Table S2. *Rejection Rates for Each Effect Under the Null Model, a Small Sample Size, Three Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.052	.049	.051	.054	.055	.055
	$D_{1,M=5}$		.049	.056	*.059	*.061	.058
	$D_{1,M=100}$		.051	.051	.054	.054	.053
	$D_{2,M=5}$		.047	.052	.052	.052	.054
	$D_{2,M=100}$		.052	.053	.056	*.060	.058
	$D_{3,M=5}$		.045	*.034	*.027	*.019	*.016
	$D_{3,M=100}$		.044	*.036	*.024	*.006	*.005
B	Type III	.047	.049	.054	.049	.048	.048
	$D_{0,M=5}$		.054	*.062	*.067	*.077	*.082
	$D_{0,M=100}$		.053	*.059	.053	.053	.053
	$D_{1,M=5}$		.051	.046	.054	.050	.054
	$D_{1,M=100}$		.053	.058	.051	.052	.053
	$D_{2,M=5}$		.050	.055	.058	.054	.057
	$D_{2,M=100}$		.055	*.060	.054	.050	.051
	$D_{3,M=5}$		.042	*.034	*.026	*.024	*.023
	$D_{3,M=100}$		.048	.042	*.026	*.014	*.018
A × B	Type III	.058	.048	.054	.056	.045	.045
	$D_{0,M=5}$		.055	.057	*.070	*.083	*.084
	$D_{0,M=100}$		.056	.054	.058	.050	.048
	$D_{1,M=5}$		.047	.049	.048	.053	.052
	$D_{1,M=100}$		.057	.055	.056	.050	.052
	$D_{2,M=5}$		.048	.050	.052	.056	.055
	$D_{2,M=100}$		.058	.056	*.059	.046	.048
	$D_{3,M=5}$		*.041	*.031	*.028	*.021	*.022
	$D_{3,M=100}$		.048	*.037	*.031	*.012	*.015

*Significantly different from theoretical significance level of α = .05.

Table S3. *Rejection Rates for Each Effect Under the Alternative Model, a Small Sample Size, Three Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III		.742	.722	.686	.549	.549
	$D_{1,M=5}$		.728	*.666	*.585	*.415	*.406
	$D_{1,M=100}$		.748	.728	.680	.543	.541
	$D_{2,M=5}$	.764	*.715	*.636	*.547	*.388	*.370
	$D_{2,M=100}$		.751	.731	.687	.558	.556
	$D_{3,M=5}$		*.698	*.546	*.370	*.140	*.142
	$D_{3,M=100}$		.732	*.671	*.555	*.261	*.253
B	Type III		.972	.957	.922	.826	.836
	$D_{0,M=5}$		.966	*.934	*.870	*.729	*.745
	$D_{0,M=100}$		.976	.960	.925	.829	.838
	$D_{1,M=5}$		*.963	*.926	*.850	*.645	*.665
	$D_{1,M=100}$	.976	.974	.964	*.934	.830	.837
	$D_{2,M=5}$		*.944	*.843	*.687	*.426	*.426
	$D_{2,M=100}$		.976	.961	.924	*.807	*.818
	$D_{3,M=5}$		*.947	*.861	*.706	*.384	*.398
	$D_{3,M=100}$		.972	*.945	*.886	*.643	*.642
A × B	Type III		.176	.162	.150	.101	.148
	$D_{0,M=5}$		.174	.157	.160	*.131	*.173
	$D_{0,M=100}$		.189	.175	.152	.111	.157
	$D_{1,M=5}$		.165	*.144	*.126	.102	*.095
	$D_{1,M=100}$	.179	.192	*.183	*.169	*.137	*.120
	$D_{2,M=5}$		*.150	*.125	*.115	*.075	*.117
	$D_{2,M=100}$		.192	.177	.149	.098	*.164
	$D_{3,M=5}$		*.146	*.106	*.077	*.050	*.042
	$D_{3,M=100}$		.180	.151	*.107	*.049	*.036

*Significantly different from Type III, assuming Type III is the “true” power.

Table S4. *Rejection Rates for Each Effect Under the Null Model, a Moderate Sample Size, Three Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.044	.047	.051	.051	.052	.051
	$D_{1,M=5}$		.048	.048	.055	.053	.057
	$D_{1,M=100}$		.046	.050	.051	.050	.049
	$D_{2,M=5}$		.044	.043	.050	.049	.050
	$D_{2,M=100}$		.048	.052	.054	.054	.055
	$D_{3,M=5}$		.047	*.038	*.041	*.031	*.027
	$D_{3,M=100}$		.044	.044	*.040	*.028	*.026
B	Type III	.053	.046	.051	.052	.050	.050
	$D_{0,M=5}$		.050	.052	*.069	*.080	*.078
	$D_{0,M=100}$		.049	.051	.052	.050	.051
	$D_{1,M=5}$		.046	.042	.047	.048	.048
	$D_{1,M=100}$		.050	.052	.053	.053	.051
	$D_{2,M=5}$		.044	.047	.053	.053	.046
	$D_{2,M=100}$		.049	.054	.053	.050	.047
	$D_{3,M=5}$		.043	*.034	*.038	*.032	*.032
	$D_{3,M=100}$		.050	.042	.042	*.030	*.032
A × B	Type III	.049	.054	.046	.045	.048	.044
	$D_{0,M=5}$		.058	.054	*.060	*.071	*.066
	$D_{0,M=100}$		.052	.048	.046	.051	.047
	$D_{1,M=5}$		.053	.046	*.036	.049	.042
	$D_{1,M=100}$		.053	.046	.046	.055	.056
	$D_{2,M=5}$		.050	.048	.046	.044	.043
	$D_{2,M=100}$		.054	.049	.049	.051	.046
	$D_{3,M=5}$		.049	*.038	*.026	*.030	*.027
	$D_{3,M=100}$		.052	*.040	*.037	*.030	*.028

*Significantly different from theoretical significance level of α = .05.

Table S5. *Rejection Rates for Each Effect Under the Alternative Model, a Moderate Sample Size, Three Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.969	.968	.956	.928	.838	.838
	$D_{1,M=5}$		*.953	*.924	*.845	*.656	*.668
	$D_{1,M=100}$		.968	.955	.923	*.820	*.820
	$D_{2,M=5}$		*.948	*.911	*.822	*.624	*.638
	$D_{2,M=100}$		.969	.958	.926	.830	.832
	$D_{3,M=5}$		*.946	*.894	*.763	*.475	*.478
	$D_{3,M=100}$		.966	.948	*.899	*.734	*.738
B	Type III	1.000	1.000	1.000	.998	.992	.990
	$D_{0,M=5}$		1.000	*.999	*.992	*.953	*.940
	$D_{0,M=100}$		1.000	1.000	.998	.990	.988
	$D_{1,M=5}$		1.000	*.999	*.994	*.922	*.910
	$D_{1,M=100}$		1.000	1.000	.998	.989	.989
	$D_{2,M=5}$		1.000	*.989	*.916	*.674	*.682
	$D_{2,M=100}$		1.000	1.000	.998	*.988	*.984
	$D_{3,M=5}$		1.000	*.998	*.983	*.834	*.828
	$D_{3,M=100}$		1.000	1.000	.998	*.979	*.979
A × B	Type III	.341	.325	.297	.243	.167	.268
	$D_{0,M=5}$		.314	.282	.254	*.190	.257
	$D_{0,M=100}$		.330	.300	.249	.172	.270
	$D_{1,M=5}$		*.305	*.262	*.222	.162	*.140
	$D_{1,M=100}$		.340	*.319	*.286	*.224	*.191
	$D_{2,M=5}$		*.277	*.211	*.177	*.101	*.171
	$D_{2,M=100}$		.333	.299	.242	*.147	.280
	$D_{3,M=5}$		*.297	*.238	*.182	*.132	*.092
	$D_{3,M=100}$		.332	.300	.243	.165	*.127

*Significantly different from Type III, assuming Type III is the “true” power.

