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A New Method in Attribution? Attempts of the Employment of Geometric Morphometrics in the Attribution of Late Archaic Attic *Lekythoi*

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Abstract:
In the Late Archaic - Early Classic period, the Attic ceramic industry was characterized by a kind of duality. On the one hand, the red-figure technique was flourishing, when Euphronios', Douris' or the Berlin Painter's works represented the height of Greek vase painting. On the other hand, the market was also covered by large quantities of low-quality black-figure pottery. Not only in Athens, but even in the whole Ancient Mediterranean these mass-produced vessels emerge constantly, even from modern excavations. Therefore, in contrast to most vases of more talented painters they can be attached to an archaeological feature or layer. Due to their inadequate style, relatively few characteristics can be determined while looking at the painting. Thus, the manufacturing criteria, such as the details of the shapes, are more important in the attribution. In this paper, I study the late black-figure lekythoi of the Museum of Fine Arts in Budapest with the help of geometric morphometrics using 3D reconstructions.

The Feasibility and Limits of Beazley's Method

It is well known that a complicated and multifactorial system is needed to ascertain a vase painter based solely on their work. This is even more problematic in the case of late black-figure vases. Due to their inferior quality (etched details are rough and few, the paintwork is mediocre, etc.), it is difficult to recognize their characteristics based on the details.Thus in attributing these vases, the theme, composition, and the vase form are far more significant. Therefore it can easily be realized that the majority of the black-figure vases made in the first half of the 5th century BC can only be referred to certain groups.[1]

Beazley himself acknowledged his scruples concerning late black-figure pottery in his letters during the preparation of *Attic Black-Figure Vase Painters.*[2] As Dietrich von Bothmer remembered in the opus released for the centenary of Beazley's birth, this great master of painter attribution often complained about one of the iconic figures of the era, *"the Haimon Painter and other lekythoi"*.[3] Even Caroline Henriette Emilie Haspels, who has laid the foundations for the attribution and classification of late black-figure *lekythoi*, states at the beginning of her chapter about the Haimon Painter that even though this painter played a central role in the black-figure pottery industry of the first half of the 5th century BC, his style is *"difficult to*

1 It is well demonstrated by the example of the *Haimon Painter:* only a small number of vases can be directly attributed to him in comparison to the closely linked *Haimon Group*, which consists of a large quantity of material (Jubier-Galinier 2016, 130).

2 Beazley 1956.

3 Bothmer 1985, 15.

tackle".[4] An additional problem is that later on in the 5th century BC, it seems as if these barely attributable painters and workshops merged together.[5]

We can call into question if it is worth the time to attribute these mass produced wares, which are better known by the repeat of iconographic schemata than any significant innovation in technique or style. The answer is most definitely 'yes', although the reason is not attribution for the sake of attribution, but the fact itself that these vases are the results of mass production. Thus, they can be found in graves, sanctuaries, different urban settings in Athens, Attica, in all of Hellas[6] and even beyond: they are constantly found in modern excavations in the Ancient Mediterranean and the peripheries of the Hellenic world.[7] According to the data in the Beazley Archive,[8] 673 pieces are currently attributed to the *Haimon Group*, 383 to the *Diosphos Painter*, 356 to the *Beldam Painter*, while only 117 to *Exekias* and 198 to the *Amasis Painter*. The difference might even be greater, since it is common for some Museums to only upload the larger, better quality vases to the Beazley Archive, while overlooking the smaller *lekythoi* which are of inferior quality – hence, the result is a rather disproportionate database. Whereas it can safely be assumed that all of the known works of *Exekias* or the *Amasis Painter* are in the Archive, we cannot say the same about the vases of the *Haimon Group* or those belonging to the *Beldam Painter*, let alone the fragments. To gain a deeper understanding of the Attic ceramic industry of the era regarding production and market, this large quantity of material will have to be attributed, located in time, and placed within the wider network of Attic black-figure pottery.[9]

The Prospects of Geometric Morphometrics

Modern researchers agree that the cornerstones of attribution when it comes to Late Archaic and Early Classic *lekythoi* are the details of their shape. When paying attention to these details, we are essentially attempting to determine certain potters, reconstructing a theoretical workshop connected to them. Only later, if we are lucky, may we identify a painter or a group.[10] The main evidence for this is Kurtz's typology of the most characteristic shapes pertaining to a vase-painter in *Athenian White Lekythoi*, thus creating the types *BL* (*Bowdoin Painter Lekythoi*),[11] *DL* (*Diosphos Painter Lekythoi*),[12] *PL* (*Petit Palais 336 Painter Lekythoi*),[13] *ATL* (*Aeschines and Tymbolos Painter Lekythoi*),[14] *CL* (*Carlsruhe Painter Lekythoi*),[15] and *BEL* (*Beldam Painter Lekythoi*).[16]

4 Haspels 1936, 130.
5 Jubier-Galinier 2003, 79.
6 Jubier-Galinier 2016, 130.
7 A good example for that is the *Lancut Group*, which was isolated within the *Haimon Group* by Beazley himself, and consists predominantly of slender *skyphoi* and other drinking vessels made with silhouette-technique (Morgan 2004, 200). What is interesting about this group is that these vases can be found everywhere on the periphery of the Mediterranean: Israel, Northern Italy, the northern part of the Aegean, Thrace, Macedonia, the Middle and Southern Adriatic, and even in the northern shore of the Black Sea, the Crimea, and the valley of the Kuban River (Shefton 1999).
8 http://www.beazley.ox.ac.uk. As of 5 March 2018.
9 Jubier-Galinier 2016, 130.
10 Comp. Haspels 1936, and Kurtz 1975.
11 Kurtz 1975, 79.
12 Kurtz 1975, 80–81.
13 Kurtz 1975, 81.
14 Kurtz 1975, 82–83.
15 Kurtz 1975, 84.
16 Kurtz 1975, 84–87.

These types are defined by several criteria: a certain kind of mouth, foot, shoulder or body, or other characteristics such as the *Bedlam Painter*'s horizontal line at the bottom of the body, etched in the still wet clay. However, these criteria are not always realized together: there are exceptions from the rule which make manual classification more difficult and thus confuse the viewer. In consequence, identification through mere inspection contains too many subjective elements, which results in an exceptionally large number of unattributed vases. It is therefore legitimate to ask whether the digital achievements such as 3D reconstruction and the analytical methods using it could help the attribution.

The approach used to compare the shapes of two- or three-dimensional structures is called *geometric morphometrics.* To (programmatically) analyse real-life objects in virtual space they have to be represented in a way that preserves relevant information. Modern morphometrics provides two state of the art methods to address this: *landmark configuration* and *outline analysis.*[17] *Landmark configuration* is a point-based analytic method. To apply it, characteristic structural elements of the object have to be determined (these are the *landmarks* themselves), recreated and fixed in a coordinate system, on which the comparison will be based. A prerequisite for this method is that the shapes to be compared should have the homologous and equal number of *landmarks*. If that does not or only partly applies, *landmark configuration* is less suitable. For example, this method can be ideal in anthropology or archaeozoology, where the human or animal bones of the same type have the same number of breakpoints in the exact same places, which are easy to observe and are representative of the object due to their (biological/anatomical) function. However, vases present a completely different and more problematic area: they are man-made, diverse, with a lot of flaws and malformations. Moreover, the majority had been broken and restored over time, which compromises their form even further. Thus, only a very few fix landmarks can be taken on them, which might not be sufficient to determine the parameters of the vase. On the other hand, using the other method, *outline analysis*, we examine the outline of the object, which is defined here as the closed polygon formed by the (*x; y*) coordinates of the consisted pixels defining it.[18] After employing both methods, the latter proved to be more useful for my analysis.

In the January of 2018 I have had the opportunity[19] to use an *Artec Space Spider 3D* scanner, which is a high-resolution 3D scanner that uses blue light technology. The scanner is small (weighing only 0.85 kg), and is capable of scanning tiny, more detailed objects with 0.1 mm accuracy and an error margin of 0.05 mm. While working, it records with 7.5 frames per second, which it immediately aligns in space. The device is operated by using a software developed for this particular hardware family called *Artec Studio,*[20] providing a real-time ability to supervise and control the scanning process.[21] To fully digitize an object, multiple scans are needed which can be aligned and merged using the software, and afterwards a 3D model can be created which can be exported in various formats.[22]

The device not only records the shape, but also the texture of the object in 1.3 mp, which is

17 Bonhomme et al. 2014, 3.

18 Bonhomme et al. 2014, 4.

19 I would like to express my gratitude to András Patay-Horváth PhD, senior lecturer of the Department of Classical Studies at the Eötvös Loránd University of Budapest, for making the scanner available for me to use.

20 I have used *Artec Studio 9.*

21 https://www.artec3d.com/files/pdf/Space-Spider-Booklet-EURO.pdf

22 The following formats are available: obj, ply, wrl, stl, aop, ascoo, ptx, e57, xyzrgb.

most advantageous.[23] This way, as we scan a vase, the model gives us even more information to work with than just the form. On the one hand, we can have an exact cross-section of the object instead of a manually drawn section plan, and on the other hand, laying out the texture the iconography of the painting becomes more visible and better examinable – as it is the same (but more accurate) image than a hand-drawn one.[24] This method is also capable of measuring the surface of an object, thus – geometric morphometrics.

Completing this article I have only had the time and the possibility to work with the pieces currently in the Museum of Fine Arts in Budapest. With the previously described device I have managed to digitize 30 whole (or fully completed from fragments) Attic *lekythoi* from the Antique Collection, all of them dated between 510 and 450 BC,[25] of various styles. After careful examination, I have excluded *squat lekythoi* from the analysis, as their shape is radically different from the others (almost as if it was a separate form).

After I finished creating the 3D models, I positioned all of them in a coordinate system: the vertical centreline of each *lekythos* was adjusted to the *y* axis, while the ear was aligned with the positive direction of the *x* axis. To perform the geometric morphometrics, I have sectioned the surface along the *yz* plane, thus ignoring the ear as it would have compromised the results in a negative way.

Full Profile Examination – Outline Analysis

First I intended to perform the *outline analysis*, therefore I have exported the results of the intersection in dxf file format, then converted it into an image in *AutoCAD,* which I then exported as a *jpeg* file since the software called *R*,[26] which is capable of different statistical analyses (such as geometric morphometrics), only supported this format. I used the *Momocs* package of the software for *outline analysis*, which lets the user complete the analysis without *landmarks,* only examining the outline.[27] I have excluded the restored pieces, as well as vases with missing foot or mouth, in order not to have the results compromised by these details. This selection has left me 30 *lekythoi* to work with.

The *jpeg/jpg* files were imported into the *R* program and closed polygons approximating the outlines were calculated by utilizing the *Momocs* package. Data was examined first with factor analysis first, which showed the relative variances through 30, monotonically decreasing axes (74.86%, 11.93%, 3.88%, 3.14%, 1.64% and further 25 pieces). The first four axes contain 93.8% of the full data collection's variance, therefore those can be seen as significant and relevant regarding to my comparison. In the following, with the help of the *NbClust* package the optimal cluster number was determined for the K-means cluster procedure. As it can be seen in

23 https://www.artec3d.com/files/pdf/Space-Spider-Booklet-EURO.pdf

24 I would like to note that laying out the painted image is only available in the case of those vases which have a cylindrical painted surface that does not have a horizontal break. This means that while the method does not work with *amphorae* for example, it is perfectly fine for *lekythoi.*
It is far from me to understate the importance of hand drawing, which is indispensable when it comes to observing the details of an image. But it is a fact that despite all efforts (if the vase shape permits), a scanned and laid-out image is much more accurate than a hand-drawn one.

25 I have scanned 16 restored or fragmented pieces, however I have excluded these from the comparison, as when it comes to analysing full profiles, these items could have negatively affected the results.

26 https://www.r-project.org. I have used version 3.4.3.

27 Bonhomme et al. 2014.

Figure 1. I realized that the optimal cluster number should be either four or six. The program package has made a lot of statistical analyses,[28] which supported the six cluster groups more, so I choose that cluster number.

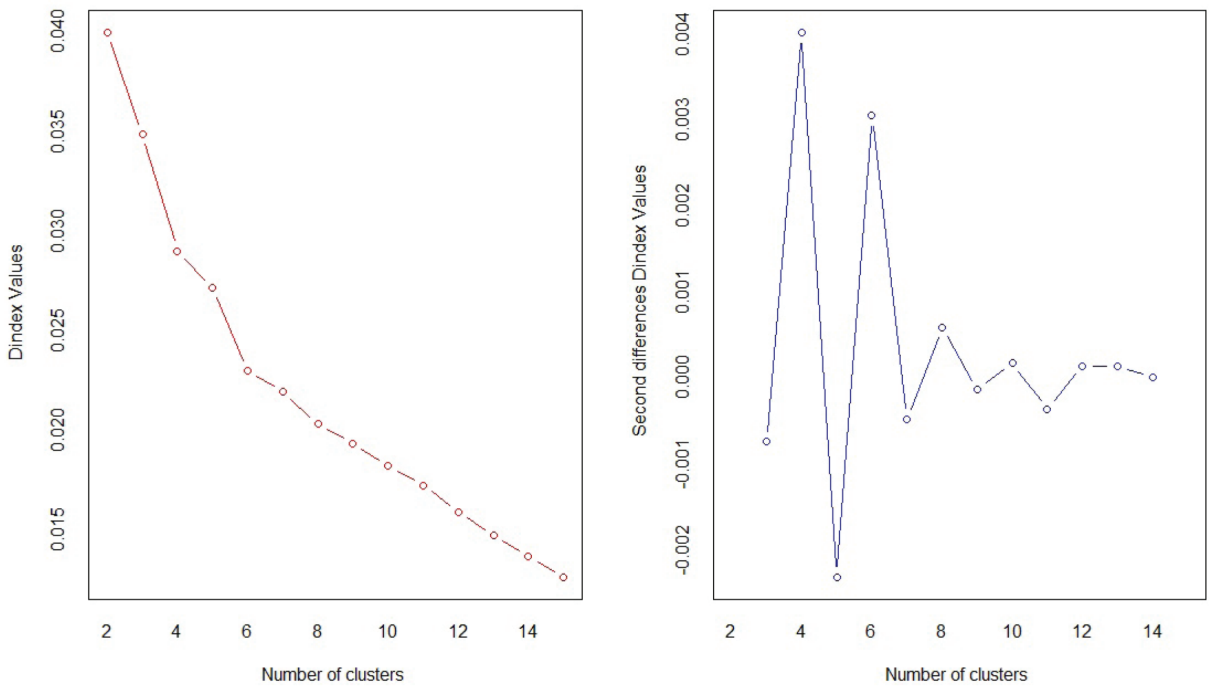

Fig. 1. Agglomeration schedule coefficients (imported from *R*, calculated by *NbClust* package).

The K-means cluster procedure requires a lot of calculation. The characteristic of the algorithm is that it finds the best cluster proportion from a randomly selected case. Because of this I ran the program 100.000 times, with six cluster groups[29] and I choose those grouping, which maximized the distance between each cluster group. The result of this analysis can be seen on *Figure 2.* Each cluster group is signed by no. 1 to 6 and the number of vases in each cluster group in a row is the following: 10, 3, 8, 5, 2, and 2. On *Figure 3* the sum squared distance of the clusters can be seen.

