SAKA003 Quantitative Methods: Multivariate Analysis
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Lab Report 4 – Mixed Models

Introduction

This report is a follow-up on Lab 2 concerning perioperative pain and its demographic, psychological and hormonal predictors. In this case we have two new datasets with data collected from different hospitals for patients that underwent wisdom tooth surgery.

Dataset A is used for fitting a linear model that accounts for the clustering of the data in different hospitals. Since there is no reason to expect that the effects of any predictor vary from one hospital to another, we fit a random intercept model. Then, dataset B is used for testing the model obtained with dataset A. We also compare these results with the ones obtained through the simple linear regression model fitted in the original data (Lab 2).

Data Exploration and Preparation

A quick exploration of the data reveals that there seems to be no coding errors or issues in general. Table 1 presents descriptive statistics for the variables involved in the analysis. A deeper exploration reveals that all scale variables are fairly normally distributed and that the sample contains 52% of females and 48% males.

Finally, we confirm that the effect of the different predictors does not systematically vary from hospital to hospital, therefore confirming the use of only random intercepts and not random slopes.

Data Analysis

Table 2 presents the results of the new mixed model considering the random intercepts for hospital ID, from data obtained at 10 different hospitals.

The estimates for the fixed effects variables obtained from the mixed model were then used to predict values in a separate dataset (dataset B) and compute the amount of variance explained by the model. Table 4 presents this result (R^2) together with the marginal R^2 (Rm), conditional R^2 (Rc), and AIC for the null and the random intercept model calculated for dataset A.

The first thing to notice is that the model is significantly better than the null model as the AIC is more than 60 points lower. The fixed effects predictors are able to explain 31.7% of the variance, while the combined effect of fixed and random predictors explain 43.6%. Furthermore, when applying de model equation to dataset B, it is able to explain 35% of the variance in pain.

Discussion

Table 3 presents the results of the linear regression fitted in Lab 2, while, as said, Table 2 presents the results of the new mixed model. It is possible to see that values are of course in the same order of magnitude but they differ quite substantially for some predictors. However, all of them, but STAI have maintained the sign. The intercept is now larger and statistically significant. Also, in this new dataset all predictors but STAI, pain catastrophizing, and gender, are statistically significant at 5% level. In contrast, in Lab 2 only pain catastrophizing and cortisol were statistically significant.

All in all, the main conclusion to be extracted from this comparison is confirming that the relationships directions – and rough magnitudes – hold. However, confidence intervals are smaller for the mixed model than for the simple linear model, which could be attributed to the fact we have the random effects predictor and a larger sample. The R^2 for the first analysis (Lab 2) was quite similar to the marginal R^2 obtained here: 0.34 vs 0.32.

Finally, the marginal R^2 is closer than the conditional R^2 (both from dataset A) to the R^2 obtained for dataset B. This was to be expected since the model equation does not include a coefficient for hospital ID, therefore it cannot account for the proportion of the variance this random predictor accounts for in the model in dataset A. Moreover, even if one were to include it, it would not make any contribution since the list of hospitals is different from dataset A to dataset B.

Appendix

Table 1. Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
Pain level	200	0.00	10.00	4.85	1.632
Age	200	28.00	51.00	39.99	4.964
STAI	200	24.00	52.00	39.66	4.908
Pain cat.	200	17.00	41.00	29.98	4.528
Cortisol (serum)	200	1.64	7.63	4.91	0.935
Mindfulness	200	1.00	5.58	3.00	1.071
Gender	200	0.00	1.00	0.52	0.501
Valid N (listwise)	200				

Table 2. Mixed Model Results

	Estimate	Std. Error	95% CI lb for Est.	95% CI ub for Est.	t	p-value
Constant	3.80	1.42	1.00	6.60	2.68	0.008
Age	-0.05	0.02	-0.09	-0.02	-2.75	0.007
STAI	0.00	0.02	-0.05	0.05	0.06	0.952
Pain cat.	0.04	0.03	-0.02	0.09	1.29	0.199
Cortisol (serum)	0.61	0.11	0.38	0.84	5.34	< .001
Mindfulness	-0.26	0.10	-0.46	-0.06	-2.61	0.010
Gender	-0.30	0.19	-0.67	0.08	-1.56	0.120

Table 3. Linear Model Results (Lab 2)

	Unstandarized Coefficients				t	p-value
	B	Std. Error	95% CI lb for B	95% CI ub for B		
Constant	2.26	1.70	-1.10	5.62	1.33	0.186
Age	-0.03	0.02	-0.08	0.01	-1.44	0.151
STAI	-0.01	0.03	-0.07	0.04	-0.49	0.626
Pain cat.	0.08	0.03	0.03	0.14	2.93	0.004
Cortisol (serum)	0.54	0.13	0.30	0.79	4.35	0.000
Mindfulness	-0.14	0.13	-0.39	0.11	-1.08	0.284
Gender	-0.32	0.21	-0.74	0.10	-1.49	0.140

Table 4. Model Comparison Statistics

Item	File	Value
Vf	A	0.834
Vr	A	0.313
Ve	A	1.487
Rm	A	0.317
Rc	A	0.436
R-square	B	0.350
AIC (Null)	A	749.4
AIC (Int.)	A	686.6

Links

Syntax: https://github.com/avonborries/SAKA003-VT20/tree/master/Lab%204