```
> #Hello! This is a transcript of the cluster Latent Class Analysis performed to classify meta
l findings into groups or clusters
> #Before this cluster analysis, many other ones were carried changing the variables
> #THE CLUSTERS OR LATENT CLASSES PRODUCED IN THIS PARTICULAR TRANSCRIPT ARE THE ONES
WHICH MAKE MORE SENSE ACCORDING TO THE AUTHOR, other possibilities exist *(see supplementary material 3)
>
> #Quick explanation: lines followed by a hashtag symbol # are clarifications with no function
al use, segments highlighted in yellow are lines of code with intructions to do the statistica
l analysis
>
> #The program employed to do the Latent Class Analysis is the open-source free software R Pro
gramming Environment for statistical computing
> #My thanks to my undergrad professor Manuel Dominguez-Rodrigo (Alcalá University) for introd
ucing me to this program
> #It is easy and free to use, the way it is employed here could potentially be used with virt
ually any archaeological database with sites and variables of any period and region of the wor
ld
> #To do the Latent Class Analysis the R package poLCA is employed, "poLCA" is an abreviation
of "Polytomous Variable Latent Class Analysis"
> #poLCA was developed by professors Jeff Lewis (UCLA) and Drew A. Linzer (Emory University, S
tanford, now director at Civiqs) you can follow them in twitter
> #Check their paper "poLCA: An R Package for Polytomous Variable Latent Class Analysis" in th
e bibliography
> #There is a great video in youtube with a quick introduction to the poLCA package "https://w
ww.youtube.com/watch?v=LL6tio9V-Vw"
> #You can also watch a far more advanced youtube video to have a glimse of the math behind th
e Latent Class Analysis "https://www.youtube.com/watch?v=rVfZHWTwXSA"
> #The R version used is the 4.1.2 (poLCA does not work in previous versions)
>
> #First we install the packages required to use poLCA in the R Programming Enviroment
> library(scatterplot3d)
> library(MASS)
> library(poLCA)
>
> #Now we insert a table called "bay_of_biscay_dataset" with all findings and their variables
> bay_of_biscay_dataset <- read.table(file.choose(), header = TRUE, row.names = 1)
>
> #We can ask R to show us an overview of the data inserted so we know it has been correctly i
nserted
> #The first column are the twenty variables, the second (int) indicates we are dealing with i
nteger values (no decimal numbers), the third and following columns with numbers are the findi
ngs studied
> #Each column of numbers is a metal finding defined by a sequence of numbers, for example two
 early bronze age collective burials with flat axes will be defined by the same sequence of nu
mbers and so on
> #Each number in each variable means something different, for example number 1 in context mea
ns "hoard" and number 1 in artefact's columns (flat axes and so on) means "zero" (see figure 5
 in the paper for the meaning of each number)
> str(bay_of_biscay_dataset)
'data.frame':   1273 obs. of  20 variables:
 $ context                                      : int  1 1 1 1 1 1 1 1 1 1 ...
 $ chronology_terminus_post_quem                : int  5 5 5 5 5 5 5 5 5 5 ...
 $ arrowheads                                   : int  1 1 1 1 1 1 1 1 1 1 ...
 $ awls                                         : int  1 1 1 1 1 1 1 1 1 1 ...
 $ bujoes_barcelos_axes                         : int  1 1 1 1 1 1 1 1 1 1 ...
 $ ch_eba_archaic_tanged_blades                 : int  1 1 1 1 1 1 1 1 1 1 ...
 $ eba_advanced_blades                          : int  1 1 1 1 1 1 1 1 1 1 ...
 $ chalcolithic_decorative_items                : int  1 1 1 1 1 1 1 1 1 1 ...
 $ copper_bronze_bracelets                      : int  2 1 1 1 1 1 2 1 2 1 ...
 $ early_bronze_age_decorative_items            : int  1 1 1 1 1 1 1 1 1 1 ...
 $ palstaves_or_flanged_axes_of_the_MBA         : int  2 2 2 2 2 2 2 2 2 2 ...
 $ flat_axes                                    : int  1 1 1 1 1 1 1 1 1 1 ...
 $ halberds                                     : int  1 1 1 1 1 1 1 1 1 1 ...
 $ mba_archaic_short_riveted_blades             : int  1 1 1 1 1 1 1 1 1 1 ...
 $ mba_advanced_short_riveted_blades            : int  1 1 1 1 1 1 1 1 2 1 ...
 $ Atlantic_and_CE_long_riveted_blades          : int  2 1 1 2 1 1 1 1 1 1 ...
 $ Iberian_long_riveted_blades_type_cuevallusa_emtrambasaguas: int  1 1 1 1 1 1 1 1 1 1 ...
 $ middle_bronze_age_decorative_items           : int  1 1 1 2 1 1 1 1 1 1 ...
 $ palmela_points                               : int  1 1 1 1 1 1 1 1 1 1 ...
 $ spearheads                                   : int  1 1 1 2 1 1 1 1 2 1 ...
>
> #Now we set the settings of the Latent Class Anlysis and we give them a name (here they are
named "alpha_lca")
> #The expression "cbind" tells R that we want to do a Latent Class Analysis with the variable
```

```
s inside the parenthesis
> #The expression "~ 1" tells R that we want a normal Latent Class Analysis, other options are
 available in poLCA
> alpha_lca <- cbind(context, chronology_terminus_post_quem, arrowheads, awls, bujoes_barcelos
_axes, ch_eba_archaic_tanged_blades, eba_advanced_blades, chalcolithic_decorative_items, coppe
r_bronze_bracelets, early_bronze_age_decorative_items, palstaves_or_flanged_axes_of_the_MBA, f
lat_axes, halberds, mba_archaic_short_riveted_blades, mba_advanced_short_riveted_blades, Atlan
tic_and_CE_long_riveted_blades, Iberian_long_riveted_blades_type_cuevallusa_emtrambasaguas, mi
ddle_bronze_age_decorative_items, palmela_points, spearheads) ~ 1
>
> #Finally we can do the Latent Class Anlysis
> #We name our analysis "lca1", the entities "alpha_lca" and "bay_of_biscay_dataset" were intr
oduced above
> #It is important to add other settings to the analysis:
> #First: "nclass=5" indicates the number of Latent Classes or clusters to find, default is 2,
 the number 5 is the result of running this code several times and deciding that 5 clusters is
 what makes more sense
> #Second: "maxiter=100000" indicates the number of iterations, default is 1000, what are iter
ations?
> #Iterations are a complex concept, poLCA uses an EM algorithm to find the "best" clustering
solution (the one which makes more statistical sense) repeating iteratively two steps
> #The first step estimates class membership probabilities and in the second step these estima