Examining *Figure 2* we can conclude that the *lekythoi* types are located in six clusters, which correspond to the terminology of classical archaeology. Cluster 1 consists of ordinary cylinder-shaped *lekythoi*, and while those of Cluster 2 are also cylindrical in shape, their mouth and neck areas are larger in proportion than those of the former group. On the other hand, vases of Cluster 3, despite being cylindrical as well, have proportionately smaller mouths and necks than the ones in Cluster 1. Cluster 4 contains broad-shouldered cylindrical shapes, while the archaizing *shoulder-lekythoi* belong in Clusters 5 and 6, which are divided most probably by the broadness of the vases' shoulders.

The whole picture becomes much more intriguing when we look at the data in *Figure 8* in reference to the results in which the relevant clusters are listed in the *Cluster outline* column. The difference between Clusters 1, 2, and 3 is clearly visible there: among the members of Cluster 2 are two very late, small black-figure *lekythoi* with white ground, where the smaller size goes along with the relatively larger mouth, moreover there is a red-figure one, in which

28 The detailed deduction of these, with illustrations, could not be obtained from *NbClust*, only the results.
29 This is part of *R*'s basic package.

case it seems likely that this shape variation was more popular. It is an important observation that all vases of Cluster 1 belong to the workshops of the *Haimon* and the *Beldam Painter* with no exception.[30] All pieces of Cluster 3 can be dated to the first quarter of the 5th century BC, while those in Cluster 4 were made around the turn of the century, probably a little earlier, just as the archaizing *lekythoi* of Clusters 5 and 6 – which shows us the trends in the changing shapes of the *lekythoi*. Clusters 1 and 2 seem to be extremely close to each other: the *pattern-lekythoi* of Cluster 2 seem to be linked to the *Beldam* or the *Haimon Workshop*. Between these two distinctive groups, Cluster 3 seems to represent the transition: its pieces show connections to both directions.

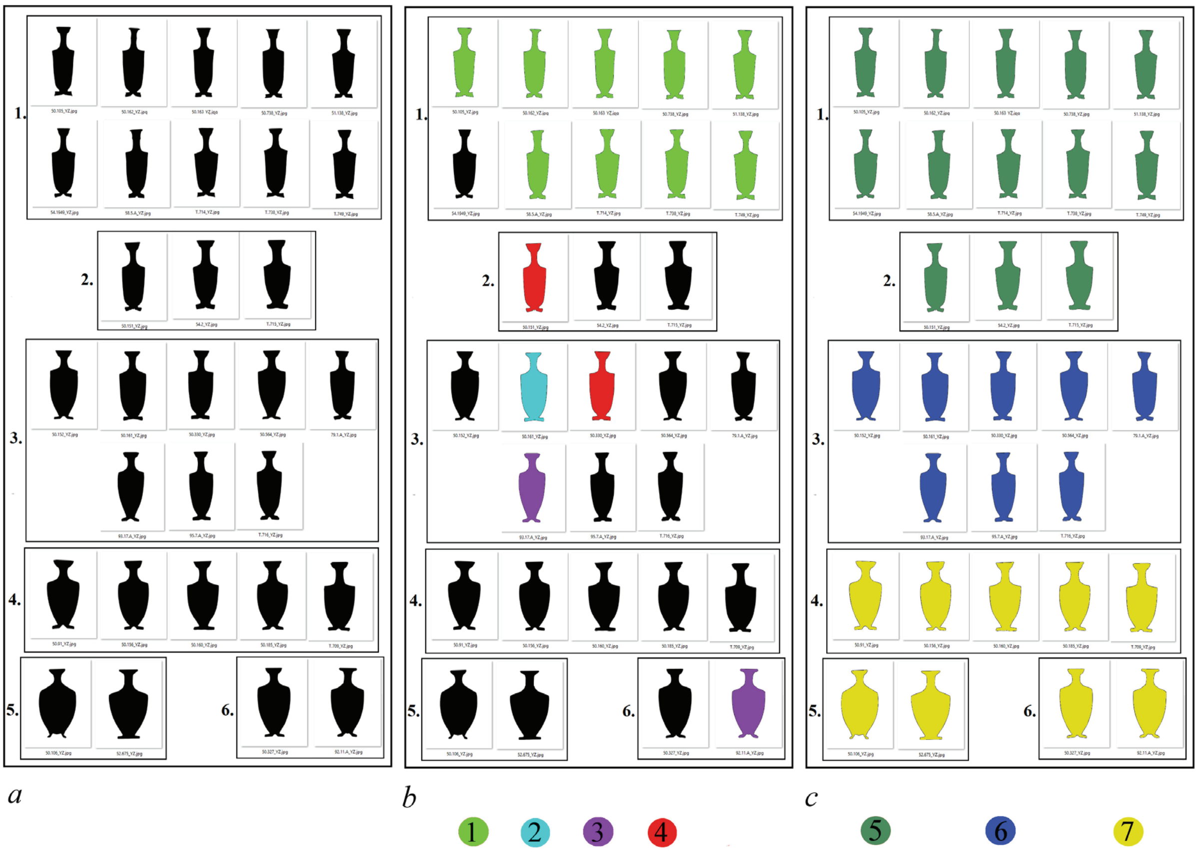

Fig. 2. The result of K-means clustering analysis in case of outline analysis. a – The 6 clusters, b – The six clusters with painters, workshops, groups and styles: 1 – Haimon-Beldam Workshop, 2 – Gela Painter, 3 – Cock Group, 4 – Red-figure *lekythoi*. c – The six clusters with dating: 5 – 490–450 BC, 6 – 500–475 BC, 7 – 510–490 BC.

Full Profile Examination – Landmark Configuration

After carrying out the *outline analysis*, I have decided to test *landmark configuration* on the objects. For this I have exported the model in obj format, then, using the software *Geomagic Design X*, I have sectioned the image in the middle with the *yz* plane excluding the ear. This was necessary since the potter's intention while shaping up the rim is best visible in this area. In the cases where there was a breakage on the surface of the vase, I have chosen a plane containing the vertical centreline to section the image.

30 Attributions are the results of the past few decades of research. See *Fig. 8* for details.

Distance between the Clusters	*Distance between the pieces inside the clustres*						*Distance between cach piece without the cluster procedure*	*Reliability of the clustering*
	1	*2*	*3*	*4*	*5*	*6*		
0.11844	0.00501	0.00161	0.00524	0.00266	0.11210	0.00070	0.13576	87.24%

Fig. 3. The reliability of the cluster analysis in case of outline analysis.

Then, I have taken 15 *landmark*s on one side of the vase on the section created by the plane: five *landmarks* on the mouth area (one at the rim, one on the top at the possible fold recurvery, one in the middle, one at the start of the lower arc, and one at the point where the mouth meets the neck), one *landmark* on the joint at the bottom of the neck, five *landmarks* on the body (one at the shoulder, one below it, one at the middle, one at the start of the lower arc, and one at the point where it connects to the foot), as well as four *landmarks* on the side of the foot (one at the top, one at the bottom, two in the middle – or in the case of a stepped foot, one at every break-point) *(Fig. 4).* I would like to note that to conduct a *landmark configuration*, an immense amount of tables were needed, which I have enclosed in a separate *Appendix.*

50.91 50.738

Fig. 4. Location of landmarks on *lekythoi.*

I have exported the recorded points to csv format and imported it into *R.* I ran Generalized Procruste Analysis (GPA), which scaled, rotated, and offseted them to minimize the distance between different landmark sets for comparison, therefore making the data set scale, offset and rotation independent. Since I scored points along one axis in *Geomagic Design X*, one of the *x, y,* and *z* coordinates determining the points was constant. For this reason, after completing the GPA, and leaving the *z* coordinate we have got a 2D set of data, with *x* and *y* coordinates. This includes for each vase 30 variables for 15 points.

First, as a preliminary analysis of the clustering procedure, I performed the factor analysis (PCA) on the data with which I tried to reduce the number of variables. In the absence of the fulfilment of the requirements, I did not analyse with the classic method. There are several reasons why the requirements have not been met: the size of the sample set or the method of data extraction(as I tried to reconstruct the same outline as by the *outline analysis*, using only 15 *landmark* points where the correlation was too small). This was automatically detected by *R* and the *corr.smooth* function brought the data closer to each other so that it could complete the PCA. The communality table clearly shows that the factors keep the data even after factorization, since the smallest V15 variable also has a 0.81 communality value, so it retains the value of the variable in 81% *(Appendix 1).* Factor analysis suggested 5 factors, in which the 86% of the data remained *(Appendix 2).*

The data in *Appendix 3* show the proportion of each variable roleplay in each factor. The absolute values of these ratios should be greater than 0.7 in at least one component. If they are smaller, they do not affect the actual factor. Our factor analysis is correct if all variables reach a minimum 0.7 value, but as we can see, this has not occurred in many places. Since there was a factor that was not influenced by any of the variables and there were many variables that did not fit into one of the factors, I tried varimax rotation, which increased the variance between the variables. This way, 86% of the data remained in the five factors *(Appendix 4).*

After the rotation, the situation has improved, as every factor was influenced well by variables, but there were still many variables that did not fit into any factors, as shown in *Appendix 5.*

To make my factor analysis correct and to do the cluster analysis, I could make two alterations: either exclude the least influential variable, or try less factors. Since I wanted to keep as many variables as possible as I tried to describe the characteristics of the vases with a few points, I tried to reduce the numer of factors first. According to the pareto rule, it is important that factors should be determined in a way that they contain at least 80% of the data, so the factor number can only be reduced to 4. In this case, this number equals to 81.6% without rotation *(Appendix 2).* The result can be seen in *Appendix 6*, where it is clear that after the reduction of the number of factors , many variables did not participate in any factor. So I decided to apply varimax rotation again. Since this calculation works with a given number of factors, the relative variance of the factors has differed from *Appendix 4:* 81.6% of the data remained in the 4 factors *(Appendix 7)*, just as before the rotation, only with a change in the proportions.

After rotation, the situation did not improve with four factor numbers either *(Appendix 8).* Although all factors were influenced by a variable, many variables did not fit into any of the factors.

Because of my results, I was forced to leave the variable with the lowest influence indicator, which is based on *Appendices 3, 5 and 6.* Since all variables are one half of a point coordinate (*x;y*), if I remove one, I have to remove its pair too, which is V11 for V26. After removing them, I restarted the PCA with the corr.smooth function, which again recommended 5 factors with 88% data retention, but even found 4 factors acceptable, where this figure was 83.5% *(Appendix 9).*

Appendix 10 shows that the situation has not improved yet, 11 variables did not fit into any of the factors, and the last 3 factors were not influenced by any variable.

Because of this, varimax rotation was performed again, after which 5 factors were sufficient for the applicable data retention by 88% *(Appendix 11).*

After the rotation, the situation was the same as before: all factors were influenced by some variables, but still many variables did not fit into any of the factors, so my factor analysis was not yet correct *(Appendix 12).*

In the following, I tried to classify the data in 4 factors without varimax rotation, but it did not help *(Appendix 13)*, therefore I used rotation. Then, just like before the rotation *(Appendix 9)*, 83.5% of the data remained in the 4 factors *(Appendix 14)*. The results are shown in *Appendix 15.*

Since we did not get the correct factor analysis, we had to leave another two variables, which became the least influential: V21 and its pair, V6.

After running PCA again, the *R* did not use the corr.smooth, as the requirements of the analysis have been met. After the change, the suggested number of factors was still 5 or 4. I checked with both number of factors, with varimax rotation and without, but there were always variables that did not fit into any factor, so I had to exclude new variables, V15 and V30, but it always failed. Variables V25 and V10, V18 and V3, V17 and V2, V1 and V16, and V8 and V23 have been abandoned before I got the right factor analysis. I confirm my steps in the 'Appendices' section with tables. However, I excluded 16 (8 points) out of 30 variables (15 points), which is 53.3% of the original data, so we can say that unfortunately our data set cannot be interpreted statistically *Figure 5* illustrates which points remained after the variables were excluded and what kind of comparison resulted from that.

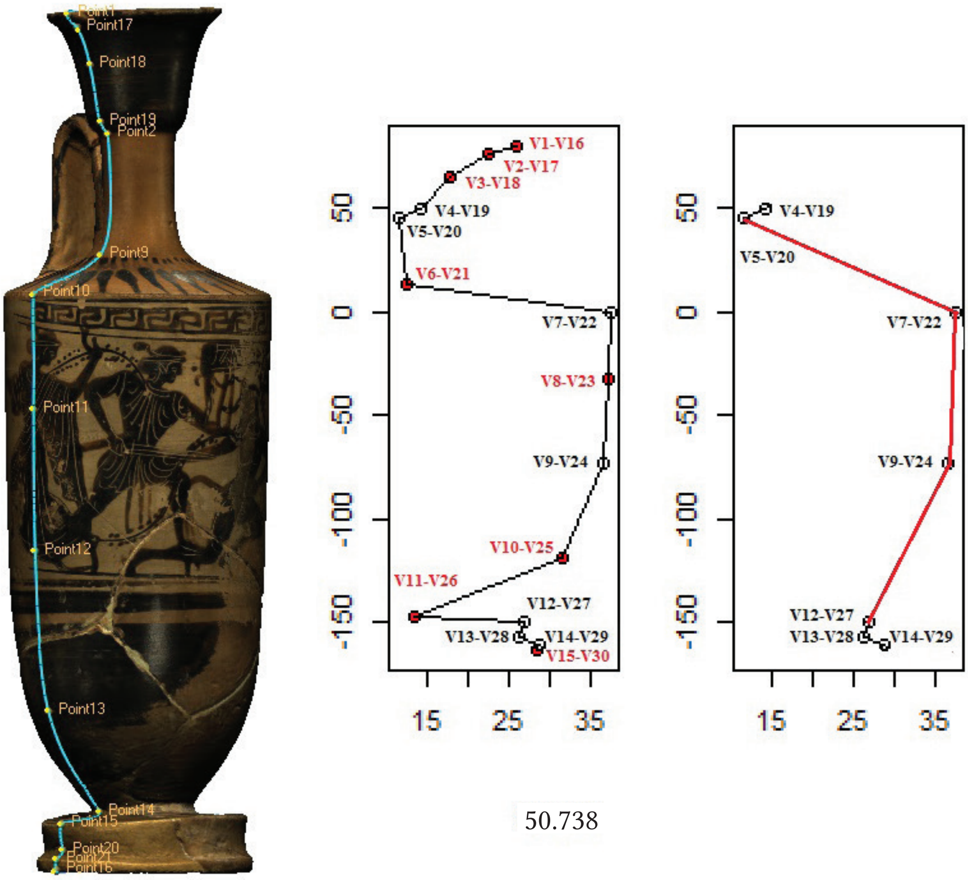

Fig. 5. Remained landmarks after the variables were left out and the basement of the comparison.

