

Bayesian Theory on the Background-Subtracted Intensity

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We consider the measurement of a signal in the presence of a background rate that has been independently measured. The usual approach to this problem is to obtain an estimate of the background rate by observing an empty part of the sky, and an estimate of the signal plus background rate by observing the region where a signal is expected. The signal rate is then estimated by subtracting the background rate. This procedure is the correct one for analyzing data regarding a signal which can be either positive or negative when a Gaussian distribution is appropriate. Thus, it works well when the background and the signal rates are both large so that the Poisson distribution is well-approximated by a Gaussian. However, when the rates are small, the procedure fails. It can lead to negative estimates of the signal rate, even when it should produce a positive value. This problem can be solved by using a Bayesian approach, which is now growing in popularity. We investigate the approach in detail.