

Associations between Chlorophyll *a* and various Microcystin-LR Health Advisory Concentrations

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Cyanobacteria harmful algal blooms (CHABs) are associated with a wide arrange of adverse health effects that stem mostly from the presence of cyanotoxins. To help protect against the impacts, several health advisory levels have been set for some of these toxins, in particular, one of the most common toxins, microcystin, has several advisory levels set for drinking water and recreational use and managing water bodies to meet those levels could have far reaching benefits. However, measuring microcystin can not currently be done *in situ* and requires samples be processed in a lab. This time consuming and expensive. It is possible to find reliable indicators that may be estimated quickly and *in situ* as a first defense against high level of microcystin. In particular, chlorophyll *a* has been shown to be positively associated with microcystin. In this paper we use this association to provide estimates of chlorophyll *a* that if exceeded would be indicative of a higher likelihood of exceeding select concentrations of microcystin. Using the 2007 National Lakes Assessment and a conditional probability approach that has been used in other water quality settings, we identify chlorophyll *a* concentrations that are more likely than not to be associated with an exceedance of a microcystin health advisory level. We look at the recent US EPA standards for drinking water as well as the World Health Organization levels for drinking water and recreational use. For microcystin concentrations of 0.3, 1, 1.6, 2, and 4 we find chlorophyll *a* concentrations of 23.68, 65.2, 79.8, 113.14, and 273.6, respectively. When managing for these various microcystin levels exceed these reported chlorophyll *a* concentrations should be a trigger for further testing and possibly management action.

1 Introduction

In the summer of 2014, the city of Toledo, OH was forced to shut down their municipal water supply due in part to an excess of Microcystin-LR that resulted from an ongoing harmful algal bloom in Lake Erie. Since this event, significant legislation has been passed in the United States and the US Environmental Protection Agency has released suggested microcystin-LR concentrations that would trigger health advisories.

MC requires lab work

MC associated with Chl *a*

Use association and cpa to id chl *a* concentration that indicative of exceeding HA

2 Methods

Source	Type	Concentration
WHO	Drinking	1 ug/l
U.S. EPA	Drinking	0.3 ug/l
U.S. EPA	Drinking	1.6 ug/l
WHO	Recreational	2-4 ug/l
WHO	Recreational	10-20 ug/l
WHO	Recreational	20-2000 ug/l
WHO	Recreational	>2000 ug/l

We evaluated associated chlorophyll *a* concentrations for an effect for each of the WHO and EPA levels. These were 0.3, 1, 1.6, 2, 4, 10, and 20 ug/l.

2.1 Data and Study Area

3 Results

Source	Microcystin	Chlorophyll
EPA_Child	0.3	23.68
WHO	1	65.2
EPA_Adult	1.6	79.8
WHO	2	113.1
WHO	4	273.6
WHO	10	338.4