Regardless, it was then possible to run a cluster analysis in *R* to see if the results were relevant from an archaeological point of view or not. The PCA provided relative variations for 14 remaining variables along 14 axes. The first four axes represent 90% of the variance of the total data set, so these four can be considered significant and relevant to my comparison *(Appendix 60).*

After the varimax rotation, all variables were applied to all factors, so my factor analysis could be seen as performed *(Appendix 61)*, although still not statistically correct.Then, with the help of the *NbClust* package, I determined the optimal number of groups for the K-means clustering procedure, which was six *(Figure 6).* Thus, I ran the K-means clustering process for 6 clusters, which result can be seen on *Figure 7.*[31] Similarly to the methodology applied in the outline analysis period, the algorithm was runned 100,000 times and chose the division that maximizes the distance between the clusters. Each cluster group is signed by number 1 to 6 and the number of vases in each cluster group in a row is the following: 2, 3, 4, 6, 7, and 7. *Appendix 62* shows the sum squared distance between the individuals and the clusters.

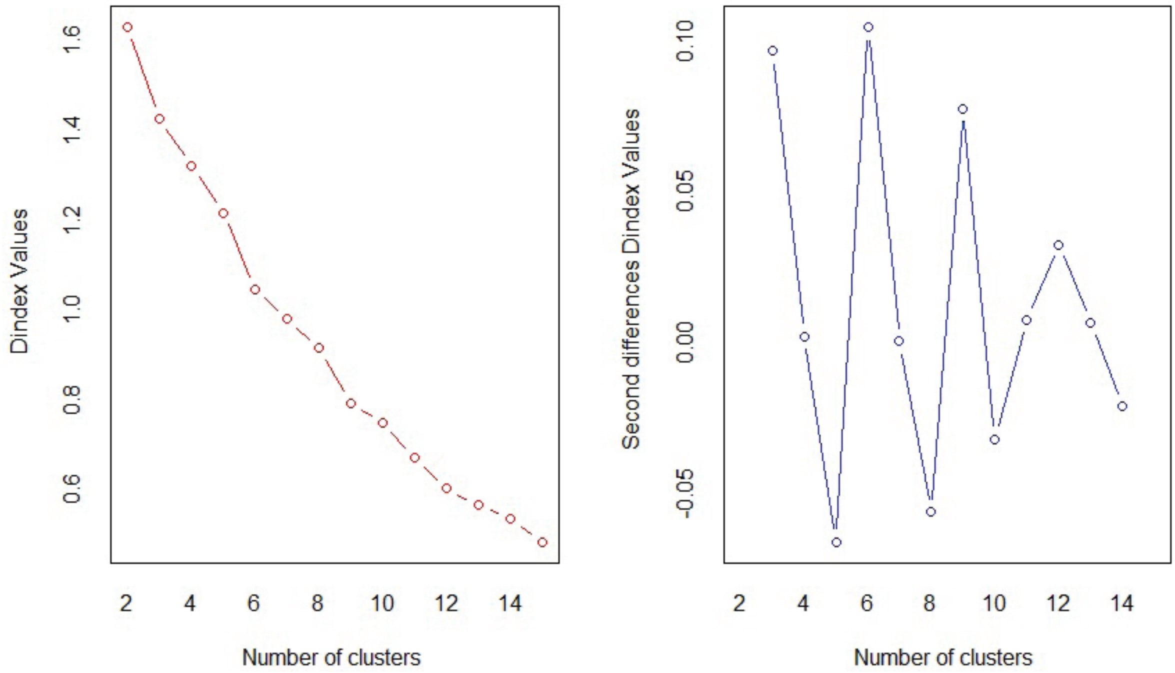

Fig. 6. Agglomeration schedule coefficients (imported from *R*, calculated by *NbClust* package).

Looking at *Figure 7* and *Figure 8* (*Cluster landmark* column) alongside, we can conclude that even though several *landmark*s were excluded, the classification turned out to be rather useful. Cluster 1 consists of the two smallest *lekythoi* of the assemblage, which is understandable considering the divergence in their proportions in comparison to the taller vases. Cluster 2 is also based on some characteristic differences: the *lekythoi* of this group are of the *archaizing* form with short mouth and neck areas and broad, spherical bodies. Interestingly, all of them are dated to the turn of the 6th and 5th centuries BC, possibly a little earlier, and they cover Clusters 5 and 6 of the *outline analysis.* Cluster 3 is also significant, since only pieces connected to the *Beldam* or *Haimon Workshops* belong in it – although not all of them. The other vases from Cluster 1 of the *outline analysis* seem to have split between Clusters 4 and 5. The *lekythoi* in Cluster 4 are cylinder-shaped with longer necks, while

31 This is part of the *R*'s basic package.

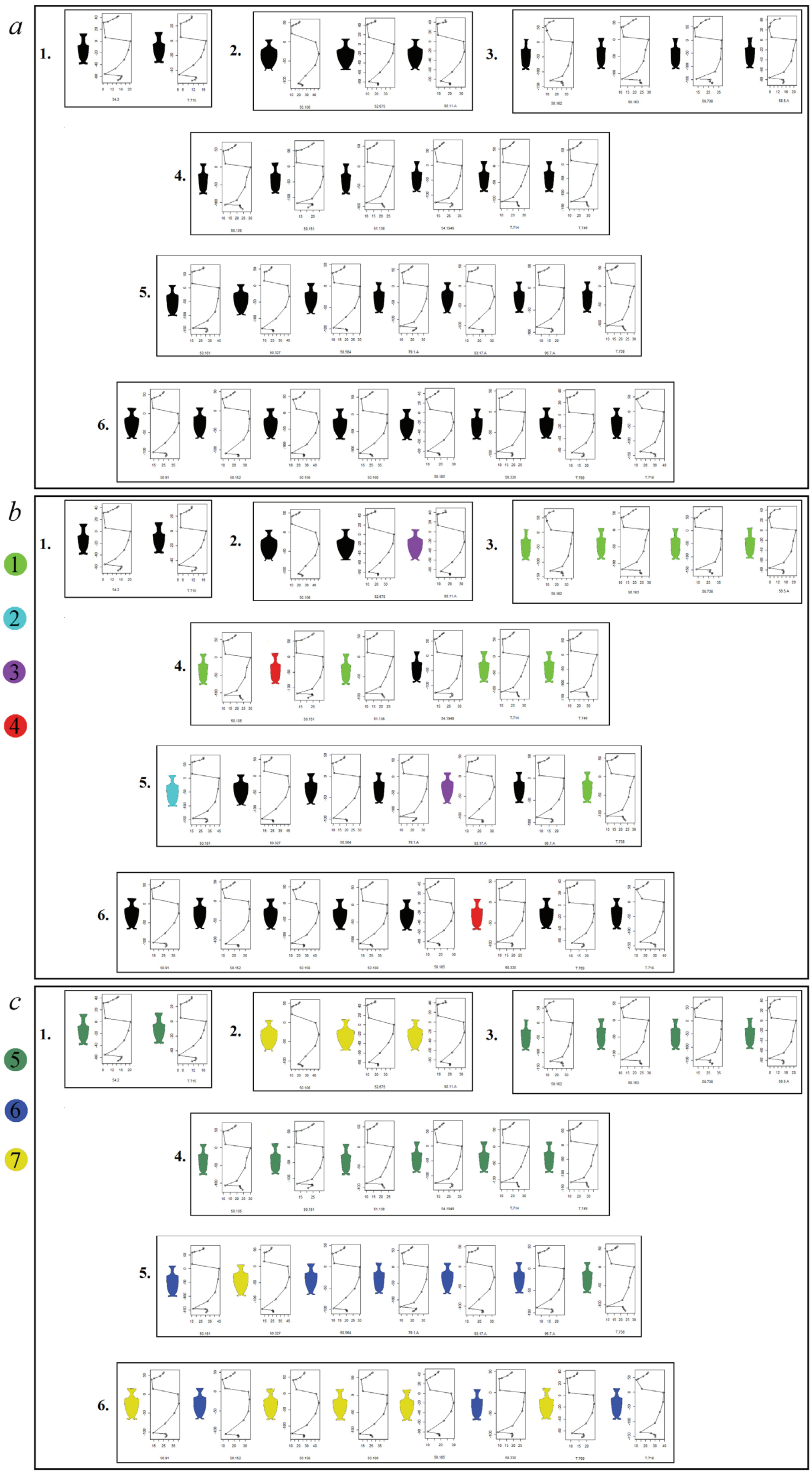

Fig. 7. The result of K-means clustering in case of landmark configuration. a – The six clusters, b – The six clusters with painters, workshops, groups and styles: 1 – Haimon-Beldam Workshop, 2 – Gela Painter, 3 – Cock Group, 4 – Red-figure *lekythoi.* c. – The six clusters with dating: 5 – 490–450 BC, 6 – 500–475 BC, 7 – 510–490 BC.

Fig. No.	*Itinerary Number*	*Date (BC)*	*Attributed to (by)*	*Style*	*Shape type*	*Cluster outline*	*Cluster landmark*	*High (cm)*	*Foot*	*Mouth*	*Shoulder*	*Bottom of the body*	*Top of the body*
1/1	50.105	470–450	Beldam Painter (J. D. Beazley)	white-ground	cylinder	1	4	17.9	trochilus	cup	horizontal	round	swings in a sharp angle
1/2	50.106	500 c.		black-figure	archaizing	5	2	17	echinus	cup	steep	narrow	swells out slightly
1/3	50.151	480–470	Rhodos 11966 Group (J. D. Beazley)	red-figure	cylinder	2	4	20.7	discos	calyx	steep	round	straight
1/4	50.152	500–490		black-figure	cylinder (broad-shouldered)	3	6	16	torus	cup	horizontal	narrow	straight
1/5	50.156	510–500		black-figure	cylinder (broad-shouldered)	4	6	19.5	torus	cup	curved	narrow	swells out slightly
1/6	50.160	510 c.		black-figure	cylinder (broad-shouldered)	4	6	18.5	trochilus	cup	horizontal	narrow	straight
1/7	50.161	490 c.	Gela Painter (J. Gy. Szilágyi)	white-ground	cylinder (broad-shouldered)	3	5	23.4	trochilus	echinus	steep	narrow	straight
1/8	50.162	480–470	Haimon or Beldam Workshop (J. Gy. Szilágyi)	black-figure	cylinder	1	3	22	two degrees	chimney	horizontal	round	swings in a sharp angle
1/9	50.163	480 c.	Haimon Workshop (J. Gy. Szilágyi)	black-figure	cylinder	1	3	19.2	two degrees	calyx	horizontal	narrow	swings in a sharp angle
1/10	50.185	490–480		black-figure	cylinder (broad-shouldered)	4	6	13	torus	cup	horizontal	narrow	swells out slightly
1/11	50.327	500 c.		black-figure	cylinder (broad-shouldered)	6	5	19	torus	cup	curved	narrow	swells out slightly
1/12	50.330	480 c.	Brygos (J. Gy. Szilágyi)	red-figure	cylinder (broad-shouldered)	3	6	15.6	torus	calyx	horizontal	round	straight
1/13	50.564	480 c.		black-figure	cylinder (broad-shouldered)	3	5	15.5	trochilus	cup	horizontal	narrow	straight
1/14	50.738	480 c.	Pholos Group (J. Gy. Szilágyi)	white-ground	cylinder	1	3	24.5	two degrees	calyx	steep	round	straight
1/15	50.91	500 c.		black-figure	cylinder (broad-shouldered)	4	6	17	torus	echinus	curved	narrow	swells out slightly
1/16	51.138	470–450	Beldam Workshop (J. Gy. Szilágyi)	black-figure	cylinder	1	4	16.1	torus	cup	steep	narrow	swings in a sharp angle
1/17	52.675	510–500		black-figure	cylinder (broad-shouldered)	5	2	13	torus	echinus	curved	narrow	straight
1/18	54.1949	450 c.		white-ground	cylinder	1	4	21.8	torus	calyx	horizontal	round	swings in a sharp angle
1/19	54.2	500–450		white-ground	cylinder	2	1	10.92	discos	cup	horizontal	narrow	swings in a sharp angle
1/20	58.5.A	500 c.	Beldam Painter (Sz. Joháczi)	black-figure	cylinder	1	3	13.22	discos	chimney	horizontal	round	swings in a sharp angle
1/21	79.1.A	500–475		black-figure	cylinder	3	5	19.43	discos	cup	horizontal	round	straight
1/22	92.11.A	510–500	Cock Group (J. Gy. Szilágyi)	black-figure	archaizing	6	2	13.51	echinus	echinus	steep	narrow	swells out slightly
1/23	93.17.A	500–480	Cock Group (J. Gy. Szilágyi)	black-figure	cylinder (broad-shouldered)	3	5	16.5	torus	cup	steep	narrow	swells out slightly
1/24	95.7.A	475–450		black-figure	cylinder	3	5	14.75	torus	cup	horizontal	narrow	straight
1/25	T.709	500–480		black-figure	cylinder (broad-shouldered)	4	6	11	torus	cup	horizontal	narrow	straight
1/26	T.714	470–450	Beldam Workshop (J. Gy. Szilágyi)	white-ground	cylinder	1	4	19.1	trochilus	cup	horizontal	round	swings in a sharp angle
1/27	T.715	500–450		white-ground	cylinder	2	1	9.85	torus	cup	horizontal	narrow	straight
1/28	T.716	500–475		white-ground	cylinder	3	6	22.4	two degrees	cup	steep	narrow	straight
1/29	T.738	470–450	Beldam Workshop (J. Gy. Szilágyi)	white-ground	cylinder	1	5	17.2	trochilus	cup	steep	round	swings in a sharp angle
4/5	T.749	470–450	Beldam Workshop (J. Gy. Szilágyi)	black-figure	cylinder	1	4	22.5	trochilus	cup	steep	round	swings in a sharp angle

Fig. 8. Summary table.

those in Cluster 5 are of stouter, shorter necks, in proportion to the taller body. It is slightly puzzling to see the piece under inv. no. 50.327 turn out to be in Cluster 5, since manually I would classify it along with the *archaizing* vases of group no. 1, as can be seen in the results of the *outline analysis*. Cluster 6 contains the broad-shouldered, steeply narrowing cylinder-shape *lekythoi*, although some anomalies can be seen here as well: the cylindrical pieces of inv. no. 50.330 and T.716. As can be seen in *Figure 5*, the basis for the comparison is most probably the breadth of the body, the joint height of the shoulder and neck areas, and quite possibly also the differentiated shape of the foot.

It can be stated in conclusion that the *outline analysis* provides a cloud of data that is statistically interpretable and well examinable. This method is certainly better suited to analyse the vases with geometric morphometrics than *landmark configuration*. In the case of the latter, data collection is a quite delicate step: as our objects are handmade, we do not have a large number of significant, similar landmarks which should be the same on each and every vase, providing certain, well comparable data. The number of vases involved in the analysis in the case of this method is more significant, as results are fewer and more sensitive here.

