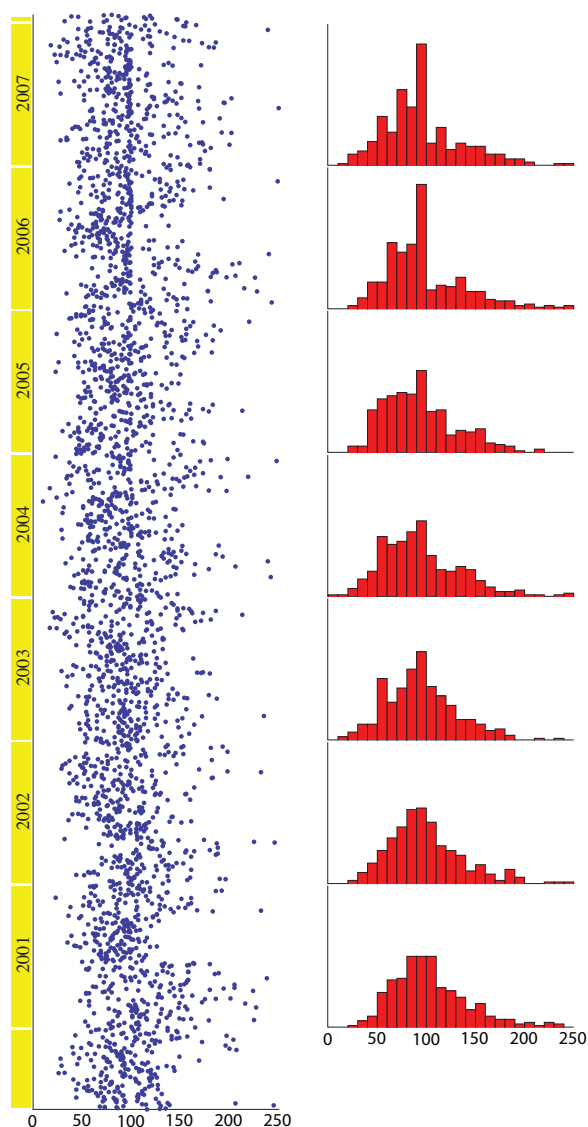
### Empirical probability distributions

EXAMPLE. The State Environmental Protection Administration (SEPA) in China monitors the air quality in 84 cities and posts the daily air quality index (AQI) for each on their website [1]. The site includes archives of these AQI back to 5 June 2000. It is relatively easy to download these data for analysis [2].

The adjacent figure shows the data for Beijing. The plot on the left side of the figure is the timeseries of AQI values in the range  $[0, 250]$ , with time plotted as the ordinate. (The highest reported AQI is 500; most are below 250. The smaller the AQI, the better the air quality.)

For each complete year of data, *i.e.*, 2001–2007, the plot on the right side of the figure is the empirical probability distribution for the AQI. That is, the area of the rectangle with base  $(x+0.5, x+10.5)$ , for  $x \in \{10k \mid 0 \leq k \leq 24, k \in \mathbb{Z}\}$  is equal to the number of days with AQI in  $(x, x+10]$  that year, divided by the number of days in the year.

Beijing is hosting the 2008 Olympic Games, so China has been working hard



to assuage concerns about the impact of pollution on the athletes. According to their standards, an AQI of 100 or less is acceptable, a “blue sky day”. It is easy to see in the empirical probability distributions that the probability of a blue sky day has increased from 2001 to 2007; the tallest rectangle in each of the 2002–2007 plots is the one for AQI in (90, 100]. Steven Q. Andrews has recently suggested that these plots indicate that China is fudging their numbers [3]. What do you think?

## References

- [1] <http://english.sepa.gov.cn/>.
- [2] One easy way is to write simple Perl code to do it. If you are interested, ask me about this.
- [3] S. Q. Andrews, “Beijing’s sky blues”, *The Wall Street Journal*, Commentary (9 January 2008).