

Radio frequency (RF) radiometers are sensitive receivers that rely on a multistage electrical network to measure electromagnetic radiation from an emitting source. Characterizing and removing low-level instrumental systematic errors accurately would advance the radiometers' ability to detect extremely weak radiation, i.e., equivalent to brightness temperature of few tens of millikelvin. For this reason, we investigate a lesser-known multiplicative noise that transforms the distribution of the input signal from a Gaussian to a lognormal one, the result of successively multiplying random gain fluctuations from one stage to another. We study the impact of this lognormal noise on a radiometer's sensitivity using analytical descriptions and computer-generated data. As a result, we present a case study for the sky-averaged 21-cm cosmology experiments. This study illustrates that conventional load-switching calibration approaches for correcting instrumental systematic errors inadequately mitigate lognormal noise. Finally, we provide methods that mitigate the influences of lognormal noise