Table S6. *Rejection Rates for Each Effect Under the Null Model, a Large Sample Size, Three Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.052	.054	.053	.056	.054	.057
	$D_{1,M=5}$		.054	.058	.056	.057	.054
	$D_{1,M=100}$		.052	.054	.058	.050	.049
	$D_{2,M=5}$		.050	.055	.051	.052	.050
	$D_{2,M=100}$		.052	.056	*.060	.055	.055
	$D_{3,M=5}$		.050	.051	.045	.046	*.039
	$D_{3,M=100}$		.052	.052	.048	*.034	*.034
B	Type III	.055	.052	.058	.050	.050	.054
	$D_{0,M=5}$		.050	*.065	*.071	*.084	*.081
	$D_{0,M=100}$		.053	.058	.054	.054	.059
	$D_{1,M=5}$		.049	.050	.050	*.061	.046
	$D_{1,M=100}$		.051	.055	.055	.049	.052
	$D_{2,M=5}$		.049	.056	.056	.055	.048
	$D_{2,M=100}$		.055	*.061	.054	.050	.056
	$D_{3,M=5}$		.049	.048	.043	.046	*.036
	$D_{3,M=100}$		.050	.050	.047	*.035	*.040
A × B	Type III	.050	.047	.052	.048	.049	.050
	$D_{0,M=5}$		.054	*.061	*.068	*.079	*.082
	$D_{0,M=100}$		.052	.052	.047	.050	.052
	$D_{1,M=5}$		.050	.047	.042	.050	.050
	$D_{1,M=100}$		.048	.051	.049	.050	.052
	$D_{2,M=5}$		.051	.052	.047	.053	.058
	$D_{2,M=100}$		.053	.053	.050	.047	.051
	$D_{3,M=5}$		.049	.046	*.036	*.039	*.036
	$D_{3,M=100}$		.049	.050	*.039	*.034	*.035

*Significantly different from theoretical significance level of α = .05.

Table S7. *Rejection Rates for Each Effect Under the Alternative Model, a Large Sample Size, Three Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.998	.997	.994	.986	.947	.947
	$D_{1,M=5}$		.996	*.983	*.950	*.818	*.829
	$D_{1,M=100}$		.997	.994	.986	.942	.939
	$D_{2,M=5}$		*.994	*.979	*.937	*.799	*.801
	$D_{2,M=100}$		.997	.994	.986	.944	.945
	$D_{3,M=5}$		*.994	*.976	*.924	*.718	*.724
	$D_{3,M=100}$		.997	.993	.983	*.924	*.923
B	Type III	1.000	1.000	1.000	1.000	.998	1.000
	$D_{0,M=5}$		1.000	1.000	1.000	*.992	*.990
	$D_{0,M=100}$		1.000	1.000	1.000	.998	1.000
	$D_{1,M=5}$		1.000	1.000	1.000	*.985	*.987
	$D_{1,M=100}$		1.000	1.000	1.000	.999	.999
	$D_{2,M=5}$		1.000	*.999	*.980	*.830	*.825
	$D_{2,M=100}$		1.000	1.000	1.000	.998	1.000
	$D_{3,M=5}$		1.000	1.000	1.000	*.966	*.969
	$D_{3,M=100}$		1.000	1.000	1.000	.998	.999
A × B	Type III	.496	.476	.430	.351	.238	.393
	$D_{0,M=5}$		*.452	.408	.334	.249	*.366
	$D_{0,M=100}$		.477	.435	.349	.242	.392
	$D_{1,M=5}$		*.444	*.393	*.306	.223	*.198
	$D_{1,M=100}$		.488	*.454	*.396	*.317	*.286
	$D_{2,M=5}$		*.416	*.326	*.221	*.136	*.245
	$D_{2,M=100}$		.478	.429	.344	.220	.396
	$D_{3,M=5}$		*.438	*.372	*.272	*.201	*.165
	$D_{3,M=100}$		.487	.444	.366	*.276	*.229

*Significantly different from Type III, assuming Type III is the “true” power.

Table S8. *Rejection Rates for Each Effect Under the Null Model, a Small Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III		.046	.047	.050	.050	.049
	$D_{1,M=5}$		.053	.046	.052	.055	*.064
	$D_{1,M=100}$		.048	.050	.052	.048	.050
	$D_{2,M=5}$	.046	.051	.043	.049	.050	.058
	$D_{2,M=100}$		.049	.051	.055	.053	.051
	$D_{3,M=5}$		.044	*.032	*.023	*.014	*.014
	$D_{3,M=100}$		.043	*.034	*.024	*.007	*.008
B	Type III		.054	.056	.053	.042	.043
	$D_{0,M=5}$		*.068	*.080	*.097	*.109	*.114
	$D_{0,M=100}$		*.061	*.061	.059	.046	.051
	$D_{1,M=5}$		*.061	.055	.053	.057	*.060
	$D_{1,M=100}$	.054	*.059	*.062	.058	.052	.055
	$D_{2,M=5}$		.054	.057	.055	.046	.051
	$D_{2,M=100}$		*.060	*.061	.060	.044	.044
	$D_{3,M=5}$		.054	*.039	*.031	*.031	*.030
	$D_{3,M=100}$		.055	.047	*.032	*.018	*.021
A × B	Type III		.049	.043	.054	.044	.045
	$D_{0,M=5}$		.058	*.073	*.094	*.113	*.116
	$D_{0,M=100}$		.052	.053	*.064	.050	.049
	$D_{1,M=5}$		.053	.047	.054	*.066	*.062
	$D_{1,M=100}$	.052	.051	.052	*.063	.057	.054
	$D_{2,M=5}$		.049	*.062	.054	.055	.049
	$D_{2,M=100}$		.054	.057	*.063	.043	.044
	$D_{3,M=5}$		.048	*.032	*.031	*.029	*.034
	$D_{3,M=100}$		.048	*.032	*.033	*.019	*.021

*Significantly different from theoretical significance level of α = .05.