Based on these observations it seems that the first results of geometric morphometrics using a 3D reconstruction technique are quite promising, as the method was able to divide the assemblage into groups that could be interpreted in of archaeology, as well as, in some cases, classify the works of certain painters into one cluster. On account of this, I believe that broadening this research by including other vase forms in an analysis similar to that described above would be useful . I would also suggest the developing of a general practical methodology, as the use of morphometrics in archaeological research, especially concerning pottery as well as in the field of Classical archaeology is still in its infancy.[32] It would be indispensable to find the exact technical detail(s) in the case of each vase form with the comparison of which we could shed light on the characteristics of certain workshops. In the case of *lekythoi* this could mean the joining of the neck (the absence or existence and nature of the 'drip-ring'), which is different in each and every shape.*

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32 Some works to start with: Elewa 2010; Selden et al. 2014.

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Appendices

Appendix 1

Variables	*Communalities*
V1	0.9713926
V2	0.9710840
V3	0.9251225
V4	0.9811602
V5	0.9063152
V6	0.9215820
V7	0.9448618
V8	0.9084362
V9	0.8453972
V10	0.8988113
V11	0.9390499
V12	0.9221864
V13	0.9384788
V14	0.8844893
V15	0.8061764
V16	0.9469621
V17	0.9680996
V18	0.9440753
V19	0.9093047
V20	0.9370658
V21	0.8638628
V22	0.9553005
V23	0.9754119
V24	0.9684783
V25	0.8225142
V26	0.9155669
V27	0.9153811
V28	0.9520261
V29	0.9305282
V30	0.8466942

Appendix 2

Relative variance in case of 30 variables and 5 or 4 factors (PCA).

	PC1	*PC2*	*PC3*	*PC4*	*PC5*
Relative variance	41.10%	19.80%	12.40%	8.20%	4.40%
Σ Relative variance	41.10%	60.90%	73.40%	81.60%	86.00%

Appendix 3

Component matrix in case of 30 variables and 5 factors (PCA).

Variables	*Components*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	**0.73656**	-0.12384	-0.17537	-0.61543	-0.01054	0.73656	
V2	**0.74294**	-0.12294	-0.16891	-0.61132	-0.01740	0.74294	
V3	**0.73297**	0.32980	0.30919	-0.31054	-0.06422	0.73297	
V4	0.09203	0.63784	0.68199	0.21678	-0.15072	0.68199	
V5	0.10852	0.68871	0.44956	0.45243	-0.07267	0.68871	
V6	-0.67081	0.12028	-0.47169	0.41290	0.21028	0.67081	
V7	-0.29515	-0.51033	-0.62918	0.43357	0.08188	0.62918	
V8	-0.46059	**-0.77533**	-0.15052	0.18512	0.13111	0.77533	
V9	-0.54742	-0.61421	0.34353	-0.15222	-0.08287	0.61421	
V10	-0.61593	-0.38759	0.47320	-0.10198	-0.33431	0.61593	
V11	**0.78389**	0.28852	-0.03260	-0.22682	-0.23950	0.78389	
V12	**0.81905**	0.41935	-0.18268	-0.07668	0.14727	0.81905	
V13	0.63714	0.68758	-0.06828	-0.03819	0.18398	0.68758	
V14	0.37383	0.65029	-0.36897	-0.14700	0.35916	0.65029	
V15	-0.22088	**0.79835**	-0.17881	0.13555	0.22625	0.79835	
V16	0.40776	-0.64995	-0.07921	-0.38199	0.40945	0.64995	
V17	0.16373	-0.44653	0.66170	-0.03738	0.52393	0.66170	
V18	0.42960	-0.36804	0.63031	0.33500	0.30271	0.63031	
V19	**0.74609**	-0.32512	-0.01780	0.29031	-0.20295	0.74609	
V20	**0.70750**	-0.17138	-0.45629	0.35112	-0.25909	0.70750	
V21	0.54679	-0.34896	-0.55852	-0.01132	-0.31369	0.55852	
V22	**-0.74699**	0.52960	-0.02647	-0.18754	-0.12575	0.74699	
V23	**-0.88689**	0.40167	0.00008	-0.12512	0.00696	0.88689	
V24	**-0.92393**	0.25673	0.04012	-0.20649	0.05314	0.92393	
V25	**-0.71467**	-0.23492	-0.01792	-0.33214	0.02577	0.71467	
V26	0.46798	0.22084	-0.36937	0.20410	0.13160	0.46798	
V27	**0.87138**	-0.10507	0.25299	0.07655	-0.08436	0.87138	
V28	**0.83320**	-0.10507	0.35787	0.16462	-0.09163	0.83320	
V29	**0.90362**	-0.20477	0.15373	0.19073	0.08208	0.90362	
V30	0.65981	-0.20661	-0.06632	0.25485	0.07090	0.65981	
Minimum value						0.46798	V26

Appendix 4

Relative variance with varimax rotation, in case of 30 variables and 5 factors (PCA).

	RC1	*RC2*	*RC3*	*RC4*	*RC5*
Relative variance	29.80%	18.30%	16.50%	13.40%	0.80%
Σ Relative variance	29.80%	48.10%	64.60%	78.00%	86.00%

Appendix 5

Component matrix with varimax rotation, in case of 30 variables and 5 factors (PCA).

Variables	*Components with varimax rotation*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	0.34113	0.26302	0.66297	0.58299	-0.05022	0.66297	
V2	0.34896	0.26021	0.66784	0.57574	-0.05151	0.66784	
V3	0.31727	0.32061	**0.78328**	-0.12012	0.10379	0.78328	
V4	-0.04091	0.07358	0.38066	**-0.87876**	0.16099	0.87876	
V5	0.04247	0.26658	0.12121	**-0.89684**	0.07939	0.89684	
V6	-0.42566	0.13844	**-0.81646**	-0.07062	-0.17234	0.81646	
V7	0.14292	-0.09863	**-0.84993**	0.37468	-0.21257	0.84993	
V8	0.00095	-0.53952	-0.63721	0.41046	0.14770	0.63721	
V9	-0.23794	**-0.81430**	-0.14046	0.18364	0.22768	0.81430	
V10	-0.30918	**-0.87356**	-0.02720	-0.11355	0.05776	0.87356	
V11	0.43849	0.39051	0.64343	-0.00082	-0.22098	0.64343	
V12	0.41142	**0.74691**	0.42344	0.01714	-0.02984	0.74691	
V13	0.17778	**0.81124**	0.41937	-0.23043	0.00050	0.81124	
V14	-0.09838	**0.89445**	0.19113	0.02627	-0.04940	0.89445	
V15	-0.46401	0.61269	-0.12583	-0.41281	-0.10370	0.61269	
V16	0.32087	-0.03667	0.14227	**0.77655**	0.42541	0.77655	
V17	0.19781	-0.26948	0.12132	0.07791	**0.89855**	0.89855	
V18	0.58418	-0.18393	0.05382	-0.18640	**0.71304**	0.71304	
V19	**0.87701**	0.02216	0.10819	0.06351	-0.05253	0.87701	
V20	**0.81933**	0.27879	-0.07938	0.15329	-0.38694	0.81933	
V21	0.60624	0.10285	0.02294	0.48301	-0.46828	0.60624	
V22	**-0.85125**	-0.02353	-0.05718	-0.29759	-0.27044	0.85125	
V23	**-0.90583**	-0.10731	-0.22230	-0.25408	-0.13261	0.90583	
V24	**-0.92336**	-0.21466	-0.21622	-0.13789	-0.04678	0.92336	
V25	-0.62228	-0.43526	-0.17578	0.26374	0.00948	0.62228	
V26	0.34338	0.56966	-0.05678	0.03321	-0.12820	0.56966	
V27	**0.77370**	0.13584	0.45072	-0.04507	0.15839	0.77370	
V28	**0.78681**	0.07396	0.41789	-0.15539	0.21332	0.78681	
V29	**0.85817**	0.21523	0.27532	0.04560	0.25405	0.85817	
V30	0.69720	0.21265	0.02949	0.09854	0.10256	0.69720	
Minimum value						0.56966	V26

Appendix 6

Component matrix in case of 30 variables and 4 factors (PCA).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	**0.73656**	-0.12384	-0.17537	-0.61543	0.73656	
V2	**0.74294**	-0.12294	-0.16891	-0.61132	0.74294	
V3	**0.73297**	0.32980	0.30919	-0.31054	0.73297	
V4	0.09203	0.63784	0.68199	0.21678	0.68199	
V5	0.10852	0.68871	0.44956	0.45243	0.68871	
V6	-0.67081	0.12028	-0.47169	0.41290	0.67081	
V7	-0.29515	-0.51033	-0.62918	0.43357	0.62918	
V8	-0.46059	**-0.77533**	-0.15052	0.18512	0.77533	
V9	-0.54742	-0.61421	0.34353	-0.15222	0.61421	
V10	-0.61593	-0.38759	0.47320	-0.10198	0.61593	
V11	**0.78389**	0.28852	-0.03260	-0.22682	0.78389	
V12	**0.81905**	0.41935	-0.18268	-0.07668	0.81905	
V13	0.63714	0.68758	-0.06828	-0.03819	0.68758	
V14	0.37383	0.65029	-0.36897	-0.14700	0.65029	
V15	-0.22088	**0.79835**	-0.17881	0.13555	0.79835	
V16	0.40776	-0.64995	-0.07921	-0.38199	0.64995	
V17	0.16373	-0.44653	0.66170	-0.03738	0.66170	
V18	0.42960	-0.36804	0.63031	0.33500	0.63031	
V19	**0.74609**	-0.32512	-0.01780	0.29031	0.74609	
V20	**0.70750**	-0.17138	-0.45629	0.35112	0.70750	
V21	0.54679	-0.34896	-0.55852	-0.01132	0.55852	
V22	**-0.74699**	0.52960	-0.02647	-0.18754	0.74699	
V23	**-0.88689**	0.40167	0.00008	-0.12512	0.88689	
V24	**-0.92393**	0.25673	0.04012	-0.20649	0.92393	
V25	**-0.71467**	-0.23492	-0.01792	-0.33214	0.71467	
V26	0.46798	0.22084	-0.36937	0.20410	0.46798	
V27	**0.87138**	-0.10507	0.25299	0.07655	0.87138	
V28	**0.83320**	-0.10507	0.35787	0.16462	0.83320	
V29	**0.90362**	-0.20477	0.15373	0.19073	0.90362	
V30	0.65981	-0.20661	-0.06632	0.25485	0.65981	
Minimum value					0.46798	V26

Appendix 7

Relative variance with varimax rotation, in case of 30 variables and 4 factors (PCA).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	30.20%	20.20%	17.00%	14.20%
Σ Relative variance	30.20%	50.50%	67.40%	81.60%

Appendix 8

Component matrix with varimax rotation, in case of 30 variables and 4 factors (PCA).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.31672	0.27820	0.64067	0.61579	0.64067	
V2	0.32416	0.27756	0.64416	0.61012	0.64416	
V3	0.34409	0.29126	**0.79065**	-0.09845	0.79065	
V4	0.01681	0.04086	0.40172	**-0.87412**	0.87412	
V5	0.08569	0.24588	0.14650	**-0.89646**	0.89646	
V6	-0.44827	0.14038	**-0.78945**	-0.11639	0.78945	
V7	0.08139	-0.02280	**-0.88230**	0.38185	0.88230	
V8	0.00895	-0.58526	-0.62397	0.37183	0.62397	
V9	-0.20853	**-0.85233**	-0.14424	0.16541	0.85233	
V10	-0.30995	**-0.80900**	-0.08447	-0.07883	0.80900	
V11	0.39073	0.50727	0.57707	0.08505	0.57707	
V12	0.41489	**0.71378**	0.45168	0.01823	0.71378	
V13	0.20076	**0.74786**	0.47172	-0.25045	0.74786	
V14	-0.08311	**0.80015**	0.26892	-0.03016	0.80015	
V15	-0.44980	0.56026	-0.06347	-0.46503	0.56026	
V16	0.38769	-0.24293	0.23276	0.69094	0.69094	
V17	0.37975	-0.65014	0.30296	-0.08226	0.65014	
V18	**0.72426**	-0.44414	0.17337	-0.27867	0.72426	
V19	**0.84330**	0.11795	0.04226	0.14173	0.84330	
V20	**0.71896**	0.48596	-0.19041	0.26853	0.71896	
V21	0.48155	0.34225	-0.11242	0.60923	0.60923	
V22	**-0.88334**	0.05199	-0.07932	-0.29165	0.88334	
V23	**-0.90994**	-0.10031	-0.20821	-0.28663	0.90994	
V24	**-0.91377**	-0.24198	-0.18899	-0.18589	0.91377	
V25	-0.62255	-0.45435	-0.16992	0.23171	0.62255	
V26	0.32151	0.58198	-0.04818	0.03840	0.58198	
V27	**0.79423**	0.12530	0.44005	-0.00808	0.79423	
V28	**0.81972**	0.05021	0.41333	-0.12303	0.81972	
V29	**0.89741**	0.14407	0.29995	0.04889	0.89741	
V30	**0.70594**	0.18944	0.03600	0.10882	0.70594	
Minimum value					0.56026	V15

Appendix 9

Relative variance in case of 28 variables and 5 or 4 factors (PCA) (not included: V11 and V26).

	PC1	*PC2*	*PC3*	*PC4*	*PC5*
Relative variance	41.20%	20.80%	12.90%	0.86%	0.45%
Σ Relative variance	41.20%	62.00%	74.90%	83.50%	88.00%

Appendix 10

Component matrix in case of 28 variables and 5 factors (PCA) (not included: V11 and V26).

Variables	*Components*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	**0.73108**	-0.09807	-0.21372	-0.60754	-0.03803	0.73108	
V2	**0.74088**	-0.09339	-0.21201	-0.60346	-0.05208	0.74088	
V3	**0.71895**	0.37815	0.27091	-0.34262	-0.14275	0.71895	
V4	0.07216	0.66798	0.66813	0.18106	-0.18131	0.66813	
V5	0.08264	**0.71255**	0.43718	0.43625	-0.04447	0.71255	
V6	-0.68722	0.06463	-0.42958	0.42196	0.25280	0.68722	
V7	-0.27571	-0.54500	-0.58491	0.46342	0.13134	0.58491	
V8	-0.40867	**-0.79193**	-0.11605	0.19717	0.15441	0.79193	
V9	-0.50464	-0.62662	0.36588	-0.15050	-0.08594	0.62662	
V10	-0.59072	-0.40745	0.50357	-0.10260	-0.34383	0.59072	
V12	**0.79354**	0.45699	-0.22400	-0.08458	0.12965	0.79354	
V13	0.60479	**0.72376**	-0.11595	-0.05836	0.15044	0.72376	
V14	0.34098	0.66370	-0.41135	-0.16764	0.31113	0.66370	
V15	-0.26078	**0.78414**	-0.20466	0.13423	0.24715	0.78414	
V16	0.43277	-0.63776	-0.06161	-0.40439	0.39800	0.63776	
V17	0.20415	-0.40862	0.67814	-0.08805	0.53478	0.67814	
V18	0.47223	-0.31049	0.64810	0.28296	0.28479	0.64810	
V19	**0.76533**	-0.28318	-0.00365	0.27512	-0.25480	0.76533	
V20	**0.70162**	-0.15560	-0.44440	0.37430	-0.24360	0.70162	
V21	0.55483	-0.33862	-0.57287	0.03514	-0.30138	0.57287	
V22	**-0.77197**	0.49133	-0.05541	-0.15966	-0.09934	0.77197	
V23	**-0.90830**	0.35286	-0.00313	-0.11309	0.02626	0.90830	
V24	**-0.93602**	0.20814	0.04355	-0.20519	0.04485	0.93602	
V25	**-0.70169**	-0.27426	0.00324	-0.34469	-0.04247	0.70169	
V27	**0.87994**	-0.04897	0.22809	0.08368	-0.04244	0.87994	
V28	**0.84326**	-0.04776	0.34064	0.16623	-0.04493	0.84326	
V29	**0.92053**	-0.14650	0.14529	0.17505	0.08712	0.92053	
V30	0.68781	-0.15473	-0.09085	0.25683	0.07043	0.68781	
Minimum value						0.57287	V21

Appendix 11

Relative variance with varimax rotation, in case of 28 variables and 5 factors (PCA)(not included: V11 and V26).

