Risk Patterns and Correlated Brain Activities. Multidimensional Statistical Analysis of fMRI Data with Application to Risk Patterns

Alena Mysickova[(1)], Song Song[(2)], Piotr Majer[(2)], Peter N.C.Mohr[(3)], Hauke R. Heekeren[(3)], and Wolfgang K. Härdle[(4)*]

[(1)]Max Planck Institute for Molecular Genetics, Berlin, Germany
[(2)]C.A.S.E. Center for Applied Statistics and Economics, Humboldt-University at zu Berlin, Berlin, Germany
[(3)]Max Planck Institute for Human Development, Berlin, Germany
[(4)]School of Business and Economics, Humboldt-University zu Berlin, Berlin, Germany
stat@wiwi.hu-berlin.de

Abstract

Decision making involves uncertainty and risk. Understanding which part of the human brain is activated during risky decisions and whether there is a significant reaction to a specic stimuli in the hemodynamic response (neural processes underlying investment decisions) are important goals in decision neuroscience. We apply a novel investment decision task on 17 studied objects exercised in the functional magnetic resonance imaging (fMRI) scan. We obtain a time series of three-dimensional images of the blood-oxygen-level dependent (BOLD) fMRI signals. The challenge is to capture the dynamic behavior of specic brain regions in this high-dimensional time series data, by a flexible factor approach resulting in a low dimensional representation. We apply the dynamic semiparametric factor model (DSFM) presented in (Park et al., 2009) which can identify the corresponding brain's activation areas in space and dynamics in time. Further, we classify the risk attitudes of all subjects based on the estimated low-dimensional time series. Our classi-cation analysis conrm the estimated risk attitudes from subjects' answers directly.

Keywords: Risk; Risk attitude; fMRI; Decision making; Medial orbifrontal.