tes are altered to maximise the likelihood function, each of these two steps is an iteration
> #Simplifying the more complex the dataset, the more iterations it requires
> #Third: "nrep=10" indicates the R program will do the anlysis ten times and give you the "be
st" result
> #Fourth: "verbose=TRUE" indicates we want a written report of the analysis (the different pa
rts of the report are explained below after the report)
> #Fifth: "graph=False" indicates we don't want a visual representation of the results (it doe
s not look very well as we are using many variables, it looks great with up until 8 variables)
> lca1 <- poLCA (alpha_lca, bay_of_biscay_dataset, nclass=5, maxiter=100000, nrep=10, verbose=
TRUE, graph=FALSE)
Model 1: llik = -4518.546 ... best llik = -4518.546
Model 2: llik = -4525.805 ... best llik = -4518.546
Model 3: llik = -4970.385 ... best llik = -4518.546
Model 4: llik = -4738.961 ... best llik = -4518.546
Model 5: llik = -4562.286 ... best llik = -4518.546
Model 6: llik = -4698.385 ... best llik = -4518.546
Model 7: llik = -5132.365 ... best llik = -4518.546
Model 8: llik = -4758.127 ... best llik = -4518.546
Model 9: llik = -5235.504 ... best llik = -4518.546
Model 10: llik = -4654.659 ... best llik = -4518.546
Conditional item response (column) probabilities,
 by outcome variable, for each class (row)

$context
           Pr(1)  Pr(2)  Pr(3)  Pr(4)  Pr(5)
class 1:  0.9055 0.0000 0.0945 0.0000 0.0000
class 2:  0.3317 0.5829 0.0000 0.0854 0.0000
class 3:  0.4252 0.0070 0.4977 0.0000 0.0701
class 4:  0.9659 0.0000 0.0161 0.0000 0.0179
class 5:  1.0000 0.0000 0.0000 0.0000 0.0000

$chronology_terminus_post_quem
           Pr(1)  Pr(2) Pr(3)  Pr(4) Pr(5)
class 1:  0.0000 0.0000     0 1.0000     0
class 2:  0.0000 0.0000     1 0.0000     0
class 3:  1.0000 0.0000     0 0.0000     0
class 4:  0.0000 0.0000     0 0.0000     1
class 5:  0.0012 0.8379     0 0.1609     0

$arrowheads
           Pr(1)  Pr(2)
class 1:  0.7166 0.2834
class 2:  0.9950 0.0050
class 3:  1.0000 0.0000
class 4:  0.9964 0.0036
class 5:  1.0000 0.0000

$awls
           Pr(1)  Pr(2)
class 1:  0.9685 0.0315
class 2:  0.9799 0.0201
class 3:  0.8037 0.1963
```

```
class 4:  0.9982 0.0018
class 5:  1.0000 0.0000

$bujoes_barcelos_axes
           Pr(1)  Pr(2)
class 1:  0.4227 0.5773
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9964 0.0036
class 5:  1.0000 0.0000

$ch_eba_archaic_tanged_blades
           Pr(1)  Pr(2)
class 1:  0.9790 0.0210
class 2:  1.0000 0.0000
class 3:  0.7827 0.2173
class 4:  0.9982 0.0018
class 5:  1.0000 0.0000

$eba_advanced_blades
           Pr(1)  Pr(2)
class 1:  0.9895 0.0105
class 2:  0.4422 0.5578
class 3:  1.0000 0.0000
class 4:  1.0000 0.0000
class 5:  0.9964 0.0036

$chalcolithic_decorative_items
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  0.9950 0.0050
class 3:  0.7266 0.2734
class 4:  1.0000 0.0000
class 5:  1.0000 0.0000

$copper_bronze_bracelets
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9032 0.0968
class 5:  1.0000 0.0000

$early_bronze_age_decorative_items
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  0.7538 0.2462
class 3:  0.9790 0.0210
class 4:  1.0000 0.0000
class 5:  1.0000 0.0000

$palstaves_or_flanged_axes_of_the_MBA
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.1792 0.8208
class 5:  0.9964 0.0036

$flat_axes
           Pr(1)  Pr(2)
class 1:  0.9867 0.0133
class 2:  0.8643 0.1357
class 3:  0.8551 0.1449
class 4:  1.0000 0.0000
class 5:  0.0000 1.0000

$halberds
           Pr(1)  Pr(2)
class 1:  0.9895 0.0105
class 2:  0.7889 0.2111
class 3:  1.0000 0.0000
class 4:  1.0000 0.0000
class 5:  1.0000 0.0000
```

```
$mba_archaic_short_riveted_blades
           Pr(1)  Pr(2)
class 1:  0.9265 0.0735
class 2:  0.9950 0.0050
class 3:  1.0000 0.0000
class 4:  0.9946 0.0054
class 5:  1.0000 0.0000

$mba_advanced_short_riveted_blades
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9767 0.0233
class 5:  1.0000 0.0000

$Atlantic_and_CE_long_riveted_blades
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9158 0.0842
class 5:  1.0000 0.0000

$Iberian_long_riveted_blades_type_cuevallusa_emtrambasaguas
           Pr(1)  Pr(2)
class 1:  0.9160 0.0840
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9982 0.0018
class 5:  1.0000 0.0000

$middle_bronze_age_decorative_items
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9624 0.0376
class 5:  1.0000 0.0000

$palmela_points
           Pr(1)  Pr(2)
class 1:  0.9895 0.0105
class 2:  0.9347 0.0653
class 3:  0.6706 0.3294
class 4:  1.0000 0.0000
class 5:  0.9964 0.0036

$spearheads
           Pr(1)  Pr(2)
class 1:  1.0000 0.0000
class 2:  1.0000 0.0000
class 3:  1.0000 0.0000
class 4:  0.9014 0.0986
class 5:  1.0000 0.0000

Estimated class population shares
 0.0748 0.1563 0.1121 0.4383 0.2184

Predicted class memberships (by modal posterior prob.)
 0.0746 0.1563 0.1123 0.4383 0.2184

=========================================================
Fit for 5 latent classes:
=========================================================
number of observations: 1273
number of estimated parameters: 134
residual degrees of freedom: 1139
maximum log-likelihood: -4518.546

AIC(5): 9305.092
BIC(5): 9995.076
G^2(5): 1557.962 (Likelihood ratio/deviance statistic)
```

```
X^2(5): 2802874110 (Chi-square goodness of fit)

> #Don't be intimidated by the all the numbers above (see page 12 of the paper "poLCA: An R Pa
ckage for Polytomous Variable Latent Class Analysis" in the bibliography for a complete explan
ation
> #There are three main things we must pay attention to: degrees of freedom, the tables that o
ccupy most of the resuls of the analysis and the BIC value at the end
>
> #Degrees of freedom is the result of a complex relation between the number of subjects studi
ed and the number of variables (see page 636 of the 2019 book "Multivariate data analysis: Eig
hth edition" by Joseph Hair for an excellent and complete definition)
> #Oversimplifying, the number of subjects studied must be larger than the variables analysed,
 it is a way to avoid the researcher to study datasets with a few entities and many variables
which does not make sense
> #If there is a problem with the degrees of freedom the R program will say "ALERT: negative d
egrees of freedom; respecify model", only models with positive degrees of freedom should be co
nsidered
>