Table S9. *Rejection Rates for Each Effect Under the Alternative Model, a Small Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.869	.864	.844	.812	.716	.716
	$D_{1,M=5}$		*.842	*.788	*.700	*.575	*.565
	$D_{1,M=100}$		.863	.844	.811	.707	.705
	$D_{2,M=5}$		*.831	*.765	*.676	*.536	*.529
	$D_{2,M=100}$		.866	.846	.814	.718	.718
	$D_{3,M=5}$		*.814	*.682	*.474	*.218	*.215
	$D_{3,M=100}$		.857	*.805	*.710	*.448	*.445
B	Type III	.979	.978	.968	.945	.859	.890
	$D_{0,M=5}$		*.971	*.952	*.912	.847	*.866
	$D_{0,M=100}$		.981	.971	.944	.859	.894
	$D_{1,M=5}$		*.970	*.945	*.874	*.746	*.746
	$D_{1,M=100}$		.980	.972	.950	.854	*.872
	$D_{2,M=5}$		*.934	*.778	*.594	*.358	*.395
	$D_{2,M=100}$		.981	.969	.940	*.823	*.856
	$D_{3,M=5}$		*.960	*.905	*.778	*.525	*.542
	$D_{3,M=100}$		.978	*.961	*.912	*.720	*.730
A × B	Type III	.149	.146	.138	.124	.089	.133
	$D_{0,M=5}$		*.160	*.170	*.184	*.166	*.213
	$D_{0,M=100}$		.156	.148	.132	.099	.145
	$D_{1,M=5}$		.147	.133	.120	*.114	*.102
	$D_{1,M=100}$		.159	*.156	*.148	*.126	*.111
	$D_{2,M=5}$		.132	*.109	*.092	*.072	*.095
	$D_{2,M=100}$		.156	.148	.123	*.077	.143
	$D_{3,M=5}$		.136	*.092	*.080	*.062	*.050
	$D_{3,M=100}$		.153	*.124	*.088	*.058	*.045

*Significantly different from Type III, assuming Type III is the “true” power.

Table S10. *Rejection Rates for Each Effect Under the Null Model, a Moderate Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III		.053	.056	.056	.056	.056
	$D_{1,M=5}$		.056	*.061	.052	.056	.054
	$D_{1,M=100}$		.055	.056	.053	.053	.055
	$D_{2,M=5}$	.054	.052	.058	.047	.048	.051
	$D_{2,M=100}$		.055	.058	.054	.057	*.059
	$D_{3,M=5}$		.052	.053	*.039	*.029	*.031
	$D_{3,M=100}$		.053	.050	.043	*.030	*.032
B	Type III		.049	.051	.050	.053	.053
	$D_{0,M=5}$		.058	*.073	*.095	*.116	*.110
	$D_{0,M=100}$		.051	.054	.052	.056	.056
	$D_{1,M=5}$		.051	.050	.053	.058	.058
	$D_{1,M=100}$	.053	.050	.052	.056	.056	.058
	$D_{2,M=5}$		.047	.051	.049	.048	.050
	$D_{2,M=100}$		.054	.056	.056	.048	.046
	$D_{3,M=5}$		.050	.043	*.041	.045	.042
	$D_{3,M=100}$		.049	.044	.043	*.036	*.036
A × B	Type III		.042	.052	.056	.050	.050
	$D_{0,M=5}$		.055	*.067	*.088	*.116	*.114
	$D_{0,M=100}$		.046	.054	*.060	.052	.052
	$D_{1,M=5}$		.044	.046	.049	*.062	*.061
	$D_{1,M=100}$	.050	.042	.053	.055	*.062	*.059
	$D_{2,M=5}$		*.040	.044	.047	.052	.045
	$D_{2,M=100}$		.047	.056	*.059	.046	.045
	$D_{3,M=5}$		.042	*.041	*.040	.042	.045
	$D_{3,M=100}$		.042	.046	.045	*.040	*.040

*Significantly different from theoretical significance level of α = .05.

Table S11. *Rejection Rates for Each Effect Under the Alternative Model, a Moderate Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.994	.994	.991	.982	.943	.943
	$D_{1,M=5}$		*.988	*.977	*.940	*.835	*.834
	$D_{1,M=100}$		.994	.991	.982	.939	.936
	$D_{2,M=5}$		*.987	*.970	*.927	*.811	*.812
	$D_{2,M=100}$		.994	.991	.983	.942	.941
	$D_{3,M=5}$		*.987	*.962	*.896	*.665	*.671
	$D_{3,M=100}$		.993	.990	*.975	*.910	*.910
B	Type III	1.000	1.000	1.000	1.000	.996	.997
	$D_{0,M=5}$		1.000	1.000	*.996	*.986	*.986
	$D_{0,M=100}$		1.000	1.000	1.000	.995	.997
	$D_{1,M=5}$		1.000	1.000	*.997	*.970	*.960
	$D_{1,M=100}$		1.000	1.000	1.000	.996	.995
	$D_{2,M=5}$		*.998	*.974	*.850	*.573	*.588
	$D_{2,M=100}$		1.000	1.000	1.000	*.991	*.994
	$D_{3,M=5}$		1.000	*.999	*.991	*.928	*.917
	$D_{3,M=100}$		1.000	1.000	1.000	*.992	*.990
A × B	Type III	.300	.277	.255	.222	.158	.247
	$D_{0,M=5}$		.287	*.276	*.279	*.241	*.313
	$D_{0,M=100}$		.284	.258	.227	.167	.251
	$D_{1,M=5}$		.276	.250	.211	.170	*.156
	$D_{1,M=100}$		.290	*.275	*.259	*.201	*.192
	$D_{2,M=5}$		*.238	*.185	*.144	*.084	*.140
	$D_{2,M=100}$		.285	.257	.216	*.132	*.228
	$D_{3,M=5}$		.272	*.230	*.186	*.138	*.116
	$D_{3,M=100}$		.288	.258	.226	.159	*.127

*Significantly different from Type III, assuming Type III is the “true” power.

Table S12. *Rejection Rates for Each Effect Under the Null Model, a Large Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.052	.055	.054	.054	.052	.052
	$D_{1,M=5}$		.052	.055	.051	.053	*.059
	$D_{1,M=100}$		.055	.054	.054	.052	.053
	$D_{2,M=5}$		.050	.050	.047	.045	.051
	$D_{2,M=100}$		.056	.055	.056	.055	.056
	$D_{3,M=5}$		.050	.048	.044	*.038	*.041
	$D_{3,M=100}$		.054	.048	.045	*.037	*.038
B	Type III	.050	.052	.054	.054	.052	.052
	$D_{0,M=5}$		.058	*.080	*.092	*.119	*.116
	$D_{0,M=100}$		.054	*.060	*.059	.057	.058
	$D_{1,M=5}$		.050	.051	.054	*.059	.058
	$D_{1,M=100}$		.051	.056	.054	.055	.054
	$D_{2,M=5}$		.047	.054	.057	.056	.054
	$D_{2,M=100}$		.055	*.060	*.062	.048	.046
	$D_{3,M=5}$		.050	.045	.046	.046	.047
	$D_{3,M=100}$		.050	.051	.044	.042	*.041
A × B	Type III	.051	.043	*.040	.052	.046	.046
	$D_{0,M=5}$		.054	*.064	*.084	*.105	*.115
	$D_{0,M=100}$		.044	.044	.051	.050	.052
	$D_{1,M=5}$		.044	*.041	*.041	.057	*.066
	$D_{1,M=100}$		.044	*.041	.052	.058	*.059
	$D_{2,M=5}$		.042	.045	.044	.045	.046
	$D_{2,M=100}$		.046	.046	.051	*.040	.043
	$D_{3,M=5}$		.043	*.037	*.036	.052	.051
	$D_{3,M=100}$		.043	*.038	.044	.046	.046

*Significantly different from theoretical significance level of α = .05.

