University of Hamburg

Master Thesis

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Department of Psychology with focus on Quantitative Methods

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Abstract

Institute of Psychology

Department of Psychology with focus on Quantitative Methods

Master of Science

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by Lona Frießner

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Methods

3.1 Data generation

A simulation study was conducted to compare the methods of missing data handling. (erklären, was eine Simulationsstudie ist)

Data was generated from a parametric model with known parameters.

3.2 Data-generating model

The data-generating model was a two-level random intercept model:

$$Y_{ij} = \gamma_{10} \left(X_{ij} - \bar{X}_{\cdot j}\right) + \gamma_{01} \bar{X}_{\cdot j} + \gamma_{02} W_j + u_{0j} + e_{ij} \tag{3.1}$$

The random effects are normally distributed with $u_{0j} \sim N\left(0, \psi^2\right)$ and $e_{ij} \sim N(0, \sigma^2)$ and independent of each other. Y_{ij}, X_{ij} and W_j are created as z-standardized variables, which means that they have a mean of zero and a variance of 1. First,

3.3 Missing data generation

3.4 Factors and simulation conditions

3.4.1 Constants

3.4.2 Level-2 sample size

As the small-sample performance of the methods is of interest, three different group sizes are used: - N2 = 15 - N2 = 30 - N2 = 60 These sizes are chosen to reflect McNeish´s (2017) summary that group sizes below 25 almost certainly face issues and below 50 there is a susceptibility to small sample biases. These sample sizes should therefore cover problematic, likely problematic and not problematic magnitudes. ### Effect size of the group-level effect { 01} The effect size of the group-level effect of X is varied between 0.0 and 0.30. This is to investigate the performance both with a null effect of the parameter of interest as well as a substantive effect.

3.4.3 ICC of X and residual Y

3.4.4 Missing data mechanism

Missing data mechanism is set to either MCAR or MAR. For MAR, the strength of relationship between W and missing of X is set to 0.4, which corresponds to 0.4^2 % 100% explanation of variance in missingness through W.

3.5 Methods of missing data handling

3.5.1 Estimands

3.5.2 Performance measures

3.6 Execution of simulation

Chapter 4

Results

Results text

Table 4.1: Simulation results (N2 = 15, $\gamma_{01} = 0$)

	CD			LD			MI-R			MI-a			Bayes		
	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD
MCAR															
ICC = 0.1															
γ_{01}	0.002	0.942	0.284	0.037	0.941	0.300	0.005	0.966	0.252	0.005	0.986	0.252	0.003	0.980	0.291
γ_{10}	-0.106	0.771	0.084	-0.106	0.831	0.104	-0.108	0.825	0.103	-0.108	0.831	0.103	-0.110	0.823	0.100
ICC = 0.3															
γ_{01}	0.000	0.960	0.272	0.012	0.953	0.280	-0.001	0.942	0.278	-0.001	0.972	0.278	-0.003	0.980	0.288
γ_{10}	-0.099	0.776	0.089	-0.100	0.818	0.111	-0.105	0.822	0.108	-0.105	0.827	0.108	-0.106	0.816	0.108
MAR															
ICC = 0.1															
γ_{01}	-0.002	0.949	0.283	0.031	0.947	0.284	0.007	0.970	0.247	0.007	0.985	0.247	0.001	0.987	0.289
γ_{10}	-0.100	0.782	0.087	-0.102	0.835	0.106	-0.107	0.820	0.104	-0.107	0.828	0.104	-0.107	0.806	0.102
ICC = 0.3															
γ_{01}	-0.016	0.943	0.279	0.007	0.949	0.279	-0.014	0.943	0.275	-0.014	0.968	0.275	-0.016	0.975	0.291
γ_{10}	-0.099	0.800	0.087	-0.101	0.837	0.105	-0.104	0.841	0.102	-0.104	0.846	0.102	-0.105	0.842	0.101

TABLE 4.2: Simulation results (N2 = 15, γ_{01} = 0.4)