> #The tables that occupy most of the results of the Latent Class Analysis tell us important i
nformation about the groups or clusters (the label "latent classes" is more precise) created
> #Each table refers to one of the twenty variables studied (chronology, context and each of t
he eighteen artefact categories in the analysis)
> #Each table has rows with five classes (class 1 to 5), each class is one of our latent class
es or clusters or groups of metal findings
> #Each table also has columns, each column refers to one of the values of the variable, for e
xample chronology has five (1=Chalcolithic, 2=Chalcolithic-Early Bronze Age, and so on, see fi
gure 2 in the paper for the rest)
> #Each table has decimal numbers which are actually a %, we have to mentally multiply by 100
to have the %, for example 0.5625 is 56.25%
> #The percentage expresses the possibility a metal finding classified in one of the five clas
ses or clusters has a particular value
> #For example if a class has a value of 1 (i.e., 100%) it means that ALL its members have tha
t value, conversely a value of 56.25% indicates the percentage the members of the class may ha
ve that value
> #For example, if in the table "$flat_axes" a class has a value of 1, it  means that 100% of
its findings contain flat axes
> #More important, if in the table "$context" the same class has a value of for example 96.59%
, it means that virtually all its findings are hoards
> #This shows that there are many hoards with flat axes that the Latent Class Analysis has dec
ided to group toguether into a class or cluster
> #Simplifying, patterns like this one in the dataset are used by poLCA to group similar findi
ngs into homogenous latent classes or clusters with homogenous features (chronology, content,
context)
>
> #At the end of the results there are four values, BIC (Bayesian Information Criterion) among
 others (AIC, G^2, X^2), that are also important
> #They can be used to compare different Latent Classes Analyses, Latent Classes Analyses coul
d differ for example (and very importantly) in the number of latent classes or clusters we ask
 them to find (here 5)
> #As we vary the Latent Class Analysis to study the same dataset, the four previous measures
(BIC being the most used one in the literature) also change
> #The values of these four measures can help us decide which Latent Class Analysis creates a
"better" model
> #In the case of BIC, if we compare several Latent Class Analyses of the same dataset, the on
e with a lower BIC is statistically speaking the one with the "best" results
> #In this study the author has followed another philosophy focusing not in these four measure
s but in which Latent Class Anlysis produces a result that makes more sense
> #Weller (see Weller et al. 2020 page 292 in the bibliography) has synthesised this "philosph
y" in the sentence "A class solution with superior statistics is not useful if it makes no sen
se theoretically"
> #The Latent Class Analysis with 5 latent classes in this transcript is the one which accordi
ng to the author made more sense and was therefore superior to the others
>
> #AFTER THIS LONG EXPLANATION WE FOCUS ON THE RESULTS OF THE LATENT CLASS ANALYSIS
>
> #To see the results, we can create a table named "lca_final" in which each finding in the st
udy and their assigned cluster appear in two columns (one for findings and other for the assig
ned cluster)
> #Clusters, which should be actually called latent classes, appear as numbers from 1 to 5
> #We also ask R to name the column with the findings "findings_id" and the column with the la
tent classes (or "clusters") "latent_class"
> #With the command below the table is created but R does not show it to us, it is a long tabl
e with 1273 rows each corresponding to a find
> lca_final <- data.frame(findings_id=row.names(bay_of_biscay_dataset),latent_class=lca1$predc
```

```
lass)
>
> #We can ask R to see the first seven rows just to see how the table with the results looks l
ike
> #The column to the left numbered from 1 to 7 is automatically created by the program R to na
me each row
> head (lca_final, 7)
  findings_id latent_class
1         877            4
2        1030            4
3         353            4
4         836            4
5        1163            4
6          44            4
7         838            4
>
> #We can export this table to an excel (.csv) document in the following way
> #The expression "row.names=FALSE" eliminates the numbers in the column to the left naming ea
ch row
> write.csv(lca_final, file.choose(), row.names=FALSE)
>
> #Before this transcript finishes I show the entire final table with each finding id and its
corresponding assigned latent class or cluster
> #Remember each of the 5 clusters or latent classes is represented by a number from 1 to 5, e
ach row is a metal findings
> #This transcript ends with the table below, live long and prosper
> lca_final
     findings_id latent_class
1            877            4
2           1030            4
3            353            4
4            836            4
5           1163            4
6             44            4
7            838            4
8            106            4
9             83            4
10           576            4
11           651            4
12           144            4
13          1322            4
14          1150            4
15           754            4
16           983            4
17           897            4
18            15            4
19           462            4
20           693            3
21          1016            4
22           469            4
23           360            5
24           366            4
25           368            4
26           369            1
27           365            4
28           371            4
29           363            3
30           367            4
31           359            2
32           358            5
33           357            4
34           356            4
35           354            4
36           351            5
37           350            4
38           349            1
39           347            5
40           346            4
41           345            2
42           344            4
43           343            1
44           355            4
45           400            5
46           374            4
```

