aequationes
mathematicae
2025

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Symmetric probabilistic divergence generator

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Abstract. Probabilistic divergence measures the statistical distance between two probability distributions. Traditionally, they are used in probability theory and information theory. Nowadays, many machine learning algorithms rely on such divergences to learn models and distributions of parameters, enabling them to perform a wide range of automated tasks. This small article proposes a new family of symmetric probabilistic divergences generated using a novel functional generator. The generator uses monotonically increasing and decreasing functions to create a variety of probabilistic divergences. While it is possible to generate a variety of probabilistic divergences based on the suitable choices of functions, here the focus on six new probabilistic divergences.

Mathematics Subject Classification. 60J35.

Keywords. Function generator, Probabilistic divergences, Monotonic functions, Information theory, Machine learning.

1. Introduction

A probabilistic divergence is a statistical distance that measures separateness between two probability distributions, a notion similar to the concept of geometrical distance. It has become an essential tool in data analytic toolkit, especially in the areas of information theory [1], statistical inferencing [2], and new-fangled ways of data exploration and generation [3]. Modern probabilistic machine learning techniques, like Deep Learning and Generative AI depend on probabilistic divergences to comprehend the structures and modalities of datasets, and allow such models to generate new data [4].

The standard probabilistic divergences like Kulback-Liebler divergence (also known as KL-divergence) [1], or Jensen-Shannon divergence [5,6] have become standard tools to measure the separateness of two different probability distributions. Renyi [7] introduced the use of a functional in f-divergence and Csiszar [8] and others [9] has explored the topic in detail. It is well-known that

Roychowdhury, S. (2025). Symmetric probabilistic divergence generator. Aequationes Mathematicae, 1–15.
https://doi.org/10.1007/s00010-024-01148-z