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 agains 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 micorcystin 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 agains high level of microcystin. In particular, chlorophyll *a* has been shown to be postively associated with microcystin. In this paper we use this assocation to provide estimates of chlorophyll *a* that if exceeded would be indiciative of a higher likelihood of exceeding select concentrations of microcystin. Using the 2007 National Lakes Assessment and a conditional probability appoach that has been used in other water quality settings, we idenfify 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 receational 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 microsystin levels exceed these reproted chlorophyll *a* concentratoins should be a trigger for further testing and possibly managment action.

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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 a ongoin harmful algal bloom in Lake Erie. Since this event, signficant legislation has been passed in the United States and the US Environmental Protection Agency (USEPA) has released suggested microcystin-LR concentrations that would trigger health advisories. While these levels and association advisories are likey to help mitigate the impacts from harmful algal blooms, they are not without complications. One of these complications is that they rely on availble measurments of Microcysin-LR which requires taking regular water samples and having those samples process in a lab to determin the toxin concentration. This has the potentially to be costly and time consuming both factors which could limit monitoring efforts. Fortunately, microcystin-LR has been shown to be associated with several other, more easily measured components of water quality.

Chlorophyll *a* is one of the most commonly measured components of water quality that is also known to be strongly associated with Microsystin-LR concentrations [REFS].

MC associated with Chl a These levels, along with the existing World Health Organization (WHO) levels represent a range concentrations that occur

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 evaulated associated chlorohpyll *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
WHO	20	338.4