47	393	5
48	395	4
49	396	4
50	397	4
51	390	2
52	399	3
53	389	2
54	401	5
55	402	4
56	403	4
57	404	1
58	405	2
59	406	4
60	398	4
61	381	2
62	373	4
63	375	5
64	338	4
65	376	4
66	377	2
67	391	4
68	379	2
69	372	2
70	383	3
71	384	2
72	385	5
73	386	5
74	387	5
75	388	2
76	378	5
77	300	2
78	307	4
79	294	4
80	295	5
81	296	4
82	297	4
83	292	2
84	299	2
85	291	5
86	301	5
87	302	4
88	303	4
89	304	4
90	305	3
91	340	4
92	298	5
93	283	5
94	275	2
95	276	4
96	278	5
97	279	4
98	280	4
99	293	3
100	282	3
101	308	4
102	284	5
103	286	4
104	287	2
105	288	2
106	289	4
107	290	4
108	281	5
109	334	2
110	306	4
111	328	4
112	329	2
113	330	2
114	331	4
115	325	5
116	333	4
117	324	4
118	336	4
119	337	1
120	415	2

121	339	3
122	407	2
123	341	2
124	332	4
125	317	2
126	309	2
127	310	2
128	312	4
129	313	2
130	314	2
131	326	2
132	316	4
133	342	2
134	318	3
135	319	4
136	320	4
137	321	4
138	322	5
139	323	4
140	315	4
141	488	4
142	503	4
143	502	4
144	501	5
145	500	2
146	499	1
147	498	3
148	497	1
149	496	4
150	495	1
151	494	4
152	493	1
153	492	4
154	491	4
155	474	2
156	482	3
157	413	4
158	476	1
159	477	4
160	478	5
161	479	5
162	490	4
163	481	1
164	489	4
165	483	4
166	484	3
167	485	4
168	486	2
169	487	5
170	506	4
171	480	4
172	531	2
173	504	3
174	524	3
175	526	2
176	527	3
177	528	2
178	522	4
179	530	2
180	521	4
181	533	4
182	534	4
183	535	4
184	536	4
185	537	1
186	538	4
187	529	2
188	513	5
189	473	5
190	507	1
191	508	5
192	509	1
193	510	5
194	523	5

