

Lab Report 6 – Exploratory Factor Analysis

Introduction

People's attitudes towards animal experimentation, suffering and rights can be informative about their political inclination and preferences regarding other aspects of societal life. Here, I explore the underlying factors that govern these attitudes by performing an Exploratory Factor Analysis (EFA) over data collected for 154 individuals on the Animal Rights Scale, which contains 28 items, to then attempt explaining their ideological affiliation (conservative-liberal scale).

Data Exploration and Preparation

Checking basic descriptive statistics for all variables, it is possible to see that there are some missing values, but everything else seems to be in order. In terms of bi-variate correlations, most are weak to moderate, although one is found to be strong ($R = 0.834$) between questions 13 and 5.

Further, the assumptions of factorability and multivariate normality were checked and found to be met. Since the sample is considered big enough ($154/28 > 5$), Bartlett's test could not be used. However, KMO is 0.877 (> 0.6) which indicates good factorability for this set of variables. Figure 1 shows the scatterplot of Chi-square vs Mahalanobis distance, where it is possible to see that multivariate normality is reasonably met. This means that the factor extraction method to be used is Maximum Likelihood.

Data Analysis

Now, moving to the EFA itself, the first step is to identify the number of factors to be selected. A first exploration, based on eigenvalues > 1 , suggests extracting 7 factors. However, when looking at the screeplot, presented in Figure 2, one would be drawn to extract 1 or 5 factors. Moreover, the parallel analysis also seems to suggest 4 or 5 factors to be extracted, as shown in the screeplot of Figure 3.

Even though it is known that this technique tends to overestimate the number of factors, further exploration was done with 5 factors. This revealed that the fourth factor has the highest loading in only one item, while the fifth has none. Further exploration with 4 and 3 factors reveals that the latter seems to be the most appropriate, since each factor is most highly loaded into, at least, three items. However, interpretability is still fuzzy.

The next step was exploring rotations, both orthogonal and oblique. Given the nature of the topic and the questions, one would expect the final factors to be correlated. This could be why the screeplot seems to suggest extracting only one factor (animals rights).

Both rotations give similar results with the same questions loaded into the same factors, while an exploration of the items and factor begins to reveal an interpretation of the factors around three distinct uses of animals. While the first two factors are clear, the third one mixes attitude towards eating different animal products and issues like plague control, hunting, and animal displacement. Thus, the essence of this factor could be captured by the concept of human “life support”. The final factor names are: **Research, Domestication, and Life support.**

A further exploration reveals that items 8, 16, and 26 should be removed. Items 8 and 16 have quite low post-extraction communalities, and their conceptual relation with the factors is weak. Item 26 is more highly loaded clearly into the wrong factor.

The final factors extracted explain 39.75% of the variance of the 25 questions retained. This is shown in Table 1 together with the post-extraction eigenvalues and variance explained by each factor extracted using the Promax rotation. Table 2 contains the post-extraction communalities and the loadings of each item retained on the factors, where it is possible to see that only one item retained has a maximum loading lower than 0.4, while 10 items have a post-extraction commonality lower than 0.3 and four more lower than 0.4.

The scores from the extracted factors were used in a linear regression model to predict the standing of the participants on the conservative-liberal scale. A higher score (in any factor) means higher reluctance to use animals for that specific purpose. Results show that the factors only explain 11.3% of the variance of the ideological standings ($F=6.177$, $p\text{-value}=0.001$). In Table 3 it is possible to see that “research” and “domestication” present a negative relation with liberal self-identification, meaning that showing greater concern for animals being used for these purposes is related to a more conservative leaning, although both coefficients are not statistically significant at 5% level. Life support is significant at the 0.1% level and presents a positive relation with liberal self-identification. There is no problematic multicollinearity since all VIFs are lower than 3.

Discussion

The main limitation of this analysis is that we were able to explain less than 40% of the variance of the original items with the final 3 factors. From the outset almost all post-extraction communalities were below 0.6, and in our final structure the average ended up being lower than 0.4. Finally, in terms of explaining ideological affiliation, it is clear that there is much more to it than attitudes towards animal suffering and rights.