Source	Microcystin	Chlorophyll
WHO	20	338.4

4 Discussion

5 Figures

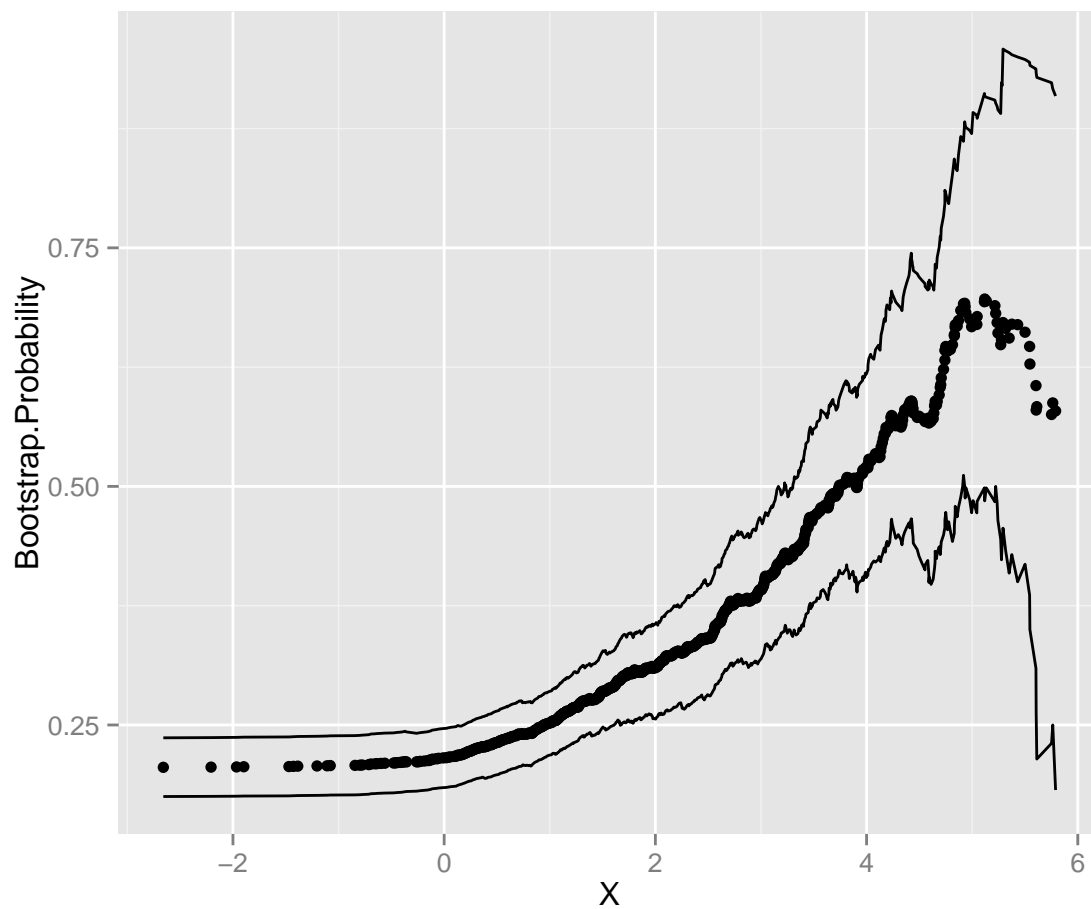


Figure 1

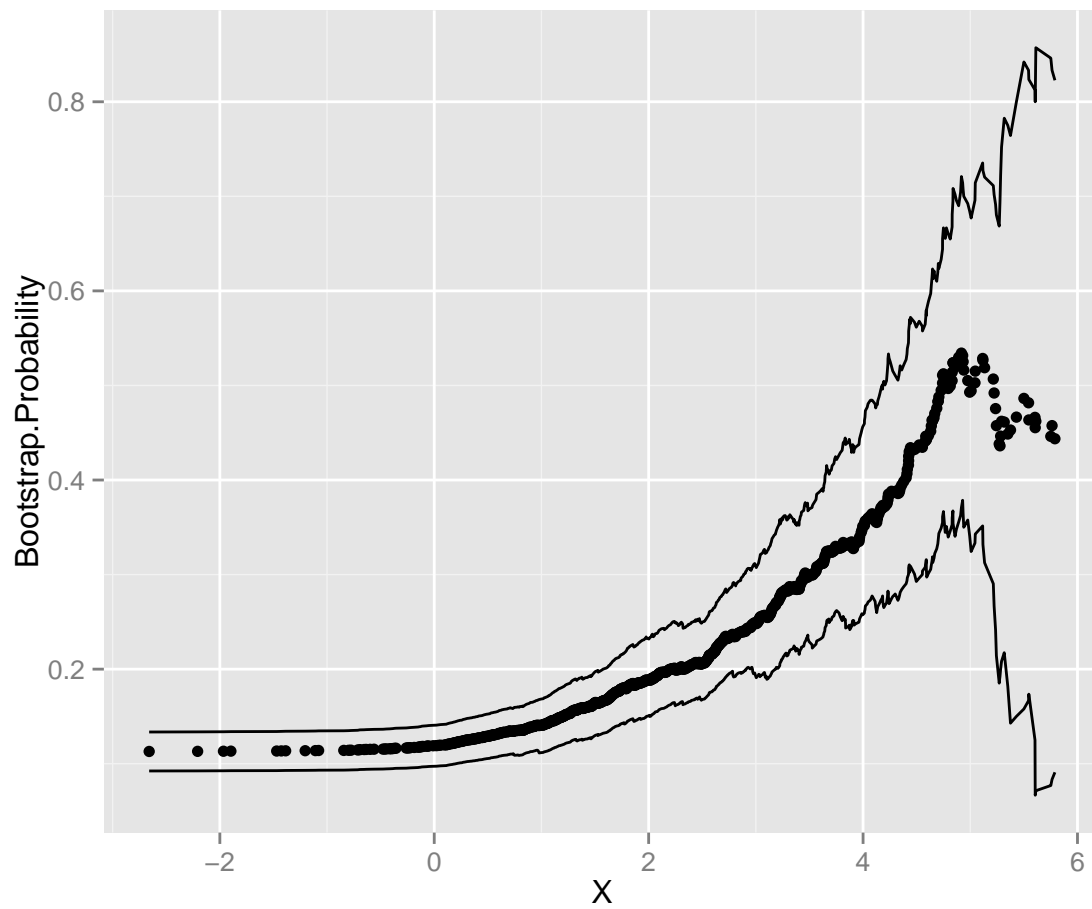