195	512	4
196	505	4
197	514	5
198	516	5
199	517	5
200	518	2
201	519	3
202	520	3
203	511	1
204	423	2
205	438	2
206	437	2
207	436	4
208	435	4
209	434	5
210	433	5
211	432	2
212	431	4
213	430	4
214	429	4
215	428	3
216	427	4
217	426	1
218	475	5
219	417	5
220	409	5
221	410	1
222	411	4
223	274	3
224	414	4
225	425	4
226	416	4
227	424	2
228	418	2
229	419	4
230	420	2
231	421	4
232	422	4
233	441	3
234	267	4
235	465	1
236	439	4
237	458	3
238	459	4
239	460	5
240	461	2
241	456	4
242	464	4
243	455	4
244	466	2
245	467	4
246	468	1
247	470	5
248	471	4
249	472	5
250	463	3
251	448	3
252	408	5
253	442	3
254	443	2
255	444	4
256	445	5
257	457	4
258	447	4
259	440	5
260	449	5
261	450	4
262	451	2
263	452	5
264	453	5
265	454	4
266	446	2
267	87	2
268	269	5

269	101	3
270	100	3
271	99	4
272	98	4
273	97	3
274	96	4
275	95	4
276	94	4
277	93	4
278	92	2
279	91	1
280	90	4
281	103	5
282	80	2
283	73	1
284	74	4
285	75	5
286	76	1
287	77	4
288	89	2
289	79	4
290	88	2
291	81	5
292	82	2
293	84	2
294	85	5
295	86	4
296	104	4
297	78	4
298	120	4
299	135	5
300	134	5
301	133	4
302	132	1
303	131	4
304	130	4
305	129	4
306	128	4
307	127	4
308	126	4
309	125	4
310	124	4
311	123	4
312	102	2
313	114	4
314	105	3
315	107	4
316	108	4
317	109	4
318	110	2
319	122	2
320	113	4
321	121	3
322	115	4
323	116	4
324	117	4
325	118	4
326	119	4
327	70	2
328	111	4
329	16	4
330	34	2
331	32	2
332	31	3
333	30	4
334	29	2
335	28	4
336	27	4
337	26	4
338	25	1
339	24	5
340	23	4
341	21	4
342	19	2

343	72	4
344	9	5
345	2	4
346	3	4
347	4	5
348	5	5
349	6	4
350	18	5
351	8	5
352	17	4
353	10	4
354	11	3
355	12	1
356	13	4
357	14	4
358	37	4
359	7	1
360	64	4
361	35	2
362	57	2
363	58	4
364	59	5
365	60	5
366	55	3
367	63	4
368	54	4
369	65	5
370	66	4
371	67	4
372	68	5
373	69	4
374	138	4
375	61	5
376	47	5
377	71	4
378	39	2
379	40	3
380	42	4
381	43	5
382	56	4
383	46	5
384	36	4
385	48	5
386	49	4
387	50	4
388	51	3
389	52	2
390	53	4
391	45	4
392	221	2
393	236	4
394	235	1
395	234	4
396	233	4
397	232	5
398	231	2
399	230	4
400	229	4
401	228	3
402	227	5
403	226	2
404	225	4
405	224	4
406	207	2
407	215	4
408	136	4
409	209	2
410	210	1
411	211	2
412	212	4
413	223	3
414	214	2
415	222	5
416	216	5