Appendix

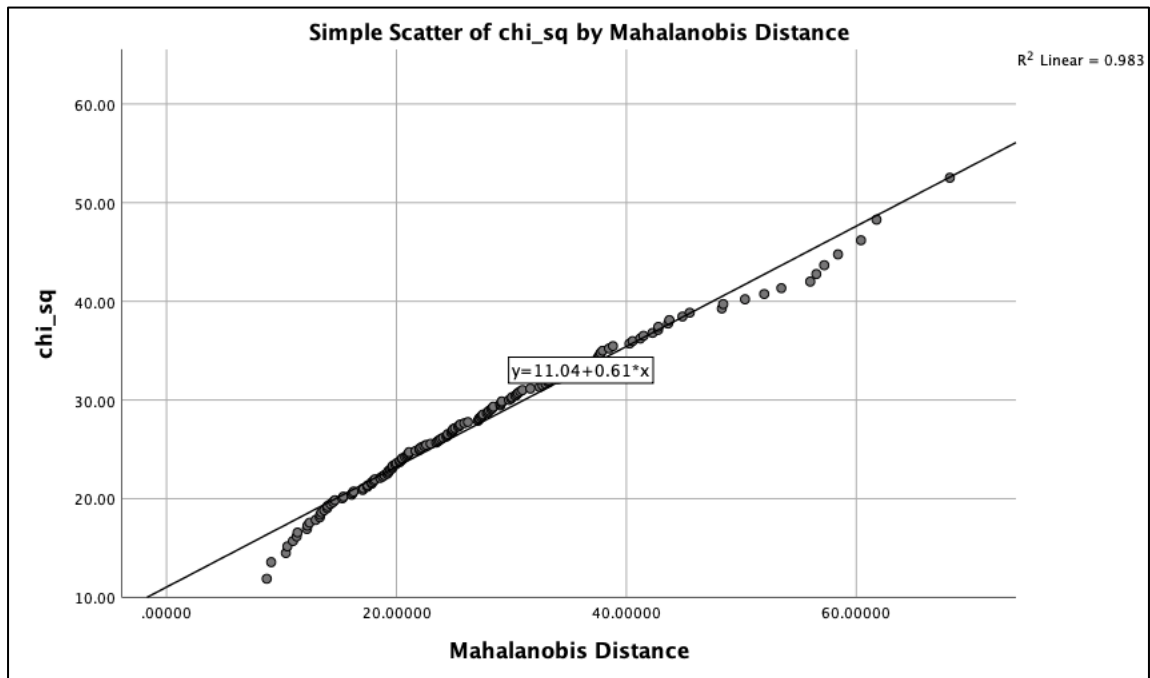


Figure 1. Multivariate Normality Plot

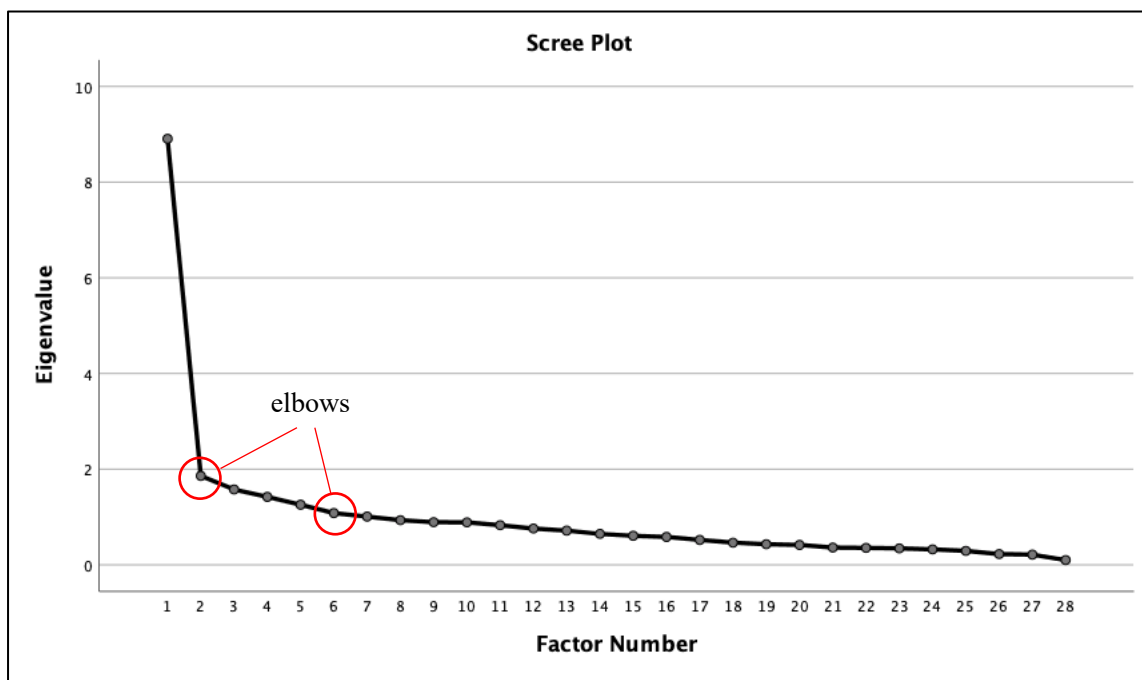


Figure 2. Exploratory Factor Analysis Screeplot

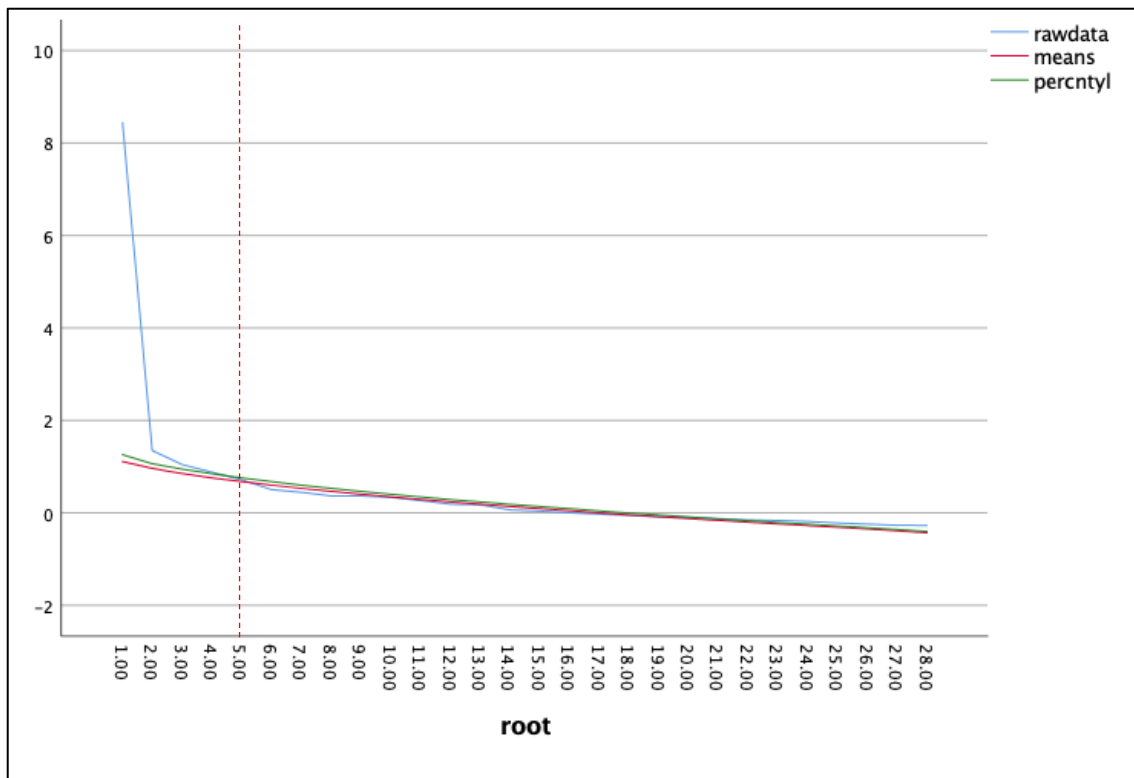


Figure 3. Parallel Analysis Screeplot

Table 1. Post-extraction Eigenvalues, and Variance Explained

Extraction Sums of Squared Loadings		
Total	% of Variance	Cumulative %
4.89	19.57	19.57
3.84	15.37	34.94
1.20	4.81	39.75