Table S13. *Rejection Rates for Each Effect Under the Alternative Model, a Large Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.999	.998	.998	.998	.992	.992
	$D_{1,M=5}$		.999	.997	*.989	*.941	*.934
	$D_{1,M=100}$		.999	.999	.998	.991	.990
	$D_{2,M=5}$		.999	.997	*.986	*.930	*.926
	$D_{2,M=100}$		.999	.999	.998	.992	.991
	$D_{3,M=5}$		.999	.997	*.980	*.884	*.878
	$D_{3,M=100}$		.999	.999	.997	*.985	*.985
B	Type III	1.000	1.000	1.000	1.000	1.000	1.000
	$D_{0,M=5}$		1.000	1.000	1.000	*.998	1.000
	$D_{0,M=100}$		1.000	1.000	1.000	1.000	1.000
	$D_{1,M=5}$		1.000	1.000	1.000	*.996	*.997
	$D_{1,M=100}$		1.000	1.000	1.000	1.000	1.000
	$D_{2,M=5}$		1.000	*.994	*.938	*.708	*.725
	$D_{2,M=100}$		1.000	1.000	1.000	1.000	1.000
	$D_{3,M=5}$		1.000	1.000	1.000	*.989	*.994
	$D_{3,M=100}$		1.000	1.000	1.000	1.000	1.000
A × B	Type III	.416	.398	.376	.308	.215	.360
	$D_{0,M=5}$		.398	.380	*.335	*.290	*.413
	$D_{0,M=100}$		.406	.376	.306	.216	.357
	$D_{1,M=5}$		.385	*.348	.291	.225	*.201
	$D_{1,M=100}$		.414	*.406	*.358	*.279	*.274
	$D_{2,M=5}$		*.330	*.250	*.173	*.092	*.180
	$D_{2,M=100}$		.407	.376	.293	*.169	.341
	$D_{3,M=5}$		.383	*.333	*.268	.202	*.169
	$D_{3,M=100}$		.414	.389	*.332	*.245	*.227

*Significantly different from Type III, assuming Type III is the “true” power.

Table S14. *Rejection Rates for Each Effect Under the Null Model, a Small Sample Size, Five Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.048	.050	.051	.050	.049	.049
	$D_{1,M=5}$		.050	.056	.049	.056	*.060
	$D_{1,M=100}$		.052	.051	.049	.049	.048
	$D_{2,M=5}$		.048	.049	.042	.048	.049
	$D_{2,M=100}$		.054	.053	.050	.053	.052
	$D_{3,M=5}$		.044	*.032	*.021	*.014	*.012
	$D_{3,M=100}$		.048	*.036	*.024	*.011	*.010
B	Type III	.050	*.041	*.040	.048	.054	.054
	$D_{0,M=5}$		.058	*.079	*.112	*.164	*.156
	$D_{0,M=100}$		.049	.044	.054	*.061	*.064
	$D_{1,M=5}$		.044	.049	.054	*.066	*.066
	$D_{1,M=100}$		.045	.044	.052	*.063	*.059
	$D_{2,M=5}$		*.038	*.040	.050	.055	.058
	$D_{2,M=100}$		.050	.048	.056	.047	.050
	$D_{3,M=5}$		.042	*.036	*.030	*.031	*.035
	$D_{3,M=100}$		.042	*.032	*.026	*.024	*.026
A × B	Type III	.051	*.038	.049	.045	.043	.043
	$D_{0,M=5}$		.054	*.075	*.111	*.146	*.141
	$D_{0,M=100}$		.042	.057	.050	.052	.053
	$D_{1,M=5}$		.045	.044	.053	.058	*.060
	$D_{1,M=100}$		.042	.051	.048	.051	.056
	$D_{2,M=5}$		*.038	.042	.048	.047	.050
	$D_{2,M=100}$		.044	*.059	.053	*.038	*.041
	$D_{3,M=5}$		*.040	*.034	*.031	*.025	*.029
	$D_{3,M=100}$		*.039	*.038	*.030	*.021	*.022

*Significantly different from theoretical significance level of α = .05.

Table S15. *Rejection Rates for Each Effect Under the Alternative Model, a Small Sample Size, Four Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.931	.929	.921	.897	.824	.824
	$D_{1,M=5}$		*.912	*.866	*.814	*.677	*.676
	$D_{1,M=100}$		.933	.920	.892	.822	.819
	$D_{2,M=5}$		*.907	*.855	*.788	*.640	*.641
	$D_{2,M=100}$		.935	.922	.898	.828	.828
	$D_{3,M=5}$		*.896	*.784	*.608	*.308	*.306
	$D_{3,M=100}$		.925	*.888	*.826	*.629	*.625
B	Type III	.969	.969	.959	.925	.840	.860
	$D_{0,M=5}$		.964	*.942	.919	.848	.861
	$D_{0,M=100}$		.971	.961	.931	.852	.868
	$D_{1,M=5}$		.964	*.935	*.881	*.739	*.742
	$D_{1,M=100}$		.972	.964	*.936	.853	.860
	$D_{2,M=5}$		*.888	*.708	*.500	*.277	*.277
	$D_{2,M=100}$		.971	.958	.918	*.771	*.796
	$D_{3,M=5}$		*.954	*.900	*.800	*.566	*.574
	$D_{3,M=100}$		.971	*.944	*.894	*.722	*.740
A × B	Type III	.154	.142	.132	.119	.094	.134
	$D_{0,M=5}$		*.164	*.178	*.209	*.214	*.244
	$D_{0,M=100}$		*.157	.144	.130	.103	*.148
	$D_{1,M=5}$		.150	.141	*.134	*.115	*.110
	$D_{1,M=100}$		*.159	*.156	*.148	*.130	*.119
	$D_{2,M=5}$		*.119	*.100	*.088	*.063	*.087
	$D_{2,M=100}$		*.157	.142	.122	*.077	.124
	$D_{3,M=5}$		.139	*.105	*.084	*.063	*.059
	$D_{3,M=100}$		.150	.120	*.092	*.058	*.051

*Significantly different from Type III, assuming Type III is the “true” power.