417	217	4
418	218	4
419	219	5
420	220	4
421	239	5
422	213	2
423	266	4
424	237	3
425	260	5
426	261	5
427	262	5
428	263	2
429	257	4
430	265	5
431	256	4
432	547	4
433	268	5
434	539	5
435	270	1
436	271	3
437	272	3
438	264	4
439	248	1
440	205	2
441	240	3
442	241	1
443	242	5
444	243	3
445	258	4
446	246	4
447	238	5
448	249	5
449	250	4
450	251	4
451	253	4
452	254	5
453	255	1
454	245	2
455	152	1
456	170	4
457	169	5
458	168	2
459	167	4
460	166	2
461	165	5
462	164	3
463	161	4
464	160	4
465	159	4
466	158	4
467	157	4
468	156	5
469	208	4
470	146	5
471	273	4
472	139	4
473	140	5
474	141	5
475	142	4
476	155	5
477	145	1
478	153	1
479	147	3
480	148	2
481	149	4
482	150	5
483	151	2
484	173	1
485	143	4
486	197	2
487	171	2
488	191	4
489	192	4
490	193	4

491	194	4
492	189	3
493	196	4
494	188	4
495	198	2
496	199	4
497	201	4
498	202	5
499	203	5
500	204	4
501	195	5
502	180	3
503	137	3
504	174	4
505	175	5
506	176	2
507	177	4
508	190	1
509	179	5
510	172	5
511	181	4
512	182	5
513	183	5
514	184	5
515	186	3
516	187	2
517	178	2
518	903	5
519	920	2
520	919	4
521	917	4
522	916	4
523	915	4
524	914	3
525	913	4
526	912	1
527	910	5
528	909	5
529	908	3
530	907	2
531	906	4
532	888	5
533	896	4
534	956	5
535	890	5
536	891	3
537	892	4
538	893	2
539	905	1
540	895	5
541	904	3
542	898	1
543	899	4
544	900	5
545	901	4
546	902	5
547	923	3
548	894	2
549	949	4
550	921	2
551	943	5
552	944	4
553	945	2
554	946	1
555	940	4
556	948	1
557	939	4
558	950	3
559	951	4
560	952	4
561	953	2
562	954	2
563	817	1
564	947	4

565	930	5
566	886	3
567	924	4
568	925	4
569	926	5
570	927	4
571	942	2
572	929	1
573	922	5
574	932	4
575	933	4
576	935	4
577	936	4
578	937	4
579	938	2
580	928	1
581	832	2
582	850	4
583	849	3
584	848	1
585	847	4
586	846	4
587	845	4
588	844	4
589	843	4
590	842	4
591	840	5
592	839	5
593	837	3
594	835	4
595	889	3
596	826	4
597	545	5
598	820	4
599	821	4
600	822	4
601	823	4
602	834	5
603	825	5
604	833	4
605	827	4
606	828	1
607	829	5
608	830	2
609	831	5
610	853	5
611	824	4
612	879	5
613	851	2
614	872	3
615	873	5
616	874	4
617	875	4
618	870	5
619	878	4
620	869	5
621	880	1
622	881	5
623	882	2
624	883	5
625	884	4
626	885	4
627	876	4
628	861	2
629	957	1
630	854	4
631	855	5
632	856	2
633	857	2
634	871	5
635	860	5
636	852	4
637	862	5
638	863	3

639	864	4
640	865	1
641	866	2
642	868	5
643	859	4
644	1041	5
645	1057	2
646	1056	4
647	1055	4
648	1054	5
649	1053	5
650	1052	1
651	1051	4
652	1050	4
653	1049	5
654	1048	2
655	1047	4
656	1045	5
657	1044	3
658	1026	5
659	1035	5
660	955	5
661	1028	4
662	1029	3
663	1031	4
664	1032	4
665	1043	5
666	1034	5
667	1042	4
668	1036	3
669	1037	4
670	1038	3
671	1039	4
672	1040	4
673	1060	3
674	1033	2
675	1084	4
676	1058	5
677	1078	1
678	1079	3
679	1080	4
680	1081	5
681	1076	5
682	1083	4
683	1075	3
684	1085	4
685	1086	4
686	1087	4
687	1088	4
688	1089	4
689	1091	2
690	1082	4
691	1068	2
692	1025	5
693	1061	2
694	1062	1
695	1063	2
696	1064	5
697	1077	1
698	1067	2
699	1059	3
700	1069	4
701	1070	4
702	1071	2
703	1072	4
704	1073	5
705	1074	4
706	1065	1
707	972	2
708	989	2
709	988	4
710	987	4
711	986	3
712	985	4