	CD			LD			MI-R			MI-a			Bayes		
	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD
MCAR															
ICC = 0.1															
γ_{01}	-0.008	0.953	0.275	-0.038	0.968	0.269	-0.075	0.965	0.239	-0.075	0.981	0.239	-0.036	0.985	0.281
γ_{10}	-0.100	0.779	0.083	-0.100	0.837	0.102	-0.101	0.831	0.101	-0.101	0.837	0.101	-0.103	0.826	0.099
ICC = 0.3															
γ_{01}	0.003	0.955	0.272	-0.013	0.949	0.272	-0.016	0.951	0.275	-0.016	0.967	0.275	-0.008	0.971	0.290
γ_{10}	-0.098	0.790	0.083	-0.097	0.832	0.106	-0.101	0.827	0.103	-0.101	0.834	0.103	-0.103	0.815	0.101
MAR															
ICC = 0.1															
γ_{01}	-0.004	0.959	0.276	-0.050	0.942	0.283	-0.078	0.965	0.238	-0.078	0.977	0.238	-0.039	0.982	0.276
γ_{10}	-0.107	0.755	0.084	-0.105	0.833	0.105	-0.107	0.820	0.102	-0.107	0.824	0.102	-0.110	0.813	0.101
ICC = 0.3															
γ_{01}	0.006	0.962	0.269	-0.019	0.956	0.275	-0.020	0.947	0.271	-0.020	0.976	0.271	-0.008	0.977	0.290
γ_{10}	-0.101	0.758	0.086	-0.100	0.823	0.105	-0.103	0.815	0.102	-0.103	0.824	0.102	-0.106	0.815	0.102

TABLE 4.3: Simulation results (N2 = 30, $\gamma_{01} = 0$)

	CD			LD			MI-R			MI-a			Bayes		
	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD
MCAR															
ICC = 0.1															
γ_{01}	0.003	0.945	0.188	0.042	0.939	0.186	0.014	0.962	0.173	0.014	0.976	0.173	0.009	0.963	0.199
γ_{10}	-0.105	0.589	0.059	-0.106	0.695	0.073	-0.107	0.685	0.073	-0.107	0.690	0.073	-0.108	0.684	0.072
ICC = 0.3															
γ_{01}	-0.004	0.957	0.185	0.010	0.964	0.185	-0.003	0.955	0.190	-0.003	0.964	0.190	-0.003	0.965	0.192
γ_{10}	-0.099	0.602	0.063	-0.100	0.716	0.077	-0.103	0.696	0.077	-0.103	0.700	0.077	-0.103	0.692	0.076
MAR															
ICC = 0.1															
γ_{01}	0.006	0.941	0.191	0.039	0.947	0.192	0.010	0.965	0.177	0.010	0.972	0.177	0.003	0.965	0.203
γ_{10}	-0.100	0.611	0.061	-0.102	0.712	0.075	-0.103	0.712	0.074	-0.103	0.718	0.074	-0.104	0.688	0.073
ICC = 0.3															
γ_{01}	0.008	0.969	0.179	0.027	0.956	0.183	0.011	0.958	0.186	0.011	0.968	0.186	0.010	0.967	0.188
γ_{10}	-0.100	0.621	0.062	-0.100	0.740	0.076	-0.103	0.718	0.075	-0.103	0.725	0.075	-0.103	0.714	0.074

Table 4.4: Simulation results (N2 = 30, γ_{01} = 0.4)

	CD			LD			MI-R			MI-a			Bayes		
	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD
MCAR															
ICC = 0.1															
γ_{01}	0.005	0.950	0.189	-0.034	0.956	0.187	-0.052	0.956	0.175	-0.052	0.966	0.175	-0.009	0.970	0.204
γ_{10}	-0.100	0.602	0.056	-0.101	0.726	0.068	-0.099	0.741	0.066	-0.099	0.747	0.066	-0.103	0.704	0.065
ICC = 0.3															
γ_{01}	0.007	0.943	0.188	-0.008	0.941	0.191	-0.002	0.938	0.194	-0.002	0.953	0.194	0.004	0.951	0.201
γ_{10}	-0.100	0.596	0.057	-0.097	0.732	0.069	-0.099	0.739	0.067	-0.099	0.740	0.067	-0.100	0.712	0.067
MAR															
ICC = 0.1															
γ_{01}	0.005	0.948	0.191	-0.033	0.944	0.190	-0.057	0.952	0.174	-0.057	0.963	0.174	-0.015	0.958	0.204
γ_{10}	-0.099	0.608	0.060	-0.099	0.738	0.073	-0.097	0.742	0.073	-0.097	0.744	0.073	-0.100	0.705	0.071
ICC = 0.3															
γ_{01}	0.002	0.941	0.182	-0.014	0.947	0.180	-0.006	0.942	0.185	-0.006	0.951	0.185	0.000	0.954	0.191
γ_{10}	-0.102	0.588	0.059	-0.101	0.694	0.075	-0.103	0.693	0.072	-0.103	0.700	0.072	-0.104	0.672	0.072

