The luminosities of the brightest cluster galaxies and brightest satellites in SDSS groups

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We show that the distribution of luminosities of Brightest Cluster Galaxies in an SDSS-based group catalog suggests that BCG luminosities are just the statistical extremes of the group galaxy luminosity function. This latter happens to be very well approximated by the all-galaxy luminosity function (restricted to Mr<-19.9), provided one uses a parametrization of this function that is accurate at the bright end. A similar analysis of the luminosity distribution of the Brightest Satellite Galaxies suggests that they are best thought of as being the second brightest pick from the same luminosity distribution of which BCGs are the brightest. I.e., BSGs are not the brightest of some universal satellite luminosity function, in contrast to what Halo Model analyses of the luminosity dependence of clustering suggest. However, we then use mark correlations to provide a novel test of these order statistics, showing that the hypothesis of a universal luminosity function (i.e. no halo mass dependence) from which the BCGs and BSGs are drawn is incompatible with the data, despite the fact that there was no hint of this in the BCG and BSG luminosity distributions themselves. We also discuss why, since extreme value statistics are explicitly a function of the number of draws, the consistency of BCG luminosities with extreme value statistics is most clearly seen if one is careful to perform the test at fixed group richness N. Tests at, e.g., fixed total group luminosity Ltot, will generally be biased and may lead to erroneous conclusions.

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