4 Discussion

5 Figures

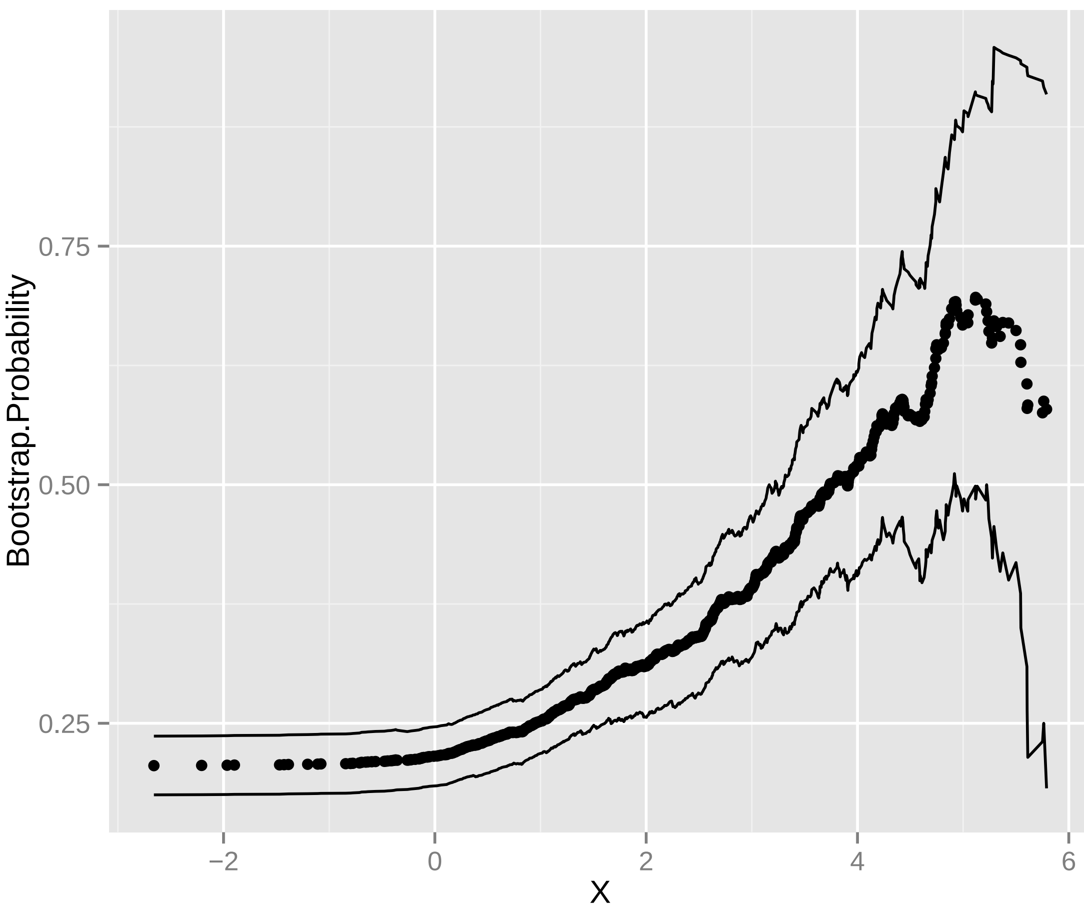


Figure 1

