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Multilevel Analysis in Analyzing Speech Data

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ABSTRACT

The speech produced by human vocal tract is a complex acoustic signal, with diverse applications in phonetics, speech synthesis, automatic speech recognition, speaker identification, communication aids, speech pathology, speech perception, machine translation, hearing research, rehabilitation and assessment of communication disorders and many more. Analysis of the acoustic characteristics of speech sounds of is needed to understand their production and perception which will further be useful in perceptual studies, speech processing strategies, diagnosis and rehabilitation of various communication disorders. In large repeated measure experiments such speech analysis data, issues regarding design effect, sphericity, standard error and missing data generally do not get adequate attention in the statistical analysis which will effect on the study outcome. Multi-level modeling (MLM) has emerged in the past decades as a highly flexible and useful tool for statistical analysis and inference. In hierarchical studies, repeated measures data, the problems that are generally encountered by usual analysis are well addressed by MLM. The main aim and objectives of this paper is to explain the use of multi-level modeling (MLM) in actual research in speech analysis and to compare MLM against its more conventional counterpart for hypothesis testing, ANOVA/multiple regression. Most of the statistical methods are inferred on fictitious data. On the actual raw data, both multiple regression analysis (naive analysis) and MLM models were applied to find relationship of age, gender and region on format frequencies and results of these analyses were compared. There is a marginal difference in estimates from the multilevel model and multiple regression analysis. The standard error of each parameter estimates from multilevel model are larger than that from naive analysis. Most importantly, we could obtain information about the variation or contribution of each level on the outcome measure. Especially in speech analysis when we fail to control individual and contextual influences while studying the target