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Spherical fuzzy TODIM method for MAGDM integrating cumulative prospect theory and CRITIC method and its application to commercial insurance selection

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Abstract
In rent years, commercial insurance selection is a hot issue in multiple attribute group decision making (MAGDM). Spherical fuzzy sets (SFSs) can better express the vague factors to commercial insurance selection. In this paper, spherical fuzzy TODIM approach based on cumulative prospect theory (SF-CPT-TODIM) is presented for MAGDM issues. It can display the psychological perception of decision makers (DMs) very well. Furthermore, when the attribute weights are unknown, we obtain the attribute weights through CRITIC method under SFSs to heighten the reasonability of weight information. Finally, this article gives a practical example of the raised approach for the hot issue about commercial insurance selection to certify the availability and superiority for the raised method via comparing with some existing approaches.

Keywords Multiple attribute group decision making (MAGDM) · Spherical fuzzy sets (SFSs) · TODIM · Cumulative prospect theory (CPT) · CRITIC · Commercial insurance selection

1 Introduction

In 1965, Zadeh (Zadeh 1965) initiated fuzzy sets (FSs) to reflect the potential ambiguity of things via defining membership degree (MD) function. By far, FSs have been extensively studied and extended into many new forms. Intuitionistic FSs (IFSs)(Atanassov 1986) added non-membership degree(N-MD) on the basis of FSs, which could describe uncertain events more truly and accurately. Pythagorean FSs (PyFSs) expanded the range of MD and N-MD of IFSs and gave a broader representation of element fuzziness. In the past decades, IFSs and PyFSs have made many remarkable achievements in dealing with uncertain problems(He et al. 2016; Chang et al. 2019; Gohain et al. 2022; Huang et al. 2020; Tang et al. 2019; Lin et al. 2021). But there are situations in real life that cannot be described with IFSs and PyFSs. For example, in the voting model, voters' opinions on candidates should include abstention and rejection in addition to approval and disapproval. In order to deal with this scenario,

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