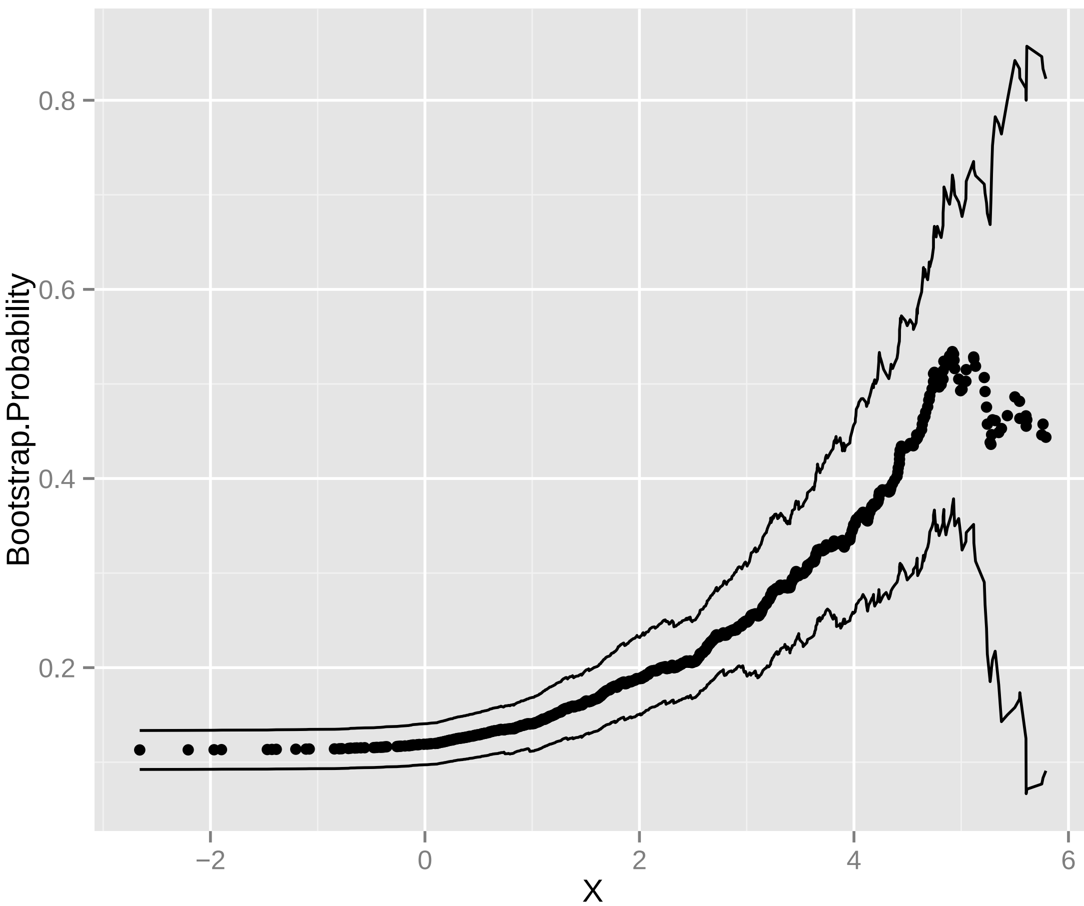
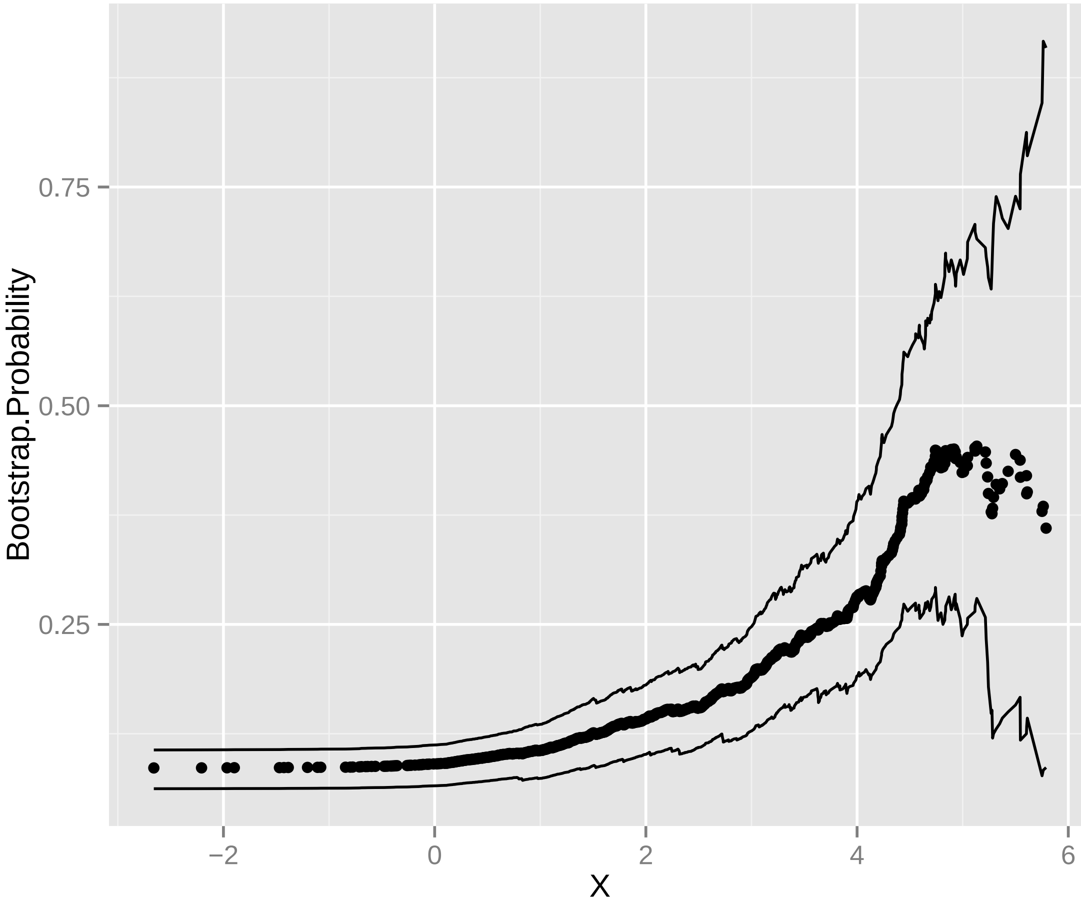