	RC1	*RC2*	*RC3*	*RC4*	*RC5*
Relative variance	31.90%	18.50%	15.10%	14.10%	0.84%
Σ Relative variance	31.90%	50.40%	65.50%	79.50%	88.00%

Appendix 12

Component matrix with varimax rotation, in case of 28 variables and 5 factors (PCA) (not included: V11 and V26).

Variables	*Components with varimax rotation*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	0.37171	0.28088	0.58142	0.63430	-0.05377	0.63430	
V2	0.38245	0.28036	0.58956	0.62685	-0.06365	0.62685	
V3	0.34938	0.33656	**0.79278**	-0.05974	0.06021	0.79278	
V4	-0.03574	0.10152	0.46501	**-0.84616**	0.14015	0.84616	
V5	0.04589	0.29788	0.16378	**-0.87850**	0.09246	0.87850	
V6	-0.44802	0.09588	**-0.80849**	-0.12829	-0.15134	0.80849	
V7	0.12083	-0.15732	**-0.88299**	0.30405	-0.18893	0.88299	
V8	-0.02712	-0.56680	-0.63336	0.35266	0.15116	0.63336	
V9	-0.26660	**-0.80863**	-0.09516	0.16193	0.22579	0.80863	
V10	-0.34166	**-0.87050**	0.05425	-0.12762	0.05973	0.87050	
V12	0.44934	**0.75800**	0.36203	0.05831	-0.04181	0.75800	
V13	0.21847	**0.83272**	0.39054	-0.18604	-0.02834	0.83272	
V14	-0.05749	**0.90099**	0.15567	0.05511	-0.09230	0.90099	
V15	-0.44682	0.64125	-0.13283	-0.40547	-0.10470	0.64125	
V16	0.31422	-0.06271	0.08424	**0.78533**	0.43962	0.78533	
V17	0.17620	-0.25530	0.13153	0.08922	**0.91694**	0.91694	
V18	0.57030	-0.19644	0.09269	-0.18682	**0.70235**	0.70235	
V19	**0.88360**	-0.03291	0.11999	0.05863	-0.08301	0.88360	
V20	**0.82832**	0.22891	-0.13113	0.14051	-0.37142	0.82832	
V21	0.62471	0.08416	-0.05493	0.47699	-0.46353	0.62471	
V22	**-0.84586**	0.03405	-0.04113	-0.29259	-0.26802	0.84586	
V23	**-0.91451**	-0.07528	-0.18744	-0.26347	-0.12832	0.91451	
V24	**-0.93472**	-0.19493	-0.16623	-0.15043	-0.05926	0.93472	
V25	-0.63616	-0.45915	-0.11317	0.24203	-0.03619	0.63616	
V27	**0.78700**	0.16555	0.39152	-0.00968	0.19328	0.78700	
V28	**0.79404**	0.10163	0.37305	-0.12282	0.25294	0.79404	
V29	**0.86907**	0.20916	0.23642	0.06546	0.26264	0.86907	
V30	**0.71621**	0.21452	-0.01048	0.09921	0.08527	0.71621	
Minimum value						0.62471	V21

Appendix 13

Component matrix in case of 28 variables and 4 factors (PCA) (not included: V11 and V26).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	**0.73108**	-0.09807	-0.21372	-0.60754	0.73108	
V2	**0.74088**	-0.09339	-0.21201	-0.60346	0.74088	
V3	**0.71895**	0.37815	0.27091	-0.34262	0.71895	
V4	0.07216	0.66798	0.66813	0.18106	0.66813	
V5	0.08264	**0.71255**	0.43718	0.43625	0.71255	
V6	-0.68722	0.06463	-0.42958	0.42196	0.68722	
V7	-0.27571	-0.54500	-0.58491	0.46342	0.58491	
V8	-0.40867	**-0.79193**	-0.11605	0.19717	0.79193	
V9	-0.50464	-0.62662	0.36588	-0.15050	0.62662	
V10	-0.59072	-0.40745	0.50357	-0.10260	0.59072	
V12	**0.79354**	0.45699	-0.22400	-0.08458	0.79354	
V13	0.60479	**0.72376**	-0.11595	-0.05836	0.72376	
V14	0.34098	0.66370	-0.41135	-0.16764	0.66370	
V15	-0.26078	**0.78414**	-0.20466	0.13423	0.78414	
V16	0.43277	-0.63776	-0.06161	-0.40439	0.63776	
V17	0.20415	-0.40862	0.67814	-0.08805	0.67814	
V18	0.47223	-0.31049	0.64810	0.28296	0.64810	
V19	**0.76533**	-0.28318	-0.00365	0.27512	0.76533	
V20	**0.70162**	-0.15560	-0.44440	0.37430	0.70162	
V21	0.55483	-0.33862	-0.57287	0.03514	0.57287	
V22	**-0.77197**	0.49133	-0.05541	-0.15966	0.77197	
V23	**-0.90830**	0.35286	-0.00313	-0.11309	0.90830	
V24	**-0.93602**	0.20814	0.04355	-0.20519	0.93602	
V25	**-0.70169**	-0.27426	0.00324	-0.34469	0.70169	
V27	**0.87994**	-0.04897	0.22809	0.08368	0.87994	
V28	**0.84326**	-0.04776	0.34064	0.16623	0.84326	
V29	**0.92053**	-0.14650	0.14529	0.17505	0.92053	
V30	0.68781	-0.15473	-0.09085	0.25683	0.68781	
Minimum value					0.57287	V21

Appendix 14

Relative variance with varimax rotation, in case of 28 variables and 4 factors (PCA) (not included: V11 and V26).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	32.70%	20.20%	16.00%	14.60%
Σ Relative variance	32.70%	52.80%	68.80%	83.50%

Appendix 15

Component matrix with varimax rotation, in case of 28 variables and 4 factors. (PCA) (not included: V11 and V26).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.34962	0.30861	0.46796	**0.72279**	0.72279	
V2	0.35844	0.31419	0.47175	**0.71902**	0.71902	
V3	0.36703	0.35085	**0.76767**	0.05941	0.76767	
V4	0.01330	0.09757	0.56090	**-0.77864**	0.77864	
V5	0.09789	0.27173	0.28320	**-0.85579**	0.85579	
V6	-0.45331	0.07440	**-0.74890**	-0.25916	0.74890	
V7	0.07472	-0.13244	**-0.93070**	0.20148	0.93070	
V8	-0.03233	-0.63785	-0.61401	0.24820	0.63785	
V9	-0.26551	**-0.84148**	-0.08391	0.13495	0.84148	
V10	-0.36691	**-0.79660**	0.01665	-0.09805	0.79660	
V12	0.46862	**0.73160**	0.36039	0.10559	0.73160	
V13	0.25423	**0.79452**	0.43474	-0.14682	0.79452	
V14	-0.02893	**0.84325**	0.20119	0.04107	0.84325	
V15	-0.41334	0.60053	-0.03145	-0.45860	0.60053	
V16	0.36595	-0.27375	0.14359	**0.72930**	0.72930	
V17	0.32493	-0.63735	0.40539	-0.01208	0.63735	
V18	0.68234	-0.46128	0.29438	-0.23340	0.68234	
V19	**0.84774**	0.05282	0.01277	0.14147	0.84774	
V20	**0.75399**	0.39053	-0.29863	0.20945	0.75399	
V21	0.52090	0.29013	-0.28993	0.55887	0.55887	
V22	**-0.86999**	0.12986	-0.04946	-0.29951	0.86999	
V23	**-0.91701**	-0.04760	-0.14296	-0.31417	0.91701	
V24	**-0.93332**	-0.18878	-0.11864	-0.20653	0.93332	
V25	-0.65991	-0.43202	-0.14063	0.21096	0.65991	
V27	**0.81373**	0.12031	0.39454	0.05847	0.81373	
V28	**0.83118**	0.03989	0.40124	-0.05989	0.83118	
V29	**0.90858**	0.11339	0.26922	0.09867	0.90858	
V30	**0.72727**	0.17246	-0.01390	0.11126	0.72727	
Minimum value					0.55887	V21

Appendix 16

Relative variance in case of 26 variables and 5 or 4 factors (PCA) (not included: V6, V11, V21 and V26).

	PC1	*PC2*	*PC3*	*PC4*	*PC5*
Relative variance	41.60%	21.90%	12.10%	8.40%	4.30%
Σ Relative variance	41.60%	63.50%	75.60%	84.00%	88.30%

Appendix 17

Component matrix in case of 26 variables and 5 factors (PCA) (not included: V6, V11, V21 and V26).

Variables	*Components*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	**0.70615**	-0.10858	-0.34542	0.56385	-0.12117	0.70615	
V2	**0.71478**	-0.10416	-0.34665	0.55248	-0.13002	0.71478	
V3	**0.71974**	0.33634	0.21208	0.39694	-0.17810	0.71974	
V4	0.10083	0.62511	**0.73933**	-0.04391	-0.13243	0.73933	
V5	0.12119	0.67974	0.56517	-0.33611	0.04166	0.67974	
V7	-0.28327	-0.50227	-0.51072	-0.57719	0.15636	0.57719	
V8	-0.43689	**-0.76854**	-0.12873	-0.23780	0.19068	0.76854	
V9	-0.54110	-0.62040	0.29511	0.19009	-0.06000	0.62040	
V10	-0.61737	-0.40453	0.46527	0.16888	-0.34731	0.61737	
V12	**0.81340**	0.43352	-0.22008	0.07024	0.10300	0.81340	
V13	0.63703	0.69998	-0.09573	0.05932	0.14261	0.69998	
V14	0.37051	0.66882	-0.40609	0.11292	0.30694	0.66882	
V15	-0.21625	**0.79713**	-0.14054	-0.16877	0.27944	0.79713	
V16	0.40633	-0.65708	-0.20239	0.42197	0.32017	0.65708	
V17	0.20123	-0.46984	0.59916	0.27335	0.52183	0.59916	
V18	0.47691	-0.38033	0.65145	-0.11280	0.28865	0.65145	
V19	**0.75568**	-0.31494	0.02305	-0.27774	-0.29321	0.75568	
V20	0.69886	-0.15714	-0.37085	-0.46096	-0.26585	0.69886	
V22	**-0.75857**	0.53084	-0.04233	0.12027	-0.05904	0.75857	
V23	**-0.89272**	0.38944	0.00071	0.09098	0.04853	0.89272	
V24	**-0.92943**	0.24359	0.01295	0.18329	0.06056	0.92943	
V25	**-0.72654**	-0.23809	-0.07659	0.30659	-0.03893	0.72654	
V27	**0.87612**	-0.09909	0.22741	-0.02098	-0.05560	0.87612	
V28	**0.84219**	-0.10325	0.36060	-0.07264	-0.04854	0.84219	
V29	**0.92259**	-0.19789	0.16209	-0.10097	0.05965	0.92259	
V30	0.68673	-0.17908	-0.04765	-0.24681	0.09244	0.68673	
Minimum value						0.57719	V7

Appendix 18

Relative variance with varimax rotation, in case of 26 variables and 5 factors (PCA) (not included: V6, V11, V21 and V26).

	RC1	*RC2*	*RC3*	*RC4*	*RC5*
Relative variance	32.70%	19.00%	14.80%	13.50%	8.20%
Σ Relative variance	32.70%	51.70%	66.60%	80.10%	88.30%

Appendix 19

Component matrix with varimax rotation, in case of 26 variables and 5 factors (PCA)(not included: V6, V11, V21 and V26).

Variables	*Components*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	0.38665	0.25285	0.31887	**0.80341**	-0.04215	0.80341	
V2	0.39834	0.25627	0.32005	**0.79658**	-0.05246	0.79658	
V3	0.39163	0.29573	**0.75724**	0.22167	0.04496	0.75724	
V4	0.00551	0.07188	**0.73764**	-0.63684	0.11019	0.73764	
V5	0.06607	0.29516	0.46199	**-0.77442**	0.07884	0.77442	
V7	0.06630	-0.10316	**-0.95304**	-0.02001	-0.16497	0.95304	
V8	-0.06978	-0.51093	**-0.76307**	0.08666	0.18790	0.76307	
V9	-0.27660	**-0.78768**	-0.18473	0.09154	0.25506	0.78768	
V10	-0.32915	**-0.88411**	0.07862	-0.10911	0.04842	0.88411	
V12	0.46328	**0.73997**	0.33407	0.19384	-0.04661	0.73997	
V13	0.24029	**0.81238**	0.45647	-0.02821	-0.04402	0.81238	
V14	-0.05839	**0.89586**	0.17392	0.11559	-0.08299	0.89586	
V15	-0.44339	0.64510	0.06260	-0.41912	-0.12717	0.64510	
V16	0.30542	-0.06485	-0.19774	**0.75672**	0.45737	0.75672	
V17	0.18485	-0.25951	0.09274	0.10009	**0.92040**	0.92040	
V18	0.58532	-0.19824	0.12182	-0.16395	0.68476	0.68476	
V19	**0.89794**	-0.04130	0.03546	0.10691	-0.11491	0.89794	
V20	**0.82052**	0.23618	-0.21359	0.10693	-0.38433	0.82052	
V22	**-0.84564**	0.03414	0.10296	-0.28535	-0.26202	0.84564	
V23	**-0.91488**	-0.07606	-0.03739	-0.30929	-0.13929	0.91488	
V24	**-0.93458**	-0.19249	-0.06801	-0.20213	-0.06810	0.93458	
V25	-0.64774	-0.44768	-0.18818	0.17413	-0.01430	0.64774	
V27	**0.80604**	0.15353	0.33095	0.12157	0.18726	0.80604	
V28	**0.81315**	0.08750	0.35729	0.00776	0.24700	0.81315	
V29	**0.87919**	0.19568	0.17830	0.14610	0.25683	0.87919	
V30	**0.70361**	0.23279	-0.07797	0.08609	0.11248	0.70361	
Minimum value						0.64510	V15