Table S16. *Rejection Rates for Each Effect Under the Null Model, a Moderate Sample Size, Five Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	.057	.058	.058	.057	.050	.050
	$D_{1,M=5}$		.057	.054	.056	.057	.051
	$D_{1,M=100}$		*.060	*.059	.056	.053	.054
	$D_{2,M=5}$		.055	.050	.053	.052	.046
	$D_{2,M=100}$		*.060	*.060	.057	.056	.055
	$D_{3,M=5}$		.056	.045	.042	*.029	*.030
	$D_{3,M=100}$		*.059	.054	.046	*.036	*.036
B	Type III	.051	.046	.049	.043	.048	.048
	$D_{0,M=5}$		.054	*.083	*.101	*.143	*.142
	$D_{0,M=100}$		.048	.051	.044	.049	.051
	$D_{1,M=5}$		.046	.044	.046	*.059	.058
	$D_{1,M=100}$		.046	.051	.046	*.061	.058
	$D_{2,M=5}$		.042	.049	*.060	.047	.047
	$D_{2,M=100}$		.048	.055	.048	*.036	*.039
	$D_{3,M=5}$		.044	*.039	*.037	.046	.047
	$D_{3,M=100}$		.045	.046	*.035	*.040	*.041
A × B	Type III	.051	.046	.045	.048	.042	.042
	$D_{0,M=5}$		.058	*.079	*.101	*.141	*.148
	$D_{0,M=100}$		.046	.051	.050	.049	.050
	$D_{1,M=5}$		.047	.046	.052	*.060	*.062
	$D_{1,M=100}$		.046	.046	.050	.053	.055
	$D_{2,M=5}$		.045	.052	.047	.050	.046
	$D_{2,M=100}$		.048	.052	.051	*.039	*.036
	$D_{3,M=5}$		.045	*.041	.042	.043	.046
	$D_{3,M=100}$		.046	.042	*.037	*.034	*.035

*Significantly different from theoretical significance level of α = .05.

Table S17. *Rejection Rates for Each Effect Under the Alternative Model, a Moderate Sample Size, Five Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III		.998	.997	.994	.984	.984
	$D_{1,M=5}$		.997	*.992	*.979	*.924	*.921
	$D_{1,M=100}$		.997	.997	.994	.984	.983
	$D_{2,M=5}$	.999	.997	*.991	*.975	*.905	*.908
	$D_{2,M=100}$		.997	.997	.994	.984	.984
	$D_{3,M=5}$		.997	*.990	*.958	*.787	*.805
	$D_{3,M=100}$		.997	.997	.992	*.970	*.971
B	Type III		1.000	.999	.998	.995	.996
	$D_{0,M=5}$		1.000	.999	*.996	*.988	*.988
	$D_{0,M=100}$		1.000	.999	.998	.993	.996
	$D_{1,M=5}$		*.999	.998	*.992	*.964	*.965
	$D_{1,M=100}$	1.000	1.000	.999	.998	.993	.995
	$D_{2,M=5}$		*.993	*.930	*.740	*.420	*.460
	$D_{2,M=100}$		1.000	1.000	.998	*.978	*.988
	$D_{3,M=5}$		*.999	*.998	*.989	*.935	*.937
	$D_{3,M=100}$		1.000	.999	.998	*.987	*.988
A × B	Type III		.256	.249	.202	.158	.232
	$D_{0,M=5}$		*.275	*.288	*.301	*.288	*.365
	$D_{0,M=100}$		.262	.254	.212	.167	.239
	$D_{1,M=5}$		.260	.246	.212	*.178	*.157
	$D_{1,M=100}$	.279	.266	*.270	*.244	*.206	*.184
	$D_{2,M=5}$		*.209	*.162	*.123	*.083	*.123
	$D_{2,M=100}$		.264	.252	.200	*.113	*.210
	$D_{3,M=5}$		.256	*.225	*.182	.146	*.120
	$D_{3,M=100}$		.264	.254	.214	.172	*.132

*Significantly different from Type III, assuming Type III is the “true” power.

Table S18. *Rejection Rates for Each Effect Under the Null Model, a Large Sample Size, Five Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III		.055	.053	.048	.053	.053
	$D_{1,M=5}$		.056	.058	.058	.058	.058
	$D_{1,M=100}$		.051	.051	.050	.049	.053
	$D_{2,M=5}$	.054	.054	.050	.050	.050	.056
	$D_{2,M=100}$		.053	.052	.052	.052	.057
	$D_{3,M=5}$		.055	.050	.046	.042	.046
	$D_{3,M=100}$		.051	.048	*.040	*.038	*.038
B	Type III		.045	.043	.043	.042	.042
	$D_{0,M=5}$		.058	*.077	*.101	*.144	*.140
	$D_{0,M=100}$		.048	.046	.046	.048	.050
	$D_{1,M=5}$		.045	.047	.043	*.066	*.064
	$D_{1,M=100}$	.046	.046	.043	.044	*.063	*.060
	$D_{2,M=5}$		*.040	.044	.048	.051	.048
	$D_{2,M=100}$		.051	.049	.049	*.037	*.038
	$D_{3,M=5}$		.046	.045	*.037	.057	.056
	$D_{3,M=100}$		.048	*.040	*.038	.049	.047
A × B	Type III		.046	.046	.046	.049	.049
	$D_{0,M=5}$		.057	*.075	*.100	*.137	*.136
	$D_{0,M=100}$		.046	.051	.048	.055	.049
	$D_{1,M=5}$		.046	.049	.050	.054	.053
	$D_{1,M=100}$	.048	.045	.047	.047	.053	.053
	$D_{2,M=5}$		.044	*.041	.051	.052	.048
	$D_{2,M=100}$		.047	.054	.050	*.038	*.041
	$D_{3,M=5}$		.047	.046	.042	.047	.044
	$D_{3,M=100}$		.045	.045	*.040	*.041	*.041

*Significantly different from theoretical significance level of α = .05.

Table S19. *Rejection Rates for Each Effect Under the Alternative Model, a Large Sample Size, Five Levels of Factor B, for Different Methods for Handling Imbalance, and Different Degrees of Imbalance.*