Figure 2



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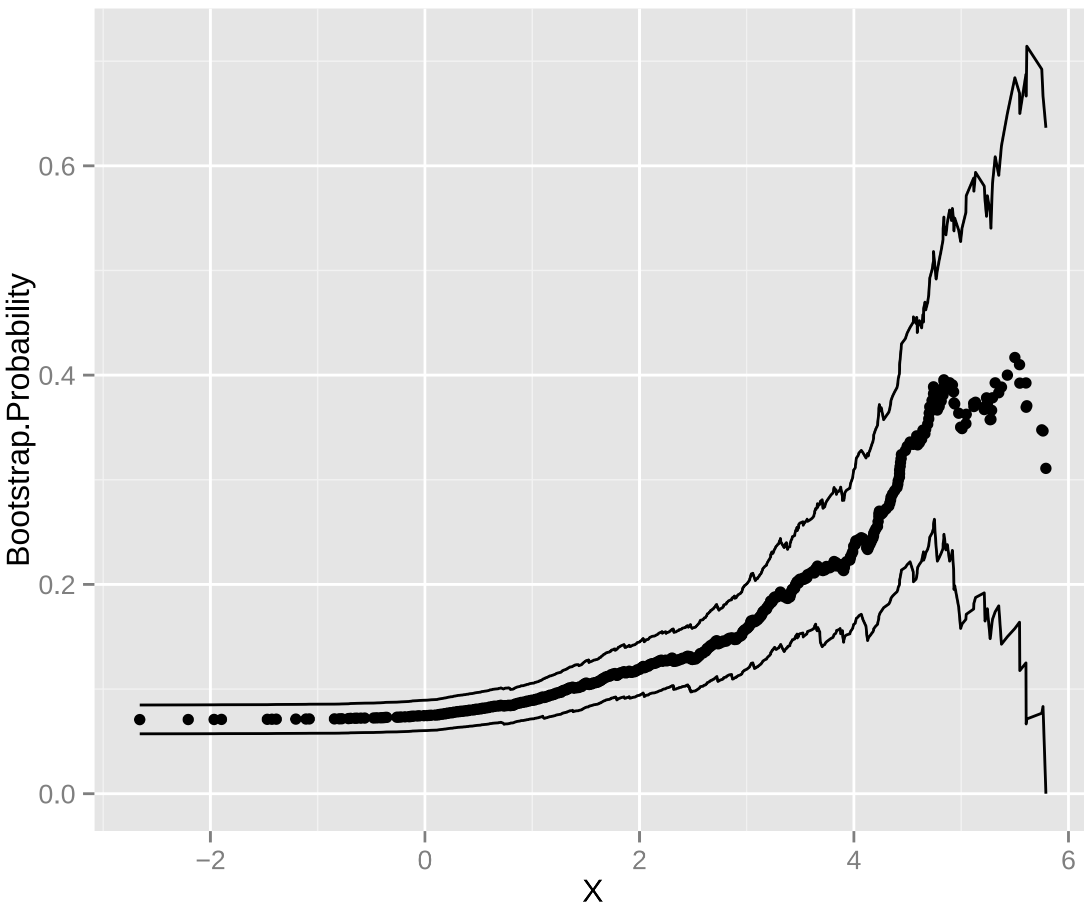