Figure 2

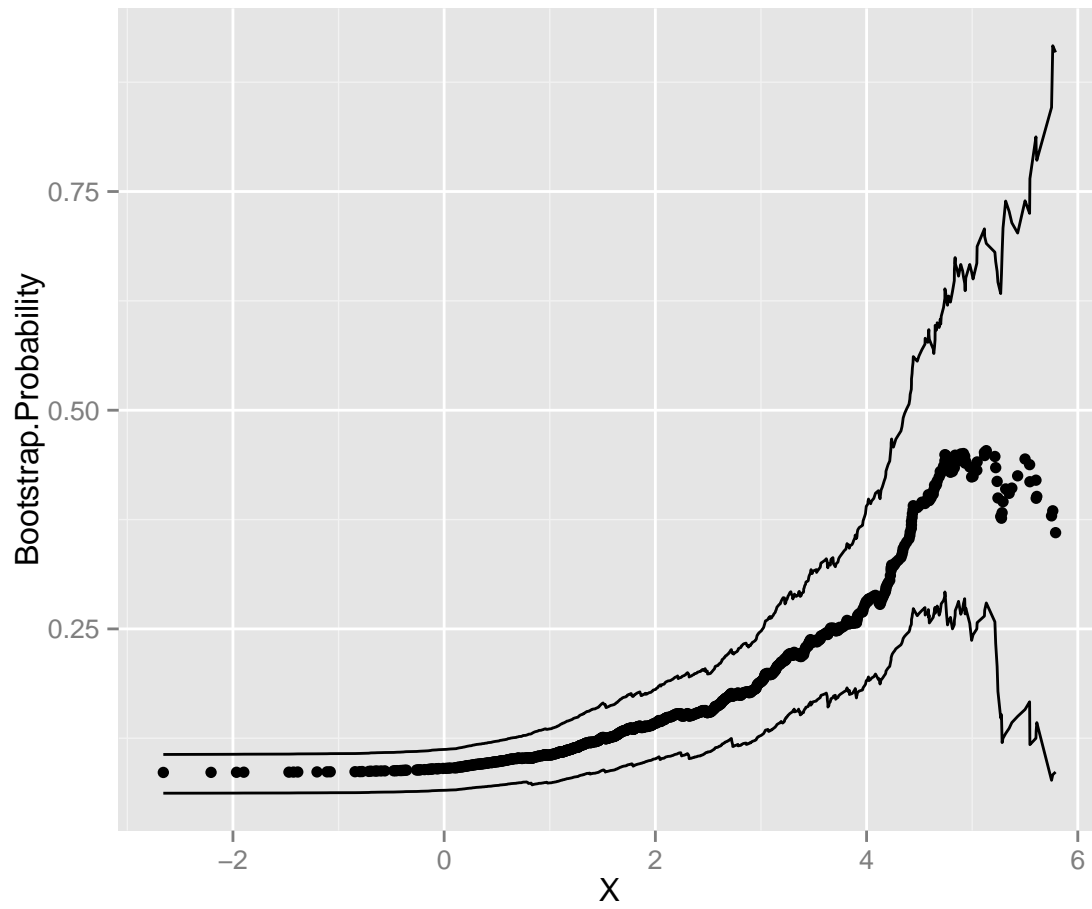


Figure 3

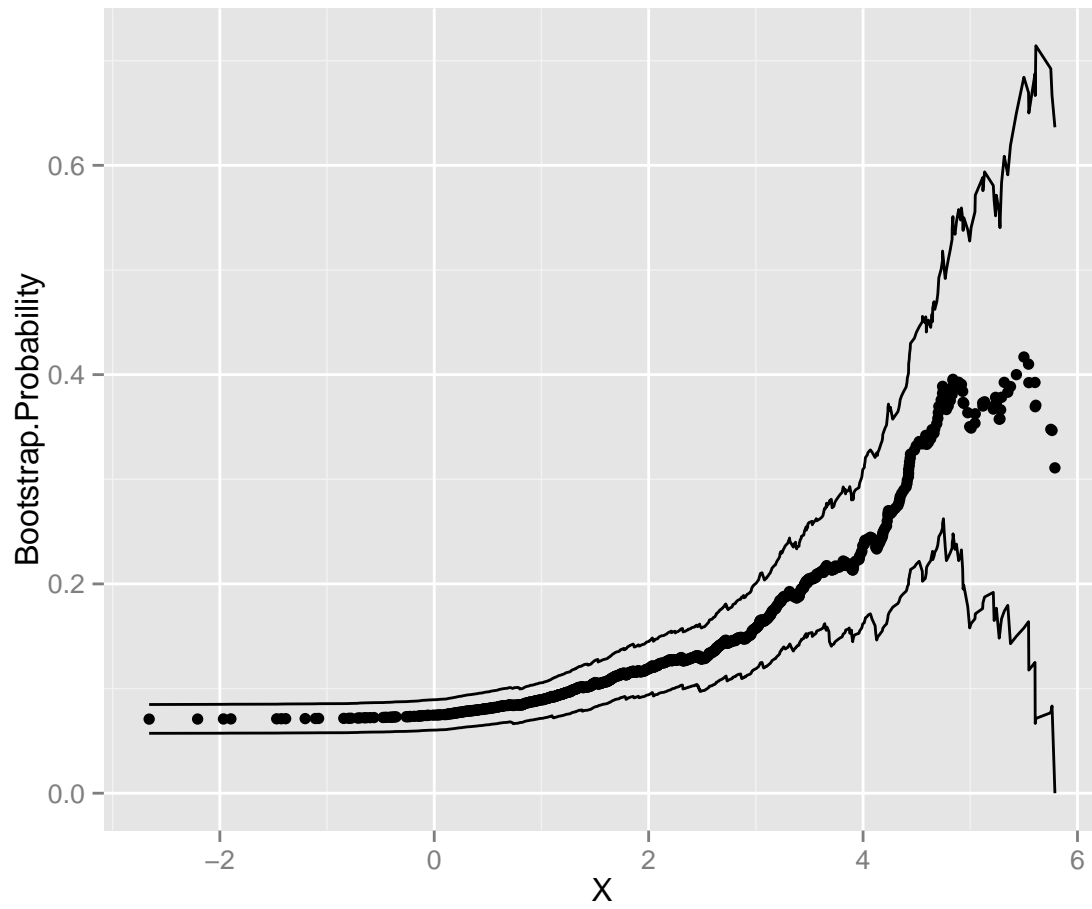