Effect	Method	Imbalance					
		Balanced	Small	Medium	Severe	Extra severe	Extra severe, order shuffled
A	Type III	1.000	1.000	1.000	1.000	.998	.998
	$D_{1,M=5}$		1.000	1.000	*.998	*.982	*.979
	$D_{1,M=100}$		1.000	1.000	1.000	.998	.998
	$D_{2,M=5}$		1.000	1.000	*.997	*.976	*.974
	$D_{2,M=100}$		1.000	1.000	1.000	.998	.998
	$D_{3,M=5}$		1.000	1.000	*.995	*.955	*.946
	$D_{3,M=100}$		1.000	1.000	1.000	.998	.998
B	Type III	1.000	1.000	1.000	1.000	1.000	1.000
	$D_{0,M=5}$		1.000	1.000	1.000	*.999	*.998
	$D_{0,M=100}$		1.000	1.000	1.000	1.000	1.000
	$D_{1,M=5}$		1.000	1.000	1.000	*.998	*.995
	$D_{1,M=100}$		1.000	1.000	1.000	1.000	1.000
	$D_{2,M=5}$		1.000	*.976	*.840	*.565	*.580
	$D_{2,M=100}$		1.000	1.000	1.000	1.000	*.999
	$D_{3,M=5}$		1.000	1.000	1.000	*.996	*.993
	$D_{3,M=100}$		1.000	1.000	1.000	1.000	1.000
A × B	Type III	.419	.396	.362	.307	.230	.368
	$D_{0,M=5}$		.411	*.410	*.382	*.368	*.472
	$D_{0,M=100}$		.394	.366	.306	.236	.371
	$D_{1,M=5}$		.390	.348	.294	*.247	*.228
	$D_{1,M=100}$		.403	*.388	*.357	*.303	*.284
	$D_{2,M=5}$		*.318	*.242	*.161	*.108	*.172
	$D_{2,M=100}$		.395	.359	*.287	*.161	*.331
	$D_{3,M=5}$		.388	*.338	*.272	.222	*.197
	$D_{3,M=100}$		.404	.372	*.340	*.267	*.230

*Significantly different from Type III, assuming Type III is the “true” power.

