We study the statistics of gamma-ray bursts, assuming that gamma-ray bursts are cosmological and they are beamed in the form of a conical jet with a large bulk Lorentz factor $\sim 100$. In such a conic beam, the relativistic ejecta may have a spatial variation in the bulk Lorentz factor and the density distribution of gamma-ray emitting jet material. An apparent luminosity function arises because the axis of the cone is randomly oriented with respect to the observer’s line of sight. The width and the shape of the luminosity function are determined by the ratio of the beam opening angle of the conical jet to the inverse of the bulk Lorentz factor, when the bulk Lorentz factor and the jet material density is uniform on the photon emitting jet surface. We calculate effects of spatial variation of the Lorentz factor and the spatial density fluctuations within the cone on the luminosity function and the statistics of gamma-ray bursts. In particular, we focus on the redshift distribution of the observed gamma-ray bursts. The maximum distance to and the average redshift of the gamma-ray bursts are strongly affected by the beaming-induced luminosity function. The bursts with the angle-dependent Lorentz factor which peaks at the center of the cone have substantially higher average gamma-ray burst redshifts. When both the jet material density and the Lorentz factor are inhomogeneous in the conical beam, the average redshift of the bursts could be 5 times higher than that of the case in which relativistic jet is completely homogeneous and structureless. Even the simplest models for the gamma-ray burst jets and their apparent luminosity distributions have a significant effect on the redshift distribution of the gamma-ray bursts.