

# Computing highest density regions for continuous univariate distributions with known probability functions

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## Abstract

We examine the problem of computing the highest density region (HDR) in a computational context where the user has access to a density function and quantile function for the distribution (e.g., in the statistical language  $\mathbb{R}$ ). We examine several common classes of continuous univariate distributions based on the shape of the density function; this includes monotone densities, quasi-concave and quasi-convex densities, and general multimodal densities. In each case we show how the user can compute the HDR from the quantile and density functions by framing the problem as a nonlinear optimisation problem. We implement these methods in  $\mathbb{R}$  to obtain general functions to compute HDRs for classes of distributions, and for commonly used families of distributions. We compare our method to existing  $\mathbb{R}$  packages for computing HDRs and we show that our method performs favourably in terms of both accuracy and average speed.

**Keywords** Highest density region · Intensity function · Univariate distribution · Monotonicity · Quasi-concavity · Nonlinear optimisation