Table 1. Communalities and Structure matrix

Item	Post-extraction Communalities	Structure Matrix		
		Factor 1	Factor 2	Factor 3
ar6. Most medical research done on animals is unnecessary and invalid.	0.653	0.796	0.491	0.363
ar2. Animal research cannot be justified and should be stopped.	0.530	0.721	0.524	0.479
ar12. Animals should be granted the same rights as humans.	0.489	0.664	0.530	0.557
ar27. Most psychological research done on animals is unnecessary and invalid.	0.450	0.659	0.314	0.324
ar15. Having extended basic rights to minorities and women, it is now time to extend themselves also to animals.	0.514	0.653	0.494	0.623
ar20. I am very concerned about pain and suffering in animals.	0.356	0.569	0.408	0.481
ar9. We need more regulations governing the use of animals in research.	0.333	0.563	0.342	0.424
ar17. There are plenty of viable alternatives to the use of animals in biomedical and behavioral research.	0.330	0.559	0.350	0.231
ar19. New surgical procedures and experimental drugs should be tested on animals before they are used on people.	0.276	-0.503	-0.382	-0.416
ar11. Insect pests (mosquitoes, cockroaches, flies, etc.) should be safely removed from the house rather than killed.	0.289	0.496	0.423	0.446
ar25. Most cosmetics research done on animals is unnecessary and invalid.	0.280	0.479	0.359	0.463
ar21. Since many important questions cannot be answered by doing experiments on people, we are left with no alternatives but to do animal research.	0.215	-0.449	-0.269	-0.344

ar18. Research on animals has little or no bearing on problems confronting people.	0.229	0.417	0.261	0.070
ar14. I would rather see humans die or suffer from disease than to see animals used in research.	0.215	0.416	0.305	0.411
ar5. It is wrong to wear leather jackets and pants.	0.999	0.524	0.988	0.491
ar13. It is wrong to wear leather belts and shoes.	0.769	0.652	0.865	0.562
ar23. It is wrong to wear animal fur (such as mink coats).	0.406	0.482	0.621	0.462
ar4. A human has no right to use a horse as a means of transportation (riding) or entertainment (racing).	0.363	0.384	0.590	0.453
ar22. It is a violation of an animal's rights to be held captive as a pet by a human.	0.197	0.338	0.433	0.317
ar7. I have seriously considered becoming a vegetarian in an effort to save animal lives.	0.511	0.436	0.520	0.704
ar10. It is morally wrong to eat beef and other "red" meat.	0.544	0.406	0.589	0.700
ar24. It is appropriate for humans to kill animals that destroy human property, for example, rats, mice, and pigeons.	0.381	-0.233	-0.319	-0.599
ar1. Humans have no right to displace wild animals by converting wilderness areas into farmlands, cities, and other things designed for people.	0.241	0.383	0.315	0.473
ar28. Hunters play an important role in regulating the size of deer populations	0.231	-0.185	-0.177	-0.460
ar3. It is morally wrong to drink milk and eat eggs.	0.134	0.258	0.271	0.359

Table 3. Linear Regression Results

	Unstandardized Coefficients			Standardized Beta	VIF
	B	95% CI lb for b	95% CI ub for b		
(Constant)	2.91	2.78	3.04		
F1. Research	-0.10	-0.30	0.10	-0.11	2.14
F2. Domestication	-0.10	-0.29	0.09	-0.12	1.99
F3. Life support	0.43	0.22	0.63	0.45	2.10

Links

Syntax: <https://github.com/avonborries/SAKA003-VT20/tree/master/Lab%206>