Programming Code of the Simulation Study.

```
#ALPHA
alpha = 0.05

#CALLING LIBRARY MASS FOR SIMULATING NORMALLY DISTRIBUTED VARIABLES
library(MASS)

#CALLING LIBRARY car FOR TYPE III SUM OF SQUARES
library(car)

#CALLING LIBRARY mice FOR PERFORMING MULTIPLE IMPUTATION
library(mice)


#CALLING LIBRARY psych FOR SIMULATING NORMALLY DISTRIBUTED DATA
library(psych)

#CALLING LIBRARY dplyr FOR RECODING FACTOR B
library(dplyr)

#AANROEPEN LIBRARY mitml FOR D3 STATISTIC
library(mitml)

#POPULATION VARIANCE
sigmaerror = 18.37


#NUMBER OF REPLICATIONS PER CONDITION
```

```
NumberOfReplications = 2500

#NUMBER OF IMPUTED DATASETS
NumberOfImp = c(5,100)

#POPULATION REGRESSION COEFFICIENTS

NumberOfEffectSizes = 2

#NUMBER OF ITERATIONS OF THE MULTIPLE IMPUTATION ALGORITHM
Numberofiterations = 10

#SAMPLE SIZES
Nmaxmultfactor <- 3

#DEGREE AND STRUCTURE OF IMBALANCE
LevelsUnbalanced = c(1,2,3,4,4)

betas <- vector('list', 3)
betas[[1]] <- matrix(c(27,0,0,0,0,0,27,-1.5,-3,0,1,-0.5),ncol = NumberOfEffectSizes)
betas[[2]] <- matrix(c(27,0,0,0,0,0,0,0,27,-1.5,-3,-1,1,1,0,-0.5),ncol = NumberOfEffectSizes)
betas[[3]] <- matrix(c(27,0,0,0,0,0,0,0,0,0,27,-1.5,-3,-1,0,1,1,0.25,-0.25,-0.5),ncol =
NumberOfEffectSizes)

#NAMES OF THE VARIABLES IN THE DATA FILE WITH SIMULATION RESULTS
columnnames = c("Replicationnumber", "LevelsB", "SampleSize", "Effectsize",
"Unbalancedness",
          "reject_H0ATypeIII", "reject_H0BTypeIII", "reject_H0ABTypeIII",
          "reject_H0A_5impD0", "reject_H0B_5impD0", "reject_H0AB_5impD0",
          "reject_H0A_100impD0", "reject_H0B_100impD0", "reject_H0AB_100impD0",
```

```
            "reject_H0A_5impD1", "reject_H0B_5impD1", "reject_H0AB_5impD1",
            "reject_H0A_100impD1", "reject_H0B_100impD1", "reject_H0AB_100impD1",
            "reject_H0A_5impD2", "reject_H0B_5impD2", "reject_H0AB_5impD2",
            "reject_H0A_100impD2", "reject_H0B_100impD2", "reject_H0AB_100impD2",
            "reject_H0A_5impD3", "reject_H0B_5impD3", "reject_H0AB_5impD3",
            "reject_H0A_100impD3", "reject_H0B_100impD3", "reject_H0AB_100impD3")

for (le in 1:length(betas)){
  levelsB <- (nrow(betas[[le]]) - 2)/2 + 1
  XB = t(cbind(t(rep(1:levelsB, each = 10))))

  unbalancedfactor1 = 2
  unbalancedfactor2 = 1

  XBunbalanced1 = matrix(rep(0, times =
levelsB*10),nrow=length(XB),ncol=max(LevelsUnbalanced))

  for (i in 1:ncol(XBunbalanced1)) {
    XBunbalanced1[,i] =
cbind(t(XB[(unbalancedfactor1*i+1):length(XB)]),t(rep(levelsB,times=(unbalancedfactor1*i))))
  }

  XBunbalanced2 = matrix(rep(0, times =
levelsB*10),nrow=length(XB),ncol=max(LevelsUnbalanced))

  for (i in 1:ncol(XBunbalanced2)) {
    XBunbalanced2[,i] = cbind(t(rep(1,times=(unbalancedfactor2*i))), t(XB[1:(length(XB) -
(unbalancedfactor2*i))]))
  }
```

```
 for (sa in 1:Nmaxmultfactor){
  betasle <- betas[[le]]
  for (be in 1:ncol(betasle)) {
   for (un in 1:length(LevelsUnbalanced)){
    resultsimp = matrix(,0,length(columnnames))
    for (i in 1:NumberOfReplications) {
     #SETTING SEED
     Seed = i + 1526
     set.seed(Seed)
     XBA1 = matrix(,0,2)
     XBA2 = matrix(,0,2)
     for (j in 1:sa){
      XBA1 <- rbind(XBA1, cbind(rep(1, times =
length(XBunbalanced1[,LevelsUnbalanced[un]])),XBunbalanced1[,LevelsUnbalanced[un]]))
     }
     for (j in 1:sa){
      XBA2 <- rbind(XBA2, cbind(rep(2, times =
length(XBunbalanced2[,LevelsUnbalanced[un]])),XBunbalanced2[,LevelsUnbalanced[un]]))
     }

     X = as.data.frame(rbind(XBA1, XBA2))
     colnames(X) = c("A", "B")
     if (un == 5) X[,"B"] <- recode(X[,"B"], '1' = 5, '2' = 4, '3' = 1, '4' = 3, '5' = 2)



     X[,"A"] <- as.factor(X[,"A"])
     X[,"B"] <- as.factor(X[,"B"])

     XAec <- model.matrix(~A, data = X, contrasts.arg = list(A = "contr.sum"))
```

```
XBec <- model.matrix(~B, data = X, contrasts.arg = list(B = "contr.sum"))
XBec <- XBec[,2:ncol(XBec)]
XABec <- XAec[,2:ncol(XAec)]*XBec

for (j in 1:(ncol(XABec))) {colnames(XABec)[j] <- paste("AB",j, sep="")}

Xec <- cbind(XAec, XBec, XABec)

n = nrow(Xec)

#SIMULATING THE ERROR
error = mvrnorm(n = n, mu=0, Sigma = sigmaerror)

#CREATING OUTCOME VARIABLE ON THE BASIS OF THE PREDICTORS AND THE ERROR
Y = rep(0,times=n)
for (j in 1:nrow(betasle)) {Y = Y + betasle[j,be]*Xec[,j]}
Y = Y + error

XY = cbind(X,Y)
XY = data.frame(XY)
colnames(XY) = c("XA", "XB", "Y")
for (v in 1:2) XY[,v] = as.factor(XY[,v])

#TYPE III
options(contrasts = rep("contr.sum", 2))
model = lm(Y ~ XA+XB+XA*XB, data=XY)
Anovamodel = Anova(model, type = 3)
pF = Anovamodel[2:(nrow(Anovamodel)-1),4]
```

```
#REJECT/NOT REJECT H0
RejectH0TypeIII = 1*(pF < alpha)


XBunbalancedfull1 = XBA1[,2]
XBunbalancedfull2 = XBA2[,2]
additionalcases1 = NULL
for (j in 1:(levelsB-1)){
  Times = length(XBunbalancedfull1[XBunbalancedfull1 == levelsB]) -
length(XBunbalancedfull1[XBunbalancedfull1 == j])
  additionalcases1 = cbind(additionalcases1, t(rep(j, times = Times)))
}
XBbalanced1 = t(cbind(t(XBunbalancedfull1), additionalcases1))
if (un == 5) XBbalanced1 <- recode(XBbalanced1, '1' = 5, '2' = 4, '3' = 1, '4' = 3, '5' = 2)



additionalcases2 = NULL
for (j in 1:levelsB){
  Times = length(XBunbalancedfull1[XBunbalancedfull1 == levelsB]) -
length(XBunbalancedfull2[XBunbalancedfull2 == j])
  additionalcases2 = cbind(additionalcases2, t(rep(j, times = Times)))
}
XBbalanced2 = t(cbind(t(XBunbalancedfull2), additionalcases2))
if (un == 5) XBbalanced2  <- recode(XBbalanced2 , '1' = 5, '2' = 4, '3' = 1, '4' = 3, '5' = 2)


Xbalanced = as.data.frame(rbind(cbind(rep(1,times =
length(XBbalanced1)),XBbalanced1),
                    cbind(rep(2,times = length(XBbalanced2)),XBbalanced2)))
#NAME OF THE OUTCOME VARIABLE
colnames(Y) = "Y"
#JOINING X AND Y IN ONE DATASET
```

```
missingvector1 = rep(NA, times = (length(additionalcases1)))

missingvector2 = rep(NA, times = (length(additionalcases2)))

Y1 =
cbind(t(Y[1:(length(XBunbalanced1[,LevelsUnbalanced[un]])*sa)]),t(missingvector1))

Y2 =
cbind(t(Y[(length(XBunbalanced1[,LevelsUnbalanced[un]])*sa+1):length(Y)]),t(missingvector2)
)

Ybalanced = t(cbind(Y1,Y2))


colnames(Xbalanced) = c("A","B")

colnames(Ybalanced) = "Y"


Xbalanced[,"A"] <- as.factor(Xbalanced[,"A"])

Xbalanced[,"B"] <- as.factor(Xbalanced[,"B"])


XAecbalanced <- model.matrix(~A, data = Xbalanced, contrasts.arg = list(A =
"contr.sum"))

XBecbalanced <- model.matrix(~B, data = Xbalanced, contrasts.arg = list(B =
"contr.sum"))

XBecbalanced <- XBecbalanced[,2:ncol(XBecbalanced)]

XAecbalanced <- XAecbalanced[,2:ncol(XAecbalanced)]

XABecbalanced <- XAecbalanced*XBecbalanced

for (j in 1:(ncol(XABecbalanced))) {colnames(XABecbalanced)[j] <- paste("AB",j, sep="")}


Xecbalanced <- cbind(XAecbalanced, XBecbalanced, XABecbalanced)