Appendix 20

Component matrix in case of 26 variables and 4 factors (PCA) (not included: V6, V11, V21 and V26).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	**0.70615**	-0.10858	-0.34542	0.56385	0.70615	
V2	**0.71478**	-0.10416	-0.34665	0.55248	0.71478	
V3	**0.71974**	0.33634	0.21208	0.39694	0.71974	
V4	0.10083	0.62511	**0.73933**	-0.04391	0.73933	
V5	0.12119	0.67974	0.56517	-0.33611	0.67974	
V7	-0.28327	-0.50227	-0.51072	-0.57719	0.57719	
V8	-0.43689	**-0.76854**	-0.12873	-0.23780	0.76854	
V9	-0.54110	-0.62040	0.29511	0.19009	0.62040	
V10	-0.61737	-0.40453	0.46527	0.16888	0.61737	
V12	**0.81340**	0.43352	-0.22008	0.07024	0.81340	
V13	0.63703	0.69998	-0.09573	0.05932	0.69998	
V14	0.37051	0.66882	-0.40609	0.11292	0.66882	
V15	-0.21625	**0.79713**	-0.14054	-0.16877	0.79713	
V16	0.40633	-0.65708	-0.20239	0.42197	0.65708	
V17	0.20123	-0.46984	0.59916	0.27335	0.59916	
V18	0.47691	-0.38033	0.65145	-0.11280	0.65145	
V19	**0.75568**	-0.31494	0.02305	-0.27774	0.75568	
V20	0.69886	-0.15714	-0.37085	-0.46096	0.69886	
V22	**-0.75857**	0.53084	-0.04233	0.12027	0.75857	
V23	**-0.89272**	0.38944	0.00071	0.09098	0.89272	
V24	**-0.92943**	0.24359	0.01295	0.18329	0.92943	
V25	**-0.72654**	-0.23809	-0.07659	0.30659	0.72654	
V27	**0.87612**	-0.09909	0.22741	-0.02098	0.87612	
V28	**0.84219**	-0.10325	0.36060	-0.07264	0.84219	
V29	**0.92259**	-0.19789	0.16209	-0.10097	0.92259	
V30	0.68673	-0.17908	-0.04765	-0.24681	0.68673	
Minimum value					0.57719	V7

Appendix 21

Relative variance with varimax rotation, in case of 26 variables and 4 factors (PCA) (not included: V6, V11, V21 and V26)

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	33.70%	20.90%	15.50%	13.90%
Σ Relative variance	33.70%	54.60%	70.10%	84.00%

Appendix 22

Component matrix with varimax rotation, in case of 26 variables and 4 factors (PCA) (not included: V6, V11, V21 and V26).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.35695	0.30253	0.25395	**0.81501**	0.81501	
V2	0.36681	0.31094	0.25139	**0.80792**	0.80792	
V3	0.38756	0.32327	**0.71872**	0.24984	0.71872	
V4	0.03249	0.05945	**0.75569**	-0.61141	0.75569	
V5	0.10814	0.24502	0.51502	**-0.75641**	0.75641	
V7	0.04782	-0.08983	**-0.95578**	-0.05115	0.95578	
V8	-0.04864	-0.60224	-0.69562	0.07549	0.69562	
V9	-0.26648	**-0.83501**	-0.15384	0.09486	0.83501	
V10	-0.36286	**-0.80356**	0.01830	-0.10987	0.80356	
V12	0.47544	**0.72046**	0.33866	0.20768	0.72046	
V13	0.26518	**0.77804**	0.48225	-0.01492	0.77804	
V14	-0.02801	**0.83499**	0.22650	0.11390	0.83499	
V15	-0.41121	0.59955	0.12398	-0.43183	0.59955	
V16	0.36608	-0.26364	-0.07678	**0.77876**	0.77876	
V17	0.33663	-0.65065	0.36785	0.15158	0.65065	
V18	0.69409	-0.46920	0.30647	-0.11559	0.69409	
V19	**0.85159**	0.06478	-0.06677	0.11857	0.85159	
V20	**0.74564**	0.41126	-0.35854	0.09722	0.74564	
V22	**-0.87057**	0.12079	0.06588	-0.31090	0.87057	
V23	**-0.91783**	-0.04993	-0.02798	-0.33348	0.91783	
V24	**-0.93255**	-0.18679	-0.04696	-0.22402	0.93255	
V25	-0.66379	-0.42433	-0.19794	0.15670	0.66379	
V27	**0.82384**	0.11063	0.33902	0.15388	0.82384	
V28	**0.84090**	0.02448	0.38157	0.04409	0.84090	
V29	**0.91364**	0.10452	0.22137	0.17924	0.91364	
V30	**0.72326**	0.17516	-0.05084	0.10235	0.72326	
Minimum value					0.59955	V15

Appendix 23

Relative variance in case of 24 variables and 5 or 4 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30)

	PC1	*PC2*	*PC3*	*PC4*	*PC5*
Relative variance	43.00%	21.10%	13.00%	8.80%	4.30%
Σ Relative variance	43.00%	64.10%	77.20%	86.00%	90.30%

Appendix 24

Component matrix in case of 24 variables and 5 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30).

Variables	*Components*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	**0.70852**	0.14642	-0.35866	0.53782	-0.15864	0.70852	
V2	**0.71685**	0.14356	-0.35930	0.52756	-0.16979	0.71685	
V3	**0.73893**	-0.32816	0.18061	0.38102	-0.19219	0.73893	
V4	0.13412	-0.65797	**0.70733**	-0.04663	-0.11383	0.70733	
V5	0.15442	-0.68887	0.54321	-0.34014	0.08993	0.68887	
V7	-0.31408	0.53581	-0.46435	-0.57352	0.18245	0.57352	
V8	-0.48350	**0.76336**	-0.07989	-0.19698	0.16156	0.76336	
V9	-0.57773	0.55206	0.31232	0.22627	-0.09149	0.57773	
V10	-0.63434	0.33115	0.47052	0.18257	-0.39395	0.63434	
V12	**0.83092**	-0.38557	-0.24075	0.05129	0.13464	0.83092	
V13	0.67411	-0.65826	-0.12813	0.03368	0.18664	0.67411	
V14	0.40725	-0.61866	-0.43489	0.09159	0.35004	0.61866	
V16	0.37883	0.69124	-0.17770	0.44158	0.26928	0.69124	
V17	0.18162	0.46867	0.62310	0.33068	0.46581	0.62310	
V18	0.45401	0.38879	0.67960	-0.06868	0.26141	0.67960	
V19	**0.73500**	0.35031	0.04348	-0.29485	-0.29277	0.73500	
V20	0.68545	0.21599	-0.35106	-0.49599	-0.23721	0.68545	
V22	**-0.73488**	-0.58082	-0.07424	0.12316	-0.04772	0.73488	
V23	**-0.86754**	-0.43242	-0.02103	0.09319	0.05698	0.86754	
V24	**-0.90952**	-0.29115	-0.00515	0.18838	0.06194	0.90952	
V25	**-0.72766**	0.19604	-0.07903	0.30356	-0.04736	0.72766	
V27	**0.87718**	0.14816	0.23609	-0.03270	-0.08143	0.87718	
V28	**0.84371**	0.13827	0.36763	-0.08803	-0.05164	0.84371	
V29	**0.90542**	0.23538	0.17611	-0.09542	0.05927	0.90542	
Minimum value						0.57352	V7

Appendix 25

Relative variance with varimax rotation, in case of 24 variables and 5 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30).

	RC1	RC2	RC3	RC4	RC5
Relative variance	31,90%	20,10%	15,40%	13,80%	9,10%
Σ Relative variance	31,90%	52,00%	67,40%	81,20%	90,30%

Appendix 26

Component matrix with varimax rotation, in case of 24 variables and 5 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30).

Variables	*Components*					*MAX*	
	1	*2*	*3*	*4*	*5*		
V1	0.39171	0.28331	0.31825	**0.79393**	-0.03441	0.79393	
V2	0.40370	0.28441	0.32068	**0.78862**	-0.04574	0.78862	
V3	0.39170	0.32657	**0.75073**	0.20532	0.05104	0.75073	
V4	0.01755	0.07238	**0.72534**	-0.65068	0.10633	0.72534	
V5	0.05737	0.29992	0.43877	**-0.79087**	0.07752	0.79087	
V7	0.05244	-0.10650	**-0.96153**	-0.00594	-0.15778	0.96153	
V8	-0.07042	-0.52724	**-0.74684**	0.11003	0.18696	0.74684	
V9	-0.26068	**-0.78896**	-0.16341	0.10363	0.26041	0.78896	
V10	-0.27383	**-0.90930**	0.09878	-0.09345	0.04089	0.90930	
V12	0.42016	**0.78118**	0.31617	0.17269	-0.03534	0.78118	
V13	0.20515	**0.83957**	0.43460	-0.05309	-0.03821	0.83957	
V14	-0.10275	**0.90264**	0.16360	0.09727	-0.08423	0.90264	
V16	0.30034	-0.03572	-0.19638	**0.75480**	0.46972	0.75480	
V17	0.18560	-0.24516	0.09289	0.09669	**0.92450**	0.92450	
V18	0.58122	-0.16425	0.10563	-0.16912	0.69831	0.69831	
V19	**0.90454**	0.00883	0.00846	0.10282	-0.09255	0.90454	
V20	**0.81276**	0.27973	-0.24429	0.10285	-0.36458	0.81276	
V22	**-0.84956**	-0.02218	0.13551	-0.27620	-0.28889	0.84956	
V23	**-0.90345**	-0.13679	-0.01316	-0.30000	-0.16397	0.90345	
V24	**-0.91785**	-0.24932	-0.04346	-0.19241	-0.08851	0.91785	
V25	-0.61853	-0.47159	-0.17531	0.18069	-0.01428	0.61853	
V27	**0.82138**	0.19031	0.30460	0.11089	0.19720	0.82138	
V28	**0.82649**	0.14228	0.31893	-0.01176	0.26711	0.82649	
V29	**0.85688**	0.25724	0.15317	0.13150	0.27867	0.85688	
Minimum value						0.61853	V25

Appendix 27

Component matrix in case of 24 variables and 4 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	**0.70852**	0.14642	-0.35866	0.53782	0.70852	
V2	**0.71685**	0.14356	-0.35930	0.52756	0.71685	
V3	**0.73893**	-0.32816	0.18061	0.38102	0.73893	
V4	0.13412	-0.65797	**0.70733**	-0.04663	0.70733	
V5	0.15442	-0.68887	0.54321	-0.34014	0.68887	
V7	-0.31408	0.53581	-0.46435	-0.57352	0.57352	
V8	-0.48350	**0.76336**	-0.07989	-0.19698	0.76336	
V9	-0.57773	0.55206	0.31232	0.22627	0.57773	
V10	-0.63434	0.33115	0.47052	0.18257	0.63434	
V12	**0.83092**	-0.38557	-0.24075	0.05129	0.83092	
V13	0.67411	-0.65826	-0.12813	0.03368	0.67411	
V14	0.40725	-0.61866	-0.43489	0.09159	0.61866	
V16	0.37883	0.69124	-0.17770	0.44158	0.69124	
V17	0.18162	0.46867	0.62310	0.33068	0.62310	
V18	0.45401	0.38879	0.67960	-0.06868	0.67960	
V19	**0.73500**	0.35031	0.04348	-0.29485	0.73500	
V20	0.68545	0.21599	-0.35106	-0.49599	0.68545	
V22	**-0.73488**	-0.58082	-0.07424	0.12316	0.73488	
V23	**-0.86754**	-0.43242	-0.02103	0.09319	0.86754	
V24	**-0.90952**	-0.29115	-0.00515	0.18838	0.90952	
V25	**-0.72766**	0.19604	-0.07903	0.30356	0.72766	
V27	**0.87718**	0.14816	0.23609	-0.03270	0.87718	
V28	**0.84371**	0.13827	0.36763	-0.08803	0.84371	
V29	**0.90542**	0.23538	0.17611	-0.09542	0.90542	
Minimum value					0.57352	V7

Appendix 28

Relative variance with varimax rotation, in case of 24 variables and 4 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	33.30%	22.40%	16.00%	14.20%
Σ Relative variance	33.30%	55.80%	71.80%	86.00%

Appendix 29

Component matrix with varimax rotation, in case of 24 variables and 4 factors (PCA) (not included: V6, V11, V15, V21, V26 and V30).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.35161	0.34654	0.23557	**0.80132**	0.80132	
V2	0.36035	0.35438	0.23303	**0.79508**	0.79508	
V3	0.38830	0.37025	0.69985	0.23204	0.69985	
V4	0.05745	0.06810	**0.74611**	-0.62353	0.74611	
V5	0.11106	0.24745	0.50185	**-0.76403**	0.76403	
V7	0.02053	-0.10530	**-0.95774**	-0.03881	0.95774	
V8	-0.03834	-0.62394	-0.67865	0.10168	0.67865	
V9	-0.22740	**-0.84173**	-0.12791	0.10351	0.84173	
V10	-0.30322	**-0.81305**	0.03164	-0.11309	0.81305	
V12	0.42787	**0.75869**	0.31998	0.19651	0.75869	
V13	0.22895	**0.79704**	0.46572	-0.02634	0.79704	
V14	-0.07583	**0.82206**	0.22702	0.11420	0.82206	
V16	0.38955	-0.24125	-0.08153	**0.79454**	0.79454	
V17	0.40405	-0.64572	0.36975	0.18252	0.64572	
V18	**0.73805**	-0.43229	0.28712	-0.09911	0.73805	
V19	**0.84260**	0.13941	-0.11172	0.09936	0.84260	
V20	**0.70250**	0.47317	-0.40330	0.07545	0.70250	
V22	**-0.88820**	0.05666	0.10887	-0.30679	0.88820	
V23	**-0.91003**	-0.12465	0.01035	-0.32396	0.91003	
V24	**-0.91337**	-0.26036	-0.00739	-0.21310	0.91337	
V25	-0.62849	-0.46452	-0.17369	0.15927	0.62849	
V27	**0.84385**	0.17135	0.29305	0.14453	0.84385	
V28	**0.86833**	0.09411	0.33197	0.02833	0.86833	
V29	**0.90547**	0.17563	0.18658	0.17259	0.90547	
Minimum value					0.62849	V25

Appendix 30

Relative variance in case of 22 variables and 4 or 3 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

	PC1	*PC2*	*PC3*	*PC4*
Relative variance	43.10%	22.40%	13.30%	9.00%
Σ Relative variance	43.10%	65.40%	78.70%	87.70%

