Dust continuum surveys (e.g., BGPS, ATLASGAL, HiGal, and JPS) have discovered on order $10^4$ dense clumps and clouds of molecular gas – potential sites of star formation – throughout the disk of the Milky Way. These surveys have enormous potential to reveal the physical conditions of star-forming gas and its distribution within the Galaxy. However, to derive physical conditions and 3D locations, distances to continuum-detected clouds and clumps must be determined. We have developed a distance probability density function formalism that combines kinematic distances (from dense gas and $^{13}$CO line-of-sight velocities) and the Galactic rotation curve with prior probabilities from mid-infrared absorption features and the Galactic $H_2$ distribution. With this formalism, we have derived well-constrained distances to 1,800 clouds and clumps in the northern Galactic Plane detected in the Bolocam Galactic Plane Survey. Sizes, masses, and densities of these clouds and clumps have been inferred and their positions established within the Milky Way, revealing spiral arm structure. This distance method is readily applicable to other continuum surveys and the incorporation of additional distance discrimination techniques, which will ultimately help enable the distribution of star forming gas within the Milky Way to be characterized at kiloparsec resolution.