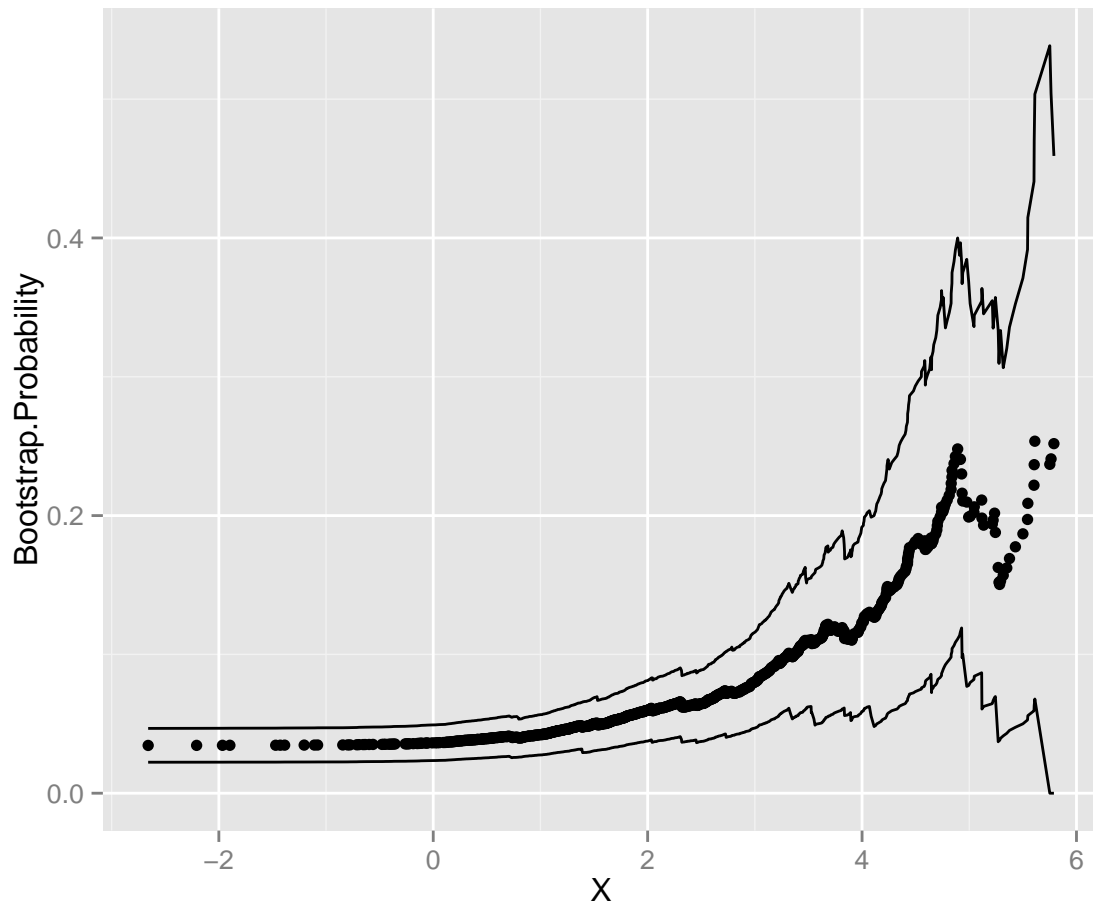
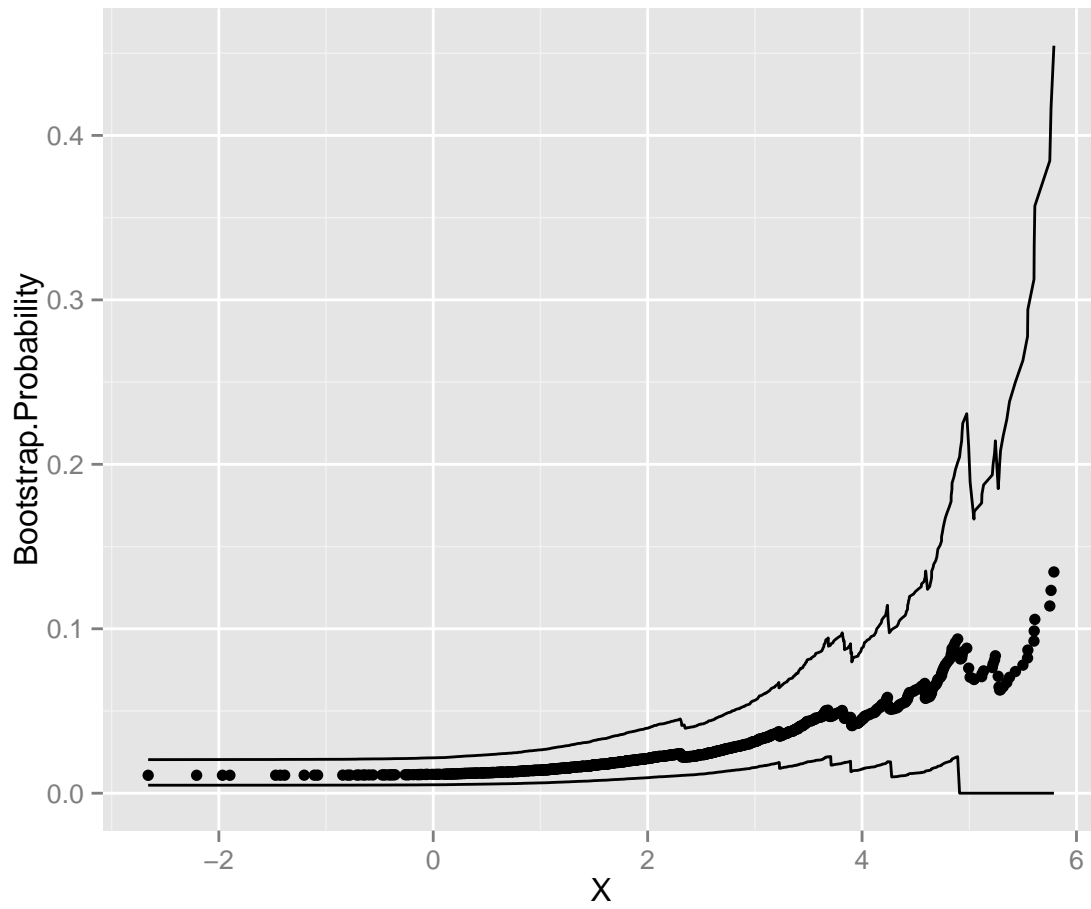