Appendix 31

Component matrix in case of 22 variables and 4 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	**0.72836**	-0.09682	-0.42744	0.47564	0.72836	
V2	**0.73685**	-0.09366	-0.42490	0.46159	0.73685	
V3	**0.74265**	0.41282	0.09303	0.31536	0.74265	
V4	0.11581	**0.71826**	0.64999	-0.05461	0.71826	
V5	0.10607	**0.71616**	0.52465	-0.32536	0.71616	
V7	-0.31732	-0.61669	-0.35434	-0.54777	0.61669	
V8	-0.43906	**-0.80852**	0.01576	-0.14072	0.80852	
V9	-0.52113	-0.55959	0.35149	0.29769	0.55959	
V12	**0.78909**	0.41773	-0.27494	-0.00201	0.78909	
V13	0.61726	0.68593	-0.17194	-0.01774	0.68593	
V14	0.34412	0.60612	-0.45840	0.04206	0.60612	
V16	0.43034	-0.66437	-0.15868	0.46543	0.66437	
V17	0.23582	-0.40948	0.65401	0.42345	0.65401	
V18	0.49586	-0.31692	**0.71618**	-0.01262	0.71618	
V19	**0.76051**	-0.29560	0.04411	-0.34985	0.76051	
V20	0.67393	-0.20717	-0.33666	-0.55753	0.67393	
V22	**-0.77695**	0.52485	-0.10384	0.13880	0.77695	
V23	**-0.89713**	0.37046	-0.02691	0.12440	0.89713	
V24	**-0.92063**	0.23387	0.00118	0.21585	0.92063	
V27	**0.88842**	-0.07384	0.21000	-0.04223	0.88842	
V28	**0.85593**	-0.05925	0.34229	-0.08388	0.85593	
V29	**0.91492**	-0.16865	0.16599	-0.09503	0.91492	
Minimum value					0.55959	V9

Appendix 32

Relative variance with varimax rotation, in case of 22 variables and 4 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	34.20%	26.30%	15.30%	11.90%
Σ Relative variance	34.20%	60.50%	75.80%	87.70%

Appendix 33

Component matrix with varimax rotation, in case of 22 variables and 4 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.37200	0.52908	**0.72582**	0.06089	0.72582	
V2	0.38398	0.53110	**0.71615**	0.05419	0.71615	
V3	0.36103	**0.78407**	0.06159	0.28486	0.78407	
V4	-0.01931	0.47745	**-0.76742**	0.37084	0.76742	
V5	0.05916	0.41100	**-0.84983**	0.10299	0.84983	
V7	0.10934	**-0.74442**	0.14750	-0.56456	0.74442	
V8	-0.02102	**-0.90065**	0.23405	-0.01193	0.90065	
V9	-0.29182	-0.67831	0.14347	0.48066	0.67831	
V12	0.45922	**0.78359**	0.10621	-0.19123	0.78359	
V13	0.24725	**0.87842**	-0.13484	-0.17454	0.87842	
V14	-0.02559	**0.74773**	0.06081	-0.36641	0.74773	
V16	0.37597	-0.11924	**0.78765**	0.30400	0.78765	
V17	0.28598	-0.18861	0.10423	**0.83792**	0.83792	
V18	0.65387	-0.12841	-0.18350	0.61780	0.65387	
V19	**0.88117**	0.04804	0.06763	-0.08221	0.88117	
V20	**0.79383**	0.07975	0.11555	-0.52097	0.79383	
V22	**-0.90165**	0.06751	-0.27384	-0.12907	0.90165	
V23	**-0.92765**	-0.13340	-0.27368	-0.07104	0.92765	
V24	**-0.93068**	-0.22862	-0.17268	0.02427	0.93068	
V27	**0.81596**	0.34971	0.05832	0.22166	0.81596	
V28	**0.82396**	0.30640	-0.05967	0.28979	0.82396	
V29	**0.88446**	0.28192	0.10755	0.16966	0.88446	
Minimum value					0.65387	V18

Appendix 34

Component matrix in case of 22 variables and 3 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

Variables	*Components*			*MAX*	
	1	*2*	*3*		
V1	**0.72836**	-0.09682	-0.42744	0.72836	
V2	**0.73685**	-0.09366	-0.42490	0.73685	
V3	**0.74265**	0.41282	0.09303	0.74265	
V4	0.11581	**0.71826**	0.64999	0.71826	
V5	0.10607	**0.71616**	0.52465	0.71616	
V7	-0.31732	-0.61669	-0.35434	0.61669	
V8	-0.43906	**-0.80852**	0.01576	0.80852	
V9	-0.52113	-0.55959	0.35149	0.55959	
V12	**0.78909**	0.41773	-0.27494	0.78909	
V13	0.61726	0.68593	-0.17194	0.68593	
V14	0.34412	0.60612	-0.45840	0.60612	
V16	0.43034	-0.66437	-0.15868	0.66437	
V17	0.23582	-0.40948	0.65401	0.65401	
V18	0.49586	-0.31692	**0.71618**	0.71618	
V19	**0.76051**	-0.29560	0.04411	0.76051	
V20	0.67393	-0.20717	-0.33666	0.67393	
V22	**-0.77695**	0.52485	-0.10384	0.77695	
V23	**-0.89713**	0.37046	-0.02691	0.89713	
V24	**-0.92063**	0.23387	0.00118	0.92063	
V27	**0.88842**	-0.07384	0.21000	0.88842	
V28	**0.85593**	-0.05925	0.34229	0.85593	
V29	**0.91492**	-0.16865	0.16599	0.91492	
Minimum value				0.55959	V9

Appendix 35

Relative variance with varimax rotation, in case of 22 variables and 3 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*
Relative variance	38.60%	21.50%	18.60%
Σ Relative variance	38.60%	60.10%	78.70%

Appendix 36

Component matrix with varimax rotation, in case of 22 variables and 3 factors (PCA) (not included: V6, V10, V11, V15, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*			*MAX*	
	1	*2*	*3*		
V1	0.61011	0.54024	-0.24187	0.61011	
V2	0.61692	0.54383	-0.23647	0.61692	
V3	0.51675	0.48433	0.47853	0.51675	
V4	-0.06174	0.01869	**0.97347**	0.97347	
V5	-0.09342	0.10060	**0.88348**	0.88348	
V7	-0.10345	-0.24747	**-0.73117**	0.73117	
V8	-0.06503	-0.66794	-0.62956	0.66794	
V9	-0.17490	**-0.78862**	-0.23614	0.78862	
V12	0.48649	**0.76222**	0.23473	0.76222	
V13	0.24428	**0.77776**	0.46529	0.77776	
V14	-0.02265	**0.81744**	0.16495	0.81744	
V16	0.62252	-0.10363	-0.50348	0.62252	
V17	0.50012	-0.59878	0.20583	0.59878	
V18	**0.70759**	-0.48038	0.35745	0.70759	
V19	**0.80841**	0.10852	-0.04899	0.80841	
V20	0.62298	0.38971	-0.26544	0.62298	
V22	**-0.92669**	0.06124	0.16554	0.92669	
V23	**-0.95761**	-0.13268	0.09045	0.95761	
V24	**-0.91838**	-0.24233	0.01023	0.91838	
V27	**0.86527**	0.17645	0.24292	0.86527	
V28	**0.85543**	0.07967	0.33938	0.85543	
V29	**0.91878**	0.16214	0.15040	0.91878	
Minimum value				0.51675	V3

Appendix 37

Relative variance in case of 20 variables and 4 or 3 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

	PC1	*PC2*	*PC3*	*PC4*
Relative variance	43.60%	23.40%	12.00%	9.40%
Σ Relative variance	43.60%	67.00%	79.00%	88.40%

Appendix 38

Component matrix in case of 20 variables and 4 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	**0.74561**	-0.12316	-0.37462	0.47478	0.74561	
V2	**0.75172**	-0.12073	-0.37554	0.45550	0.75172	
V4	0.04382	**0.76347**	0.60023	-0.00522	0.76347	
V5	0.06097	**0.77379**	0.50102	-0.25289	0.77379	
V7	-0.25181	-0.61636	-0.32209	-0.58258	0.61636	
V8	-0.40552	**-0.81178**	0.04256	-0.18599	0.81178	
V9	-0.53518	-0.57520	0.35391	0.25063	0.57520	
V12	**0.78921**	0.43243	-0.26978	0.03852	0.78921	
V13	0.60026	**0.70424**	-0.21465	0.03506	0.70424	
V14	0.34538	0.59351	-0.53291	0.07219	0.59351	
V16	0.45252	-0.67357	-0.10446	0.45516	0.67357	
V17	0.19957	-0.35722	0.65206	0.46749	0.65206	
V19	**0.76627**	-0.25169	0.11068	-0.36180	0.76627	
V20	**0.72047**	-0.18284	-0.22610	-0.56138	0.72047	
V22	**-0.78799**	0.47382	-0.17286	0.13126	0.78799	
V23	**-0.90680**	0.32865	-0.11365	0.11730	0.90680	
V24	**-0.93442**	0.18692	-0.09234	0.19286	0.93442	
V27	**0.88184**	-0.02090	0.29611	0.00222	0.88184	
V28	**0.84380**	0.00792	0.42292	-0.02641	0.84380	
V29	**0.91074**	-0.11067	0.22819	-0.05750	0.91074	
Minimum value					0.57520	V9

Appendix 39

Relative variance with varimax rotation, in case of 20 variables and 4 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	35.80%	23.80%	16.20%	12.60%
Σ Relative variance	35.80%	59.60%	75.80%	88.40%

Appendix 40

Component matrix with varimax rotation, in case of 20 variables and 4 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.40640	0.43262	**0.74232**	0.18297	0.74232	
V2	0.41663	0.43734	**0.73096**	0.17032	0.73096	
V4	0.02642	0.25618	**-0.70496**	0.61791	0.70496	
V5	0.08299	0.32186	**-0.81031**	0.38776	0.81031	
V7	0.02534	-0.39086	0.06363	**-0.85381**	0.85381	
V8	-0.06032	**-0.79032**	0.18958	-0.44233	0.79032	
V9	-0.26973	**-0.83537**	0.14534	0.11670	0.83537	
V12	0.46317	**0.79738**	0.13191	0.12799	0.79738	
V13	0.24749	**0.88557**	-0.08990	0.22361	0.88557	
V14	-0.05383	**0.86562**	0.09161	-0.01251	0.86562	
V16	0.39390	-0.23870	**0.80901**	0.09964	0.80901	
V17	0.32953	-0.51903	0.19694	0.62802	0.62802	
V19	**0.86975**	0.08205	0.04193	-0.16944	0.86975	
V20	**0.76655**	0.29055	0.04205	-0.49497	0.76655	
V22	**-0.89641**	0.10204	-0.27746	0.04000	0.89641	
V23	**-0.93639**	-0.08643	-0.26961	-0.00134	0.93639	
V24	**-0.93874**	-0.21245	-0.16511	0.01320	0.93874	
V27	**0.85423**	0.20418	0.08153	0.29617	0.85423	
V28	**0.86307**	0.14113	-0.02640	0.35515	0.86307	
V29	**0.89969**	0.18671	0.13379	0.18676	0.89969	
Minimum value					0.62802	V17

Appendix 41

Component matrix in case of 20 variables and 3 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

Variables	*Components*			*MAX*	
	1	*2*	*3*		
V1	**0.74561**	-0.12316	-0.37462	0.74561	
V2	**0.75172**	-0.12073	-0.37554	0.75172	
V4	0.04382	**0.76347**	0.60023	0.76347	
V5	0.06097	**0.77379**	0.50102	0.77379	
V7	-0.25181	-0.61636	-0.32209	0.61636	
V8	-0.40552	**-0.81178**	0.04256	0.81178	
V9	-0.53518	-0.57520	0.35391	0.57520	
V12	**0.78921**	0.43243	-0.26978	0.78921	
V13	0.60026	**0.70424**	-0.21465	0.70424	
V14	0.34538	0.59351	-0.53291	0.59351	
V16	0.45252	-0.67357	-0.10446	0.67357	
V17	0.19957	-0.35722	0.65206	0.65206	
V19	**0.76627**	-0.25169	0.11068	0.76627	
V20	**0.72047**	-0.18284	-0.22610	0.72047	
V22	**-0.78799**	0.47382	-0.17286	0.78799	
V23	**-0.90680**	0.32865	-0.11365	0.90680	
V24	**-0.93442**	0.18692	-0.09234	0.93442	
V27	**0.88184**	-0.02090	0.29611	0.88184	
V28	**0.84380**	0.00792	0.42292	0.84380	
V29	**0.91074**	-0.11067	0.22819	0.91074	
Minimum value				0.57520	V9

Appendix 42

Relative variance with varimax rotation, in case of 20 variables and 3 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*
Relative variance	39.50%	20.90%	18.60%
Σ Relative variance	39.50%	60.40%	79.00%

Appendix 43

Component matrix with varimax rotation, in case of 20 variables and 3 factors (PCA) (not included: V3, V6, V10, V11, V15, V18, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*			*MAX*	
	1	*2*	*3*		
V1	0.62857	0.49407	-0.26876	0.62857	
V2	0.63311	0.49858	-0.26698	0.63311	
V4	-0.06613	0.03215	**0.96937**	0.96937	
V5	-0.07819	0.11551	**0.91325**	0.91325	
V7	-0.10408	-0.22823	-0.69579	0.69579	
V8	-0.09017	-0.66200	-0.61553	0.66200	
V9	-0.21052	**-0.79857**	-0.24595	0.79857	
V12	0.50989	**0.75813**	0.21885	0.75813	
V13	0.26114	**0.80025**	0.44016	0.80025	
V14	-0.01230	**0.86028**	0.12371	0.86028	
V16	0.60995	-0.13357	-0.52869	0.60995	
V17	0.45976	-0.58991	0.18236	0.58991	
V19	**0.80873**	0.08313	-0.04264	0.80873	
V20	0.66178	0.34394	-0.21770	0.66178	
V22	**-0.91733**	0.08073	0.16526	0.91733	
V23	**-0.96301**	-0.09289	0.08486	0.96301	
V24	**-0.93600**	-0.20102	-0.00939	0.93600	
V27	**0.88295**	0.13105	0.26264	0.88295	
V28	**0.86977**	0.04231	0.36419	0.86977	
V29	**0.92241**	0.13903	0.15361	0.92241	
Minimum value				0.58991	V17

Appendix 44

Relative variance in case of 18 variables and 4 or 3 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

	PC1	*PC2*	*PC3*	*PC4*
Relative variance	45.40%	25.30%	10.80%	7.90%
Σ Relative variance	45.40%	70.70%	81.40%	89.30%

Appendix 45

Component matrix in case of 18 variables and 4 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.69527	-0.14366	0.42580	-0.48361	0.69527	
V4	0.09037	**0.79085**	-0.56347	-0.05966	0.79085	
V5	0.12361	**0.78088**	-0.46998	0.23251	0.78088	
V7	-0.24555	-0.65899	0.21081	0.63281	0.65899	
V8	-0.42491	**-0.79876**	-0.08954	0.17035	0.79876	
V9	-0.56708	-0.51638	-0.37291	-0.34811	0.56708	
V12	**0.79754**	0.38846	0.33811	0.01116	0.79754	
V13	0.62129	0.67073	0.29509	0.05184	0.67073	
V14	0.35442	0.55865	0.63663	0.11028	0.63663	
V16	0.39509	-0.65625	0.24159	-0.46576	0.65625	
V19	**0.77545**	-0.30405	-0.21643	0.23279	0.77545	
V20	**0.73924**	-0.26716	0.08806	0.49963	0.73924	
V22	**-0.77872**	0.49856	0.16001	-0.03456	0.77872	
V23	**-0.90066**	0.36438	0.11449	-0.01035	0.90066	
V24	**-0.93948**	0.23150	0.09839	-0.09387	0.93948	
V27	**0.88342**	-0.03854	-0.27110	-0.11530	0.88342	
V28	**0.85278**	-0.00300	-0.39102	-0.10461	0.85278	
V29	**0.91501**	-0.13510	-0.17816	-0.03951	0.91501	
Minimum value					0.56708	V9