713	984	3
714	982	3
715	981	3
716	979	4
717	978	4
718	977	4
719	976	4
720	975	4
721	1027	4
722	966	5
723	958	5
724	959	5
725	960	5
726	961	5
727	962	5
728	974	4
729	965	3
730	973	4
731	967	4
732	968	4
733	969	3
734	970	2
735	971	5
736	992	4
737	964	5
738	1018	4
739	990	4
740	1011	5
741	1012	4
742	1013	2
743	1014	4
744	1009	5
745	1017	3
746	1008	4
747	1019	4
748	1020	4
749	1021	5
750	1022	4
751	1023	3
752	1024	4
753	1015	5
754	999	1
755	816	5
756	993	5
757	994	4
758	995	4
759	996	4
760	1010	5
761	998	5
762	991	4
763	1000	3
764	1001	4
765	1003	4
766	1004	4
767	1006	5
768	1007	3
769	997	3
770	626	5
771	642	3
772	641	4
773	639	2
774	638	1
775	637	5
776	636	4
777	635	4
778	634	5
779	633	5
780	632	5
781	631	4
782	630	5
783	629	3
784	612	4
785	620	3
786	678	4

787	614	5
788	615	5
789	616	4
790	617	4
791	628	4
792	619	4
793	627	4
794	621	4
795	622	4
796	623	4
797	624	4
798	625	4
799	645	4
800	618	1
801	670	5
802	643	3
803	664	2
804	665	4
805	666	4
806	667	3
807	662	4
808	669	5
809	660	5
810	671	3
811	673	3
812	674	3
813	675	4
814	676	2
815	818	4
816	668	5
817	653	5
818	610	5
819	646	2
820	647	4
821	648	4
822	649	4
823	663	3
824	652	4
825	644	3
826	654	4
827	655	5
828	656	5
829	657	4
830	658	2
831	659	4
832	650	5
833	556	2
834	572	4
835	571	4
836	570	4
837	569	2
838	568	5
839	567	4
840	566	5
841	565	1
842	564	4
843	562	3
844	561	4
845	560	4
846	559	4
847	613	4
848	549	3
849	541	3
850	542	2
851	543	1
852	1	4
853	546	4
854	558	4
855	548	4
856	557	4
857	550	1
858	551	1
859	552	2
860	553	5

861	554	4
862	575	3
863	1092	5
864	601	4
865	573	4
866	595	5
867	596	2
868	597	2
869	598	1
870	593	3
871	600	4
872	592	5
873	604	1
874	605	4
875	606	2
876	607	5
877	608	3
878	609	2
879	599	1
880	585	1
881	679	4
882	577	2
883	579	5
884	580	1
885	581	5
886	594	4
887	583	2
888	574	4
889	586	2
890	587	4
891	588	4
892	589	4
893	590	5
894	591	4
895	582	4
896	766	2
897	781	4
898	780	2
899	779	5
900	778	1
901	777	3
902	776	4
903	775	4
904	774	2
905	773	3
906	772	4
907	771	2
908	770	3
909	769	3
910	751	4
911	760	4
912	677	4
913	753	3
914	755	5
915	756	1
916	757	3
917	768	1
918	759	4
919	767	4
920	761	4
921	762	5
922	763	2
923	764	4
924	765	3
925	784	4
926	758	4
927	809	5
928	782	5
929	802	5
930	804	4
931	805	5
932	806	4
933	800	4
934	808	4

935	799	4
936	810	4
937	811	5
938	812	5
939	813	4
940	814	5
941	815	5
942	807	3
943	792	5
944	750	2
945	786	4
946	787	4
947	788	4
948	789	1
949	801	4
950	791	4
951	783	4
952	793	4
953	794	5
954	795	2
955	796	4
956	797	2
957	798	4
958	790	4
959	698	5
960	714	4
961	713	4
962	712	2
963	711	3
964	710	5
965	709	5
966	708	2
967	706	4
968	705	5
969	704	4
970	703	5
971	702	1
972	701	4
973	752	2
974	689	5
975	680	2
976	681	5
977	683	2
978	684	5
979	685	4
980	700	4
981	688	3
982	699	5
983	690	4
984	691	2
985	692	2
986	695	2
987	696	4
988	717	2
989	686	2
990	742	5
991	715	2
992	736	3
993	737	2
994	738	4
995	739	4
996	734	5
997	741	4
998	733	2
999	743	2
1000	744	5
1001	745	4
1002	746	5
1003	748	1
1004	749	4
1005	740	5
1006	724	3
1007	540	5
1008	718	2