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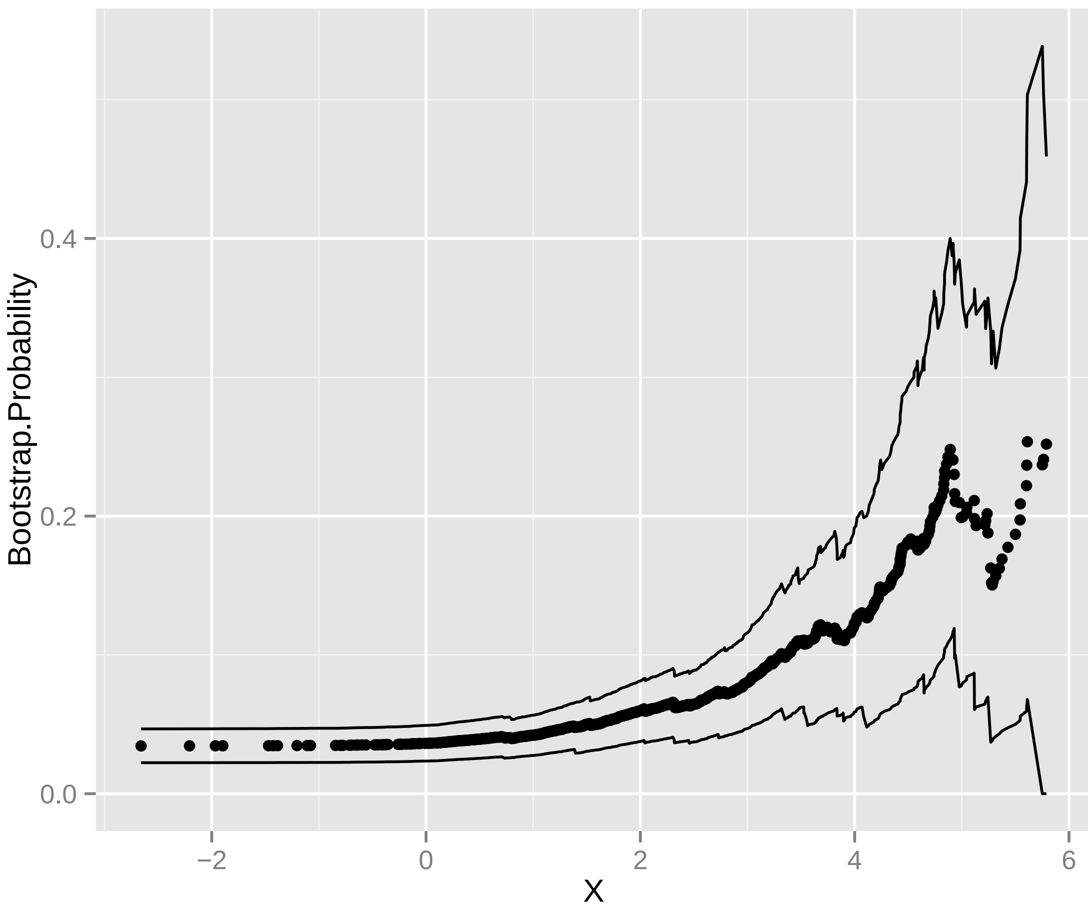