Table 4.5: Simulation results (N2 = 60, $\gamma_{01} = 0$)

	CD			LD			MI-R			MI-a			Bayes		
	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD
MCAR															
ICC = 0.1															
γ_{01}	-0.006	0.955	0.130	0.027	0.954	0.128	-0.002	0.971	0.124	-0.002	0.979	0.124	-0.010	0.961	0.139
γ_{10}	-0.100	0.341	0.043	-0.101	0.507	0.053	-0.102	0.508	0.053	-0.102	0.508	0.053	-0.102	0.484	0.052
ICC = 0.3															
γ_{01}	-0.002	0.946	0.127	0.017	0.955	0.127	0.001	0.949	0.132	0.001	0.954	0.132	0.000	0.954	0.133
γ_{10}	-0.100	0.354	0.042	-0.098	0.540	0.052	-0.100	0.523	0.051	-0.100	0.526	0.051	-0.100	0.509	0.051
MAR															
ICC = 0.1															
γ_{01}	0.000	0.951	0.131	0.037	0.949	0.129	0.008	0.960	0.126	0.008	0.965	0.126	0.001	0.953	0.142
γ_{10}	-0.101	0.345	0.043	-0.100	0.520	0.052	-0.101	0.507	0.051	-0.101	0.511	0.051	-0.101	0.486	0.050
ICC = 0.3															
γ_{01}	0.005	0.948	0.131	0.021	0.949	0.131	0.003	0.946	0.137	0.003	0.949	0.137	0.003	0.956	0.137
γ_{10}	-0.099	0.351	0.041	-0.100	0.524	0.052	-0.101	0.510	0.052	-0.101	0.513	0.052	-0.101	0.507	0.051

TABLE 4.6: Simulation results (N2 = 60, γ_{01} = 0.4)

	CD			LD			MI-R			MI-a			Bayes		
	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD	Bias	Cov	SD
MCAR															
ICC = 0.1															
γ_{01}	0.001	0.946	0.126	-0.039	0.939	0.124	-0.044	0.955	0.121	-0.044	0.960	0.121	-0.008	0.952	0.136
γ_{10}	-0.099	0.349	0.041	-0.099	0.523	0.050	-0.096	0.533	0.049	-0.096	0.538	0.049	-0.099	0.487	0.049
ICC = 0.3															
γ_{01}	-0.002	0.952	0.129	-0.021	0.947	0.128	-0.007	0.954	0.132	-0.007	0.957	0.132	-0.005	0.962	0.133
γ_{10}	-0.101	0.317	0.040	-0.101	0.496	0.049	-0.102	0.480	0.048	-0.102	0.481	0.048	-0.102	0.461	0.048
MAR															
ICC = 0.1															
γ_{01}	0.000	0.954	0.129	-0.035	0.943	0.128	-0.044	0.960	0.125	-0.044	0.962	0.125	-0.008	0.957	0.144
γ_{10}	-0.098	0.344	0.043	-0.099	0.511	0.051	-0.097	0.514	0.050	-0.097	0.516	0.050	-0.099	0.480	0.050
ICC = 0.3															
γ_{01}	-0.005	0.950	0.127	-0.022	0.956	0.125	-0.009	0.958	0.130	-0.009	0.961	0.130	-0.008	0.962	0.132
γ_{10}	-0.101	0.313	0.042	-0.102	0.495	0.051	-0.103	0.474	0.050	-0.103	0.479	0.050	-0.103	0.452	0.050

Chapter 5

Discussion

References

McNeish, D. (2017). Small Sample Methods for Multilevel Modeling: A Colloquial Elucidation of REML and the Kenward-Roger Correction. *Multivariate Behavioral Research*, *52*(5), 661–670. https://doi.org/10.1080/00273171.2017.1344538