1009	719	4
1010	720	4
1011	721	4
1012	735	2
1013	723	1
1014	716	5
1015	725	2
1016	726	4
1017	729	1
1018	730	5
1019	731	4
1020	732	2
1021	722	1
1022	1179	4
1023	1180	4
1024	1181	3
1025	1182	4
1026	1183	4
1027	1184	5
1028	1093	4
1029	1186	4
1030	1176	3
1031	1187	4
1032	1189	4
1033	1190	1
1034	1192	4
1035	1185	2
1036	1177	2
1037	1195	4
1038	1175	1
1039	1174	4
1040	1173	2
1041	1171	4
1042	1170	4
1043	1169	5
1044	1168	1
1045	1167	4
1046	1166	5
1047	1165	5
1048	1164	4
1049	1162	5
1050	1178	2
1051	1221	2
1052	1212	4
1053	1213	4
1054	1214	4
1055	1215	5
1056	1216	5
1057	1193	2
1058	1220	1
1059	1209	2
1060	1222	3
1061	1223	3
1062	1224	4
1063	1225	5
1064	1226	4
1065	1227	5
1066	1217	3
1067	1203	3
1068	1159	2
1069	1196	3
1070	1197	5
1071	1198	4
1072	1199	5
1073	1200	3
1074	1211	3
1075	1202	4
1076	1210	4
1077	1204	5
1078	1205	5
1079	1206	4
1080	1207	4
1081	1208	1
1082	1194	4

1083	1201	2
1084	1109	5
1085	1124	4
1086	1123	4
1087	1122	3
1088	1121	2
1089	1120	2
1090	1119	4
1091	1118	4
1092	1117	4
1093	1116	1
1094	1115	4
1095	1114	5
1096	1113	2
1097	1112	1
1098	1161	1
1099	1101	3
1100	1094	5
1101	1095	4
1102	1096	4
1103	1097	5
1104	1098	5
1105	1111	5
1106	1100	4
1107	1110	2
1108	1102	5
1109	1103	2
1110	1105	5
1111	1106	3
1112	1108	4
1113	1127	3
1114	1099	4
1115	1152	2
1116	1125	5
1117	1145	3
1118	1146	4
1119	1147	5
1120	1148	4
1121	1143	4
1122	1151	5
1123	1142	4
1124	1153	4
1125	1154	5
1126	1155	3
1127	1156	4
1128	1157	4
1129	1230	3
1130	1149	2
1131	1135	2
1132	1160	4
1133	1128	4
1134	1129	5
1135	1130	4
1136	1131	5
1137	1144	3
1138	1134	5
1139	1126	5
1140	1136	5
1141	1137	2
1142	1138	3
1143	1139	1
1144	1140	4
1145	1141	4
1146	1132	4
1147	1309	5
1148	1327	5
1149	1326	2
1150	1325	3
1151	1324	4
1152	1321	4
1153	1320	1
1154	1319	4
1155	1318	4
1156	1317	4

1157	1315	2
1158	1314	5
1159	1313	3
1160	1312	4
1161	1228	4
1162	1303	5
1163	1296	5
1164	1297	2
1165	1298	2
1166	1299	5
1167	1300	4
1168	1311	1
1169	1302	4
1170	1310	1
1171	1304	4
1172	1305	2
1173	1306	4
1174	1307	3
1175	1308	4
1176	1330	5
1177	1301	2
1178	1355	5
1179	1328	4
1180	1349	4
1181	1350	3
1182	1351	3
1183	1352	4
1184	1346	3
1185	1354	2
1186	1345	5
1187	1356	2
1188	1357	4
1189	1358	5
1190	1359	1
1191	1360	3
1192	1361	4
1193	1353	4
1194	1337	2
1195	1293	4
1196	1331	1
1197	1332	4
1198	1333	4
1199	1334	4
1200	1347	1
1201	1336	2
1202	1329	4
1203	1338	4
1204	1339	5
1205	1340	5
1206	1341	4
1207	1342	3
1208	1344	4
1209	1335	4
1210	1255	4
1211	1262	2
1212	1249	5
1213	1250	2
1214	1251	5
1215	1252	5
1216	1247	4
1217	1254	1
1218	1246	4
1219	1256	4
1220	1257	4
1221	1258	3
1222	1259	5
1223	1260	4
1224	1295	4
1225	1253	5
1226	1239	3
1227	1362	3
1228	1231	5
1229	1232	3
1230	1233	4

```
1231        1236        1
1232        1248        3
1233        1238        4
1234        1263        4
1235        1240        4
1236        1241        4
1237        1242        2
1238        1243        4
1239        1244        4
1240        1245        3
1241        1237        4
1242        1287        3
1243        1261        5
1244        1281        4
1245        1282        3
1246        1283        4
1247        1284        4
1248        1279        2
1249        1286        4
1250        1278        4
1251        1288        5
1252        1289        2
1253        1290        5
1254        1291        4
1255        1292        4
1256        1229        3
1257        1285        4
1258        1271        5
1259        1264        4
1260        1265        4
1261        1266        1
1262        1267        2
1263        1268        4
1264        1280        3
1265        1270        4
1266        1294        4
1267        1272        4
1268        1273        1
1269        1274        3
1270        1275        4
1271        1276        5
1272        1277        4
1273        1269        2
>
> #POSTCRIPT
> #just to clarify things completely
> #A final comment
> #In the table above: 1=Iota          2=Gamma          3=Kappa          4=Tau          5=
Chi
```