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6
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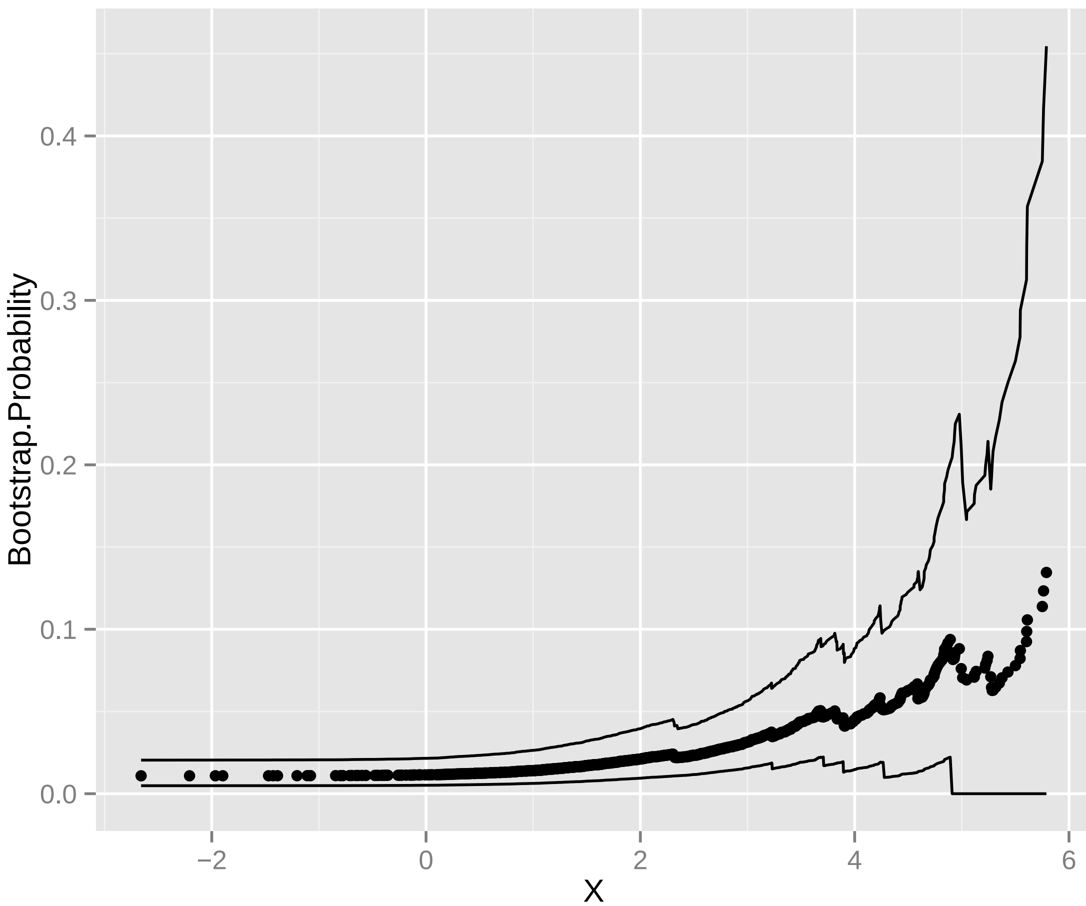
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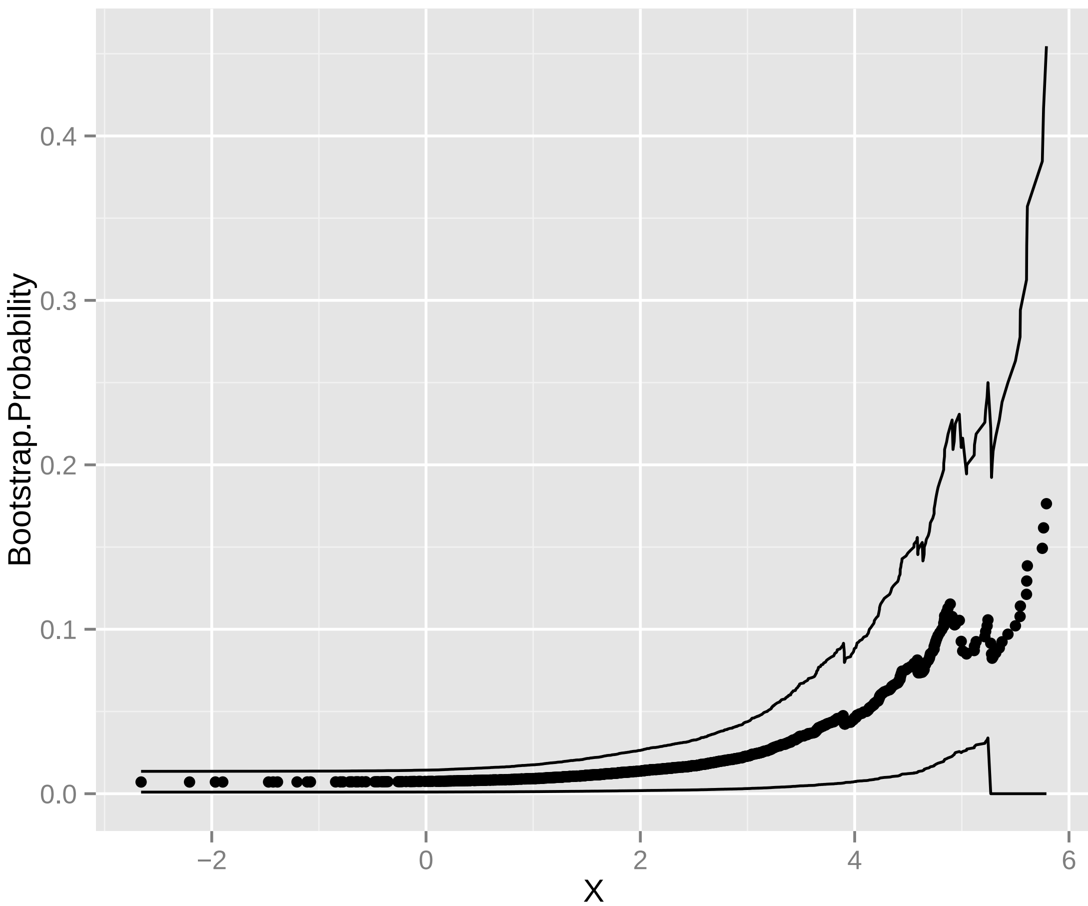
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References