Various probability distribution functions for the entire intensity range of short-term precipitation, such as the hourly and daily precipitation intensities during the snowless season in Japan, were examined. The traditional distribution functions, i.e., the exponential, Weibull, Gamma, generalized Gamma, log-normal, and Johnson's SB distributions, were insufficient to express the precipitation intensities within the rainy periods. Three types of distribution functions were newly proposed in association with the extension of the Weibull distribution. The new distributions were constructed to vary asymptotically from the exponential distribution on the weak intensity side to the Weibull distribution on the strong intensity side. The number of parameters of the distribution functions was four except for the parameter of the rainy period ratio. One or two parameters were fixed as unity parameters in all observation points in the parameter estimation in order to overcome a multi-solution problem caused by the strong non-linearity of the distribution functions. The unity parameters were determined to be the values at which the all-points average of mean square errors for logarithms of exceedance probabilities had the minimum value. Other parameters were estimated by the maximum likelihood estimation method. The new distribution functions were more suitable to express the short-term precipitation, including both weak and strong intensities, than the traditional distribution functions were. For the hourly precipitation, the boundary intensity between the exponential and Weibull distribution properties was considered to be associated with that between the main domination ranges of stratiform and convective precipitations.