Appendix 46

Relative variance with varimax rotation, in case of 18 variables and 4 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	38.60%	22.70%	15.00%	13.10%
Σ Relative variance	38.60%	61.30%	76.20%	89.30%

Appendix 47

Component matrix with varimax rotation, in case of 18 variables and 4 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V1	0.44686	0.40855	-0.68582	0.28684	0.68582	
V4	0.03010	0.13493	**0.74155**	0.62103	0.74155	
V5	0.06090	0.25938	**0.83755**	0.35709	0.83755	
V7	-0.01734	-0.24455	-0.11973	**-0.93006**	0.93006	
V8	-0.07442	-0.68830	-0.25307	-0.55880	0.68830	
V9	-0.24144	**-0.86528**	-0.19375	0.06273	0.86528	
V12	0.45787	**0.80660**	-0.07087	0.19008	0.80660	
V13	0.23652	**0.87474**	0.15733	0.28245	0.87474	
V14	-0.07805	**0.91951**	-0.04786	0.03591	0.91951	
V16	0.41035	-0.14429	**-0.81943**	0.03725	0.81943	
V19	**0.87494**	0.07241	-0.00291	-0.15502	0.87494	
V20	**0.75227**	0.32432	-0.01327	-0.45163	0.75227	
V22	**-0.89584**	0.04251	0.25670	0.10739	0.89584	
V23	**-0.94214**	-0.11619	0.23597	0.01922	0.94214	
V24	**-0.93851**	-0.23839	0.12896	0.02114	0.93851	
V27	**0.86877**	0.17681	-0.02547	0.28642	0.86877	
V28	**0.87509**	0.10904	0.07618	0.32803	0.87509	
V29	**0.90126**	0.20792	-0.09757	0.15421	0.90126	
Minimum value					0.68582	V1

Appendix 48

Component matrix in case of 18 variables and 3 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

Variables	*Components*			*MAX*	
	1	*2*	*3*		
V1	0.69527	-0.14366	0.42580	0.69527	
V4	0.09037	**0.79085**	-0.56347	0.79085	
V5	0.12361	**0.78088**	-0.46998	0.78088	
V7	-0.24555	-0.65899	0.21081	0.65899	
V8	-0.42491	**-0.79876**	-0.08954	0.79876	
V9	-0.56708	-0.51638	-0.37291	0.56708	
V12	**0.79754**	0.38846	0.33811	0.79754	
V13	0.62129	0.67073	0.29509	0.67073	
V14	0.35442	0.55865	0.63663	0.63663	
V16	0.39509	-0.65625	0.24159	0.65625	
V19	**0.77545**	-0.30405	-0.21643	0.77545	
V20	**0.73924**	-0.26716	0.08806	0.73924	
V22	**-0.77872**	0.49856	0.16001	0.77872	
V23	**-0.90066**	0.36438	0.11449	0.90066	
V24	**-0.93948**	0.23150	0.09839	0.93948	
V27	**0.88342**	-0.03854	-0.27110	0.88342	
V28	**0.85278**	-0.00300	-0.39102	0.85278	
V29	**0.91501**	-0.13510	-0.17816	0.91501	
Minimum value				0.56708	V9

Appendix 49

Relative variance with varimax rotation, in case of 18 variables and 3 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*
Relative variance	39.60%	22.50%	19.30%
Σ Relative variance	39.60%	62.10%	81.40%

Appendix 50

Component matrix with varimax rotation, in case of 18 variables and 3 factors (PCA) (not included: V2, V3, V6, V10, V11, V15, V17, V18, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*			*MAX*	
	1	*2*	*3*		
V1	0.53207	0.53575	-0.33943	0.53575	
V4	-0.01407	0.08672	**0.97129**	0.97129	
V5	-0.01044	0.16150	**0.90540**	0.90540	
V7	-0.05823	-0.33033	-0.65306	0.65306	
V8	-0.07545	-0.69882	-0.57666	0.69882	
V9	-0.20936	**-0.80505**	-0.18804	0.80505	
V12	0.46820	**0.81585**	0.12829	0.81585	
V13	0.22897	**0.86112**	0.35918	0.86112	
V14	-0.07602	**0.91430**	0.03579	0.91430	
V16	0.49891	-0.01349	-0.62930	0.62930	
V19	**0.85882**	0.03712	-0.04074	0.85882	
V20	**0.71889**	0.25271	-0.21199	0.71889	
V22	**-0.91057**	0.02966	0.22483	0.91057	
V23	**-0.95852**	-0.13212	0.14439	0.95852	
V24	**-0.94246**	-0.23460	0.05130	0.94246	
V27	**0.88082**	0.19541	0.20340	0.88082	
V28	**0.87903**	0.11758	0.30597	0.87903	
V29	**0.91277**	0.22118	0.07196	0.91277	
Minimum value				0.53575	V1

Appendix 51

Relative variance in case of 16 variables and 4 or 3 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

	PC1	*PC2*	*PC3*	*PC4*
Relative variance	47.60%	26.00%	4.80%	11.30%
Σ Relative variance	47.60%	73.60%	84.90%	89.70%

Appendix 52

Component matrix in case of 16 variables and 4 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V4	0.19052	**0.73232**	0.56441	0.21378	0.73232	
V5	0.23628	**0.70452**	0.36664	0.50968	0.70452	
V7	-0.27051	-0.68425	-0.45013	0.43570	0.68425	
V8	-0.47493	**-0.77446**	0.00115	0.13418	0.77446	
V9	-0.60943	-0.46265	0.47393	-0.24999	0.60943	
V12	**0.80831**	0.35116	-0.33075	-0.13849	0.80831	
V13	0.66479	0.63434	-0.29302	-0.05127	0.66479	
V14	0.37566	0.56574	-0.62904	-0.13234	0.62904	
V19	**0.77047**	-0.41730	0.07981	0.09887	0.77047	
V20	**0.73501**	-0.37622	-0.29419	0.33989	0.73501	
V22	**-0.74010**	0.56332	-0.09197	0.05458	0.74010	
V23	**-0.86856**	0.43816	-0.06103	0.09178	0.86856	
V24	**-0.92304**	0.31826	-0.01931	-0.01361	0.92304	
V27	**0.87946**	-0.11582	0.26809	-0.06852	0.87946	
V28	**0.86027**	-0.08816	0.37603	-0.00644	0.86027	
V29	**0.90579**	-0.21192	0.14185	-0.09807	0.90579	
Minimum value					0.60943	V9

Appendix 53

Relative variance with varimax rotation, in case of 16 variables and 4 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	41.60%	24.20%	14.80%	9.20%
Σ Relative variance	41.60%	65.70%	80.50%	89.70%

Appendix 54

Component matrix with varimax rotation, in case of 16 variables and 4 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V4	-0.03092	0.12743	**0.88618**	-0.36652	0.88618	
V5	-0.02879	0.24269	**0.94114**	-0.03002	0.94114	
V7	-0.04420	-0.25781	-0.42806	**0.82594**	0.82594	
V8	-0.07454	-0.68320	-0.43849	0.42281	0.68320	
V9	-0.21442	**-0.85005**	-0.24417	-0.21064	0.85005	
V12	0.47510	**0.81036**	0.06315	-0.13736	0.81036	
V13	0.23323	**0.87739**	0.27493	-0.18177	0.87739	
V14	-0.06310	**0.93044**	-0.04248	-0.05368	0.93044	
V19	**0.86930**	0.05656	-0.01729	0.15724	0.86930	
V20	**0.73137**	0.29449	-0.06500	0.50795	0.73137	
V22	**-0.91228**	0.04003	0.18871	-0.08389	0.91228	
V23	**-0.96251**	-0.11595	0.13587	-0.01413	0.96251	
V24	**-0.94599**	-0.23148	0.02011	-0.07045	0.94599	
V27	**0.87723**	0.17032	0.17855	-0.18170	0.87723	
V28	**0.87199**	0.10174	0.28737	-0.18969	0.87199	
V29	**0.91403**	0.21217	0.04054	-0.11400	0.91403	
Minimum value					0.68320	V8

Appendix 55

Component matrix in case of 16 variables and 3 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

Variables	*Components*			*MAX*	
	1	*2*	*3*		
V4	0.19052	**0.73232**	0.56441	0.73232	
V5	0.23628	**0.70452**	0.36664	0.70452	
V7	-0.27051	-0.68425	-0.45013	0.68425	
V8	-0.47493	**-0.77446**	0.00115	0.77446	
V9	-0.60943	-0.46265	0.47393	0.60943	
V12	**0.80831**	0.35116	-0.33075	0.80831	
V13	0.66479	0.63434	-0.29302	0.66479	
V14	0.37566	0.56574	-0.62904	0.62904	
V19	**0.77047**	-0.41730	0.07981	0.77047	
V20	**0.73501**	-0.37622	-0.29419	0.73501	
V22	**-0.74010**	0.56332	-0.09197	0.74010	
V23	**-0.86856**	0.43816	-0.06103	0.86856	
V24	**-0.92304**	0.31826	-0.01931	0.92304	
V27	**0.87946**	-0.11582	0.26809	0.87946	
V28	**0.86027**	-0.08816	0.37603	0.86027	
V29	**0.90579**	-0.21192	0.14185	0.90579	
Minimum value				0.60943	V9

Appendix 56

Relative variance with varimax rotation, in case of 16 variables and 3 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

	RC1	*RC2*	*RC3*
Relative variance	41.60%	23.00%	20.30%
Σ Relative variance	41.60%	64.60%	84.90%

Appendix 57

Component matrix with varimax rotation, in case of 16 variables and 3 factors (PCA) (not included: V1, V2, V3, V6, V10, V11, V15, V16, V17, V18, V21, V25, V26 and V30).

Variables	*Components with varimax rotation*			*MAX*	
	1	*2*	*3*		
V4	-0.04322	0.07815	**0.93977**	0.93977	
V5	-0.03317	0.22465	**0.79689**	0.79689	
V7	-0.02343	-0.16985	**-0.84534**	0.84534	
V8	-0.06413	-0.63198	-0.64949	0.64949	
V9	-0.22010	**-0.86174**	-0.13790	0.86174	
V12	0.47325	**0.79001**	0.19494	0.79001	
V13	0.22960	**0.85034**	0.39296	0.85034	
V14	-0.06209	**0.92166**	0.05973	0.92166	
V19	**0.87295**	0.06784	-0.08655	0.87295	
V20	**0.74404**	0.33997	-0.31490	0.74404	
V22	**-0.91475**	0.03303	0.18888	0.91475	
V23	**-0.96343**	-0.11440	0.09391	0.96343	
V24	**-0.94798**	-0.23318	0.02507	0.94798	
V27	**0.87228**	0.14520	0.27709	0.87228	
V28	**0.86621**	0.07457	0.36517	0.86621	
V29	**0.91138**	0.19531	0.12936	0.91138	
Minimum value				0.64949	V8

Appendix 58

Relative variance in case of 14 variables and 4 or 3 factors (PCA) (not included: V1, V2, V3, V6, V8, V10, V11, V15, V16, V17, V18, V21, V23, V25, V26 and V30).

	PC1	*PC2*	*PC3*	*PC4*
Relative variance	47.50%	24.30%	12.90%	5.30%
Σ Relative variance	47.50%	71.80%	84.70%	90.00%

Appendix 59

Component matrix in case of 14 variables and 4 factors (PCA) (not included: V1, V2, V3, V6, V8, V10, V11, V15, V16, V17, V18, V21, V23, V25, V26 and V30).

Variables	*Components*				*MAX*	
	1	*2*	*3*	*4*		
V4	0.19096	**0.74484**	0.55403	0.20096	0.74484	
V5	0.25032	**0.72928**	0.35914	0.47848	0.72928	
V7	-0.25829	-0.67738	-0.43865	0.44530	0.67738	
V9	-0.62664	-0.44961	0.47244	-0.22589	0.62664	
V12	**0.80933**	0.34280	-0.32985	-0.15955	0.80933	
V13	0.67335	0.63166	-0.29730	-0.08375	0.67335	
V14	0.38383	0.55759	-0.63595	-0.15478	0.63595	
V19	**0.76585**	-0.42406	0.09524	0.10371	0.76585	
V20	**0.73739**	-0.39517	-0.27789	0.35313	0.73739	
V22	**-0.73433**	0.55997	-0.10841	0.06684	0.73433	
V24	**-0.91812**	0.32189	-0.03381	-0.00124	0.91812	
V27	**0.87698**	-0.12098	0.28003	-0.09482	0.87698	
V28	**0.86083**	-0.09007	0.38822	-0.04008	0.86083	
V29	**0.90368**	-0.21220	0.15476	-0.12611	0.90368	
Minimum value					0.62664	V9

Appendix 60

Relative variance with varimax rotation, in case of 14 variables and 4 factors (PCA) (not included: V1, V2, V3, V6, V9, V10, V11, V15, V16, V17, V18, V21, V24, V25, V26 and V30).

	RC1	*RC2*	*RC3*	*RC4*
Relative variance	40.70%	24.20%	15.80%	9.20%
Σ Relative variance	40.70%	64.90%	80.70%	90.00%

Appendix 61

Component matrix with varimax rotation, in case of 14 variables and 4 factors (PCA) (not included: V1, V2, V3, V6, V8, V10, V11, V15, V16, V17, V18, V21, V23, V25, V26 and V30).

Variables	*Components with varimax rotation*				*MAX*	
	1	*2*	*3*	*4*		
V4	-0.00655	0.10100	**0.90000**	0.34402	0.90000	
V5	-0.01037	0.22901	**0.94822**	0.02773	0.94822	
V7	-0.06845	-0.23347	-0.45133	**-0.80832**	0.80832	
V9	-0.21398	**-0.84748**	-0.24997	0.20628	0.84748	
V12	0.46762	**0.81452**	0.07624	0.13735	0.81452	
V13	0.23421	**0.87737**	0.29375	0.19204	0.87737	
V14	-0.07433	**0.93541**	-0.01775	0.07610	0.93541	
V19	**0.86362**	0.06275	-0.03581	-0.18738	0.86362	
V20	**0.71741**	0.29687	-0.08439	-0.54026	0.71741	
V22	**-0.90295**	0.01997	0.21212	0.09122	0.90295	
V24	**-0.93799**	-0.24259	0.03755	0.08725	0.93799	
V27	**0.88727**	0.17285	0.15970	0.16881	0.88727	
V28	**0.88805**	0.10319	0.26432	0.17975	0.88805	
V29	**0.91584**	0.22430	0.02298	0.10922	0.91584	
Minimum value					0.71741	V20

Appendix 62

The reliability of the cluster analysis in case of *landmark configuration.*

Distance between the clusters	*Distance between the pieces inside the clusters*						*Distance between each piece without the cluster procedure*	*Reliability of the clustering*
	1	*2*	*3*	*4*	*5*	*6*		
78.50095	1.197566	7.062644	7.613357	4.048987	8.594415	8.982078	116	67.67%