DE GRUYTER

Mathematica Slovaca

DOI: 10.1515/ms-2023-0021
Math. Slovaca **73** (2023), No. 1, 245–262

COMPRESSIVE SENSING USING EXTROPY MEASURES OF RANKED SET SAMPLING

Saeid Tahmasebi* — Mohammad Reza Kazemi** — Ahmad Keshavarz*** — Ali Akbar Jafari**** — Francesco Buono*****, c

(*Communicated by Gejza Wimmer*)

ABSTRACT. The aim of this paper is to consider the extropy measure of uncertainty proposed by Lad, Sanfilippo and Agrò for the problem of compressive sensing. For this purpose, two sampling designs, i.e., simple random sampling (SRS) and a modified version of ranked set sampling, known as maximum ranked set sampling procedure with unequal samples (MRSSU), are utilized and some uncertainty measures such as extropy, cumulative extropy and residual extropy are obtained and compared for these sampling designs. Also, some results of extropy in record ranked set sampling data are developed. Then a study on comparing the behavior of estimators of cumulative extropy in MRSSU and SRS using simulation method is obtained. As an example, two sampling methods MRSSU and SRS are utilized for compressive sensing technique and their performances are compared via signal to noise ratio (SNR), correlation coefficient of reconstructed and the original signal and cumulative extropy measure of uncertainty. The results show that the values of SNR and correlation coefficient for MRSSU are higher than those of SRS. Furthermore, it is shown that MRSSU scheme can efficiently reduce the uncertainty measure of cumulative extropy.

1. Introduction

Compressive sensing is a signal processing technique which is used to construct a signal using a small number of measurements (see [9]). This has received lots of attention in signal processing, statistics and computer science. The purpose of compressive sensing is to reconstruct a sparse signal using a linear random projection. A signal is considered sparse if it has very few non-zero elements. When a signal is not sparse in the time domain, its transform to another domain may be sparse. Common approaches for this purpose are discrete Fourier transform, discrete cosine transform (DCT) and wavelet transform. To achieve this goal, a signal of electrocardiography is utilized.

Ranked set sampling (RSS) design is a cost-effective sampling for situations where taking actual measurements on units is expensive but ranking of units is easy. McIntyre [21] indicated that RSS is a more efficient sampling method than SRS method for estimating the population mean. RSS and some of its variants are sampling designs that allow the experimenter to span the full range of values in the population and those have been applied widely in industrial, economics, environmental and ecological studies, biostatistics and statistical genetics.

2020 Mathematics Subject Classification: Primary 62B10, 62D05, 94A17.
Keywords: Compressive sensing, cumulative extropy, maximum ranked set sampling, record ranked set sampling, stochastic ordering.
c Corresponding author.