colnames(Xecbalanced)[1] <- "A"

XYmis = cbind(Xecbalanced,Ybalanced)

XYmis = data.frame(XYmis)


seed = i + 554

imputation <- mice(XYmis, max = 0, print = FALSE)
```

```
        meth = imputation$meth
        meth["Y"] = "norm"
        pred = imputation$pred

        Bimp = matrix(0, nrow=length(NumberOfImp),ncol=ncol(Xec))
        DFG = c(1,(length(unique(X[,"A"]))-1),(length(unique(X[,"B"]))-1),
(length(unique(X[,"A"]))-1)*(length(unique(X[,"B"]))-1))
        RejectH0D0 = matrix(0, nrow=length(NumberOfImp),ncol = (length(DFG)-1))
        RejectH0D1 = matrix(0, nrow=length(NumberOfImp),ncol = (length(DFG)-1))
        RejectH0D2 = matrix(0, nrow=length(NumberOfImp),ncol = (length(DFG)-1))
        RejectH0D3 = matrix(0, nrow=length(NumberOfImp),ncol = (length(DFG)-1))

        for (me in 1:length(NumberOfImp)) {
#me=1
          imputation  <- mice(XYmis, maxit = Numberofiterations, printFlag = FALSE, m =
NumberOfImp[me], meth = meth, pred=pred, seed = seed)

          XYimp  <- complete(imputation, "long", inc = TRUE)

          #RE-SEPARATING THE X'S FROM Y IN THE IMPUTED DATASET
          Yimp = as.matrix(XYimp[,ncol(XYimp)])
          Ximp = as.matrix(XYimp[,3:(ncol(XYimp)-1)])
          XimpIntercept <- cbind(rep(1,times=nrow(Ximp)),Ximp)

          #POOLING REGRESSION COEFFICIENTS
          Regmodel = paste("Y~A")
          for (j in 1:(ncol(XABecbalanced))) {Regmodel = paste(Regmodel, "+B",j, sep="")}
          for (j in 1:(ncol(XABecbalanced))) {Regmodel <- paste(Regmodel, "+AB",j, sep="")}
```

```
Results = summary(pool(with(data=imputation, lm(as.formula(Regmodel)), method = "smallsample")))

#CREATING VECTOR WITH POOLED REGRESSION COEFFICIENTS
Bimp[me,] = Results[,2]

#CREATING POOLED COVARIANCE MATRICES FOR CALCULATING POOLED F-TESTS
WithinB = matrix(0,ncol(Bimp),ncol(Bimp))
WithinBm <- array(0,dim=c(ncol(Bimp),ncol(Bimp),NumberOfImp[me]))

#CREATING MATRIX WITH REGRESSION COEFFICIENTS OF EACH IMPUTED DATASET
Bm = matrix(0,ncol(Bimp),NumberOfImp[me])

#FILLING UP THE COVARIANCE MATRIX AND THE PARAMETERVECTOR

for (m in 1:NumberOfImp[me]) {
  Yimpm = Yimp[XYimp[,1]==m]
  Ximpm = Ximp[XYimp[,1]==m,]
  #options(contrasts = rep("contr.sum", 2))
  Regmodel <- paste("Yimpm~")
  for (j in 1:(ncol(Ximpm))) {Regmodel <- paste(Regmodel, "+Ximpm[," ,j, "]", sep="")}
  reg = lm(as.formula(Regmodel))
  covarianceBm = vcov(reg)

  WithinBm[,,m] <- covarianceBm
  WithinB = WithinB + WithinBm[,,m]
  Bm[,m] = matrix(reg$coefficients)
}

WithinB = WithinB/NumberOfImp[me]
```

```
        nbalanced <- nrow(XYmis)

        vcom = ((DFE +1)/(DFE + 3))*DFE

        DFEadjrank = rep(0,times=length(DFG))

        End = 1

#ef=1

        for (ef in 2:length(DFG)){

#ef=ef + 1

          Begin = End + 1

          End = End + DFG[ef]

          Brep =
matrix(rep(Bimp[me,c(Begin:End)],times=NumberOfImp[me]),length(Bimp[c(Begin:End)]),Nu
mberOfImp[me])

          BetweenB = ((Bm[c(Begin:End),] - Brep)%*%t(Bm[c(Begin:End),] -
Brep))/(NumberOfImp[me]-1)

          TotalB = WithinB[c(Begin:End),c(Begin:End)] + (1+1/NumberOfImp[me])*BetweenB

          r1 =
((1+1/NumberOfImp[me])*tr(BetweenB%*%solve(WithinB[c(Begin:End),c(Begin:End)])))/(leng
th(Bimp[me,c(Begin:End)]))

          if (DFG[ef] == 1) {

            #BEREKENEN ERRORVRIJHEIDSGRADEN VAN BARNARD & RUBIN (1999)

            increase =
(BetweenB*(1+1/NumberOfImp[me]))/WithinB[c(Begin:End),c(Begin:End)]

            gamma = (BetweenB*(1+1/NumberOfImp[me]))/TotalB

            dfplus = (NumberOfImp[me]-1)*(1+1/increase)^2

            dfplusob = (1-gamma)*vcom

            DFEadj = 1/(1/dfplus + 1/dfplusob)

          } else {

            #ERROR DEGREES OF FREEDOM REITER (2007)

            tt = length(Bimp[me,c(Begin:End)])*(NumberOfImp[me]-1)

            a = (r1*tt)/(tt-2)

            part1 = 1 + a
```

```
  part2 = 1/(tt-4)
  part3 = vcom - 2*part1
  part4 = vcom - 4*part1
  z = 1/part4
  z = z + part2*(((a^2)*part3)/((part1^2)*part4))
  z = z + part2*((8*(a^2)*part3)/(part1*(part4^2)) + 4*(a^2)/(part1*part4))
  z = z + part2*(4*(a^2)/(part4*part3) + 16*(a^2)*part3/(part4^3))
  z = z + part2*(8*(a^2)/(part4^2))
  DFEadj = 4 + 1/z
}

#P VALUE D0
DFEadjrank = ((DFG[ef]+1)*DFEadj)/2
F =
(t(Bimp[me,c(Begin:End)])%*%solve(TotalB)%*%Bimp[me,c(Begin:End)])/length(Bimp[me,c(Begin:End)])
pF = 1-pf(F,DFG[ef],DFEadjrank)
RejectH0D0[me,ef-1] = 1*(pF < alpha)

#P VALUE D1
TotalB = (1+r1)*WithinB[c(Begin:End),c(Begin:End)]
F =
(t(Bimp[me,c(Begin:End)])%*%solve(TotalB)%*%Bimp[me,c(Begin:End)])/length(Bimp[me,c(Begin:End)])
pF = 1-pf(F,DFG[ef],DFEadj)
RejectH0D1[me,ef-1] =  1*(pF < alpha)

#P-VALUE D2
dWm <- rep(0, times = NumberOfImp[me])
for (m in 1:NumberOfImp[me]) {
```

```
    dWm[m] <-
t(Bm[c(Begin:End),m])%*%solve(WithinBm[c(Begin:End),c(Begin:End),m])%*%Bm[c(Begin:End
),m]
  }
  dW <- mean(dWm)
  r2 <- (1+1/NumberOfImp[me])*var(sqrt(dWm))
  F <- (dW/DFG[ef] - ((NumberOfImp[me]+1)*(NumberOfImp[me]-1)^-1)*r2)/(1+r2)
  DFED2 <- DFG[ef]^(-3/NumberOfImp[me])*(NumberOfImp[me]-1)*(1+1/r2)^2
  pF = 1-pf(F,DFG[ef],DFED2)
  RejectH0D2[me,ef-1] = 1*(pF < alpha)

  #P VALUE D3
  smallmodel <- "Y~"
  largemodel <- "Y~"
  colnamesminusimpid <- colnames(XYimp)[-c(1,2,length(XYimp))]
  colnamesminuseffect <- colnamesminusimpid[-c((Begin-1):(End-1))]
  for (j in 1:(length(colnamesminusimpid))) {
    largemodel <- paste(largemodel, colnamesminusimpid[j], sep="")
    if (j < length(colnamesminusimpid)) largemodel <- paste(largemodel, "+", sep="")
  }

  for (j in 1:(length(colnamesminuseffect))) {
    smallmodel <- paste(smallmodel, colnamesminuseffect[j], sep="")
    if (j < length(colnamesminuseffect)) smallmodel <- paste(smallmodel, "+", sep="")
  }

  implist <- mids2mitml.list(imputation)
  fitsmall <- with(implist, lm(as.formula(smallmodel)))
  fitlarge <- with(implist, lm(as.formula(largemodel)))
  D3 <- testModels(fitlarge, fitsmall, method = "D3")
```

```
      pF = D3$test[4]
      RejectH0D3[me,ef-1] =  1*(pF < alpha)
     }
    }

    #CREATING VECTOR WITH RESULTS OF REPLICATION i
    Resultsrow = cbind(i,le,sa,be,un,t(RejectH0TypeIII),
                 t(RejectH0D0[1,]), t(RejectH0D0[2,]),
                 t(RejectH0D1[1,]), t(RejectH0D1[2,]),
                 t(RejectH0D2[1,]), t(RejectH0D2[2,]),
                 t(RejectH0D3[1,]), t(RejectH0D3[2,]))

    resultsimp = rbind(resultsimp, Resultsrow)
   }
   colnames(resultsimp) = columnnames
   filewrite = paste("P:/UnbalancedANOVA4/ResultsImputedData", as.character(le),
as.character(sa), as.character(be), as.character(un), ".dat", sep ="");
   write.table(resultsimp, row.names = FALSE, file = filewrite)
  }
 }
 }
}
```