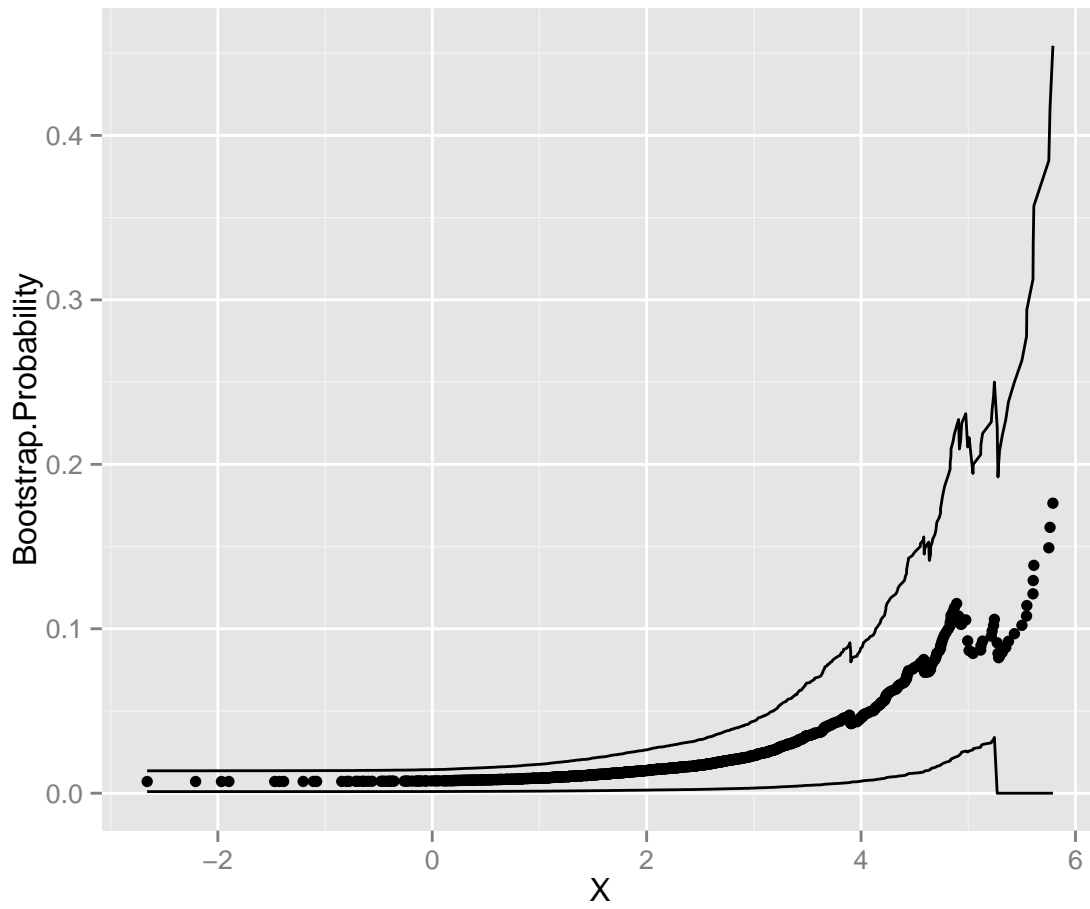


Figure 4







References