SENEM ACET COSKUN

STA 9705 – MULTIVARIATE ANALYSIS – TERM PROJECT

GLASS IDENTIFICATION – CRIMINOLOGY

"If correctly identified, a tiny glass particle might solve the case!!!"

INTRODUCTION

OBJECTIVE

If correctly identified, the glass left at the scene of the crime can be used as evidence. Therefore, the study of classification of types of glass was heavily motivated by criminological investigations.

In this project, I will first test the significance of each given attributes for different glass types by using MANOVA and then I will apply discriminant function analysis, classification analysis, principal component analysis and factor analysis to the same dataset.

DATASET DECSRIPTION

Types of Glass used in the dataset (see Appendix for full dataset):

1- Float Processed Building Windows (Float Glass):

Float glass is a sheet of glass made by floating molten glass on a bed of molten metal, typically tin, although lead and various low melting point alloys were used in the past. This method gives the sheet uniform thickness and very flat surfaces. Modern windows are made from float glass.

2- Not Float Processed Building Windows

3- Float Processed Vehicle Windows

4-Containers

5-Tablewares

6-Headlamps

Attributes of glasses used in the dataset:

Refractive Index (RI)

Na: Sodium

Mg: Magnesium

Al: Aluminum

Si: Silicon

K: Potassium

Ca: Calcium

Ba: Barium

Fe: Iron

MANOVA:

Hypothesis testing using MANOVA

Independent random samples from 9 variables.

H_0: $\underline{\mu}_1 = \underline{\mu}_2 = \cdots = \underline{\mu}_9$

H_a: ALOI

k=6 groups, p=9 variables, n=214 observations

s=min (k-1,p) = 5

$v_E = k(n-1) = 1218$

$v_H = k - 1 = 5$

Wilks' Lambda Test:

$$\Lambda_{\text{obs}} = 0.0785 < \Lambda_{.05,9,5,1218} = .946 \rightarrow \text{Reject } H_0$$

Pillai's Test:

$$V^{(s)} = 1.532 > V^{(s)}_{.05,5,2.5,204} = 0.074 \rightarrow Reject\ H_0$$

Hotelling-Lawley Test:

$$\frac{v_E}{v_H} U^{(s)} = 1337.3 > U^{(s)}_{.05,5,1218} = 8.49 \rightarrow Reject\ H_0$$

Roy's Test:

$$\theta = 0.817 > \theta_{.05,5,2.5,204} = 0.063 \rightarrow Reject\ H_0$$

LINEAR DISCRIMINANT ANALYSIS

The discriminant functions for each type of glass were obtained by applying discriminant analysis to the data. In preceding section, I will apply predictive classification to assign each observation into a class by training my data.

L(1) = 176.1*RI+9.2*Na+8.0*Mg+12.1*Al+11.7*Si+9.2*K+5.9*Ca+7.0*Ba+3.0*Fe – 187.5

L(2) = 118.7*RI+2.3*Na+4.5*Mg+13.2*Al+9.3*Si+2.9*K+15.3*Ca+4.9*Ba+2.3*Fe – 123.5

L(3) = 156.7*RI+4.5*Na+1.2*Mg+9.8*Al+12.2*Si+9.6*K+5.4*Ca+3.5*Ba+3.3*Fe – 171.5

L(4) = 109.3*RI+8.5*Na+8.2*Mg+12.1*Al+11.3*Si+3.2*K+2.8*Ca+7.7*Ba+3.0*Fe – 147.5

L(5) = 132.1*RI+5.2*Na+4.6*Mg+11.1*Al+11.7*Si+9.3*K+0.9*Ca+0.7*Ba+3.1*Fe – 78.5

L(6) = 162.1*RI+8.7*Na+6.5*Mg+12.2*Al+1.6*Si+0.4*K+4.9*Ca+5.4*Ba+3.0*Fe – 112.0

Linear Discriminant Function for Group

Variable	1	2	3	4	5	6
Constant	-187.5	-123.5	-171.5	-147.5	78.5	112.0
RI	176.1	118.7	156.7	109.3	132.1	162.1
Na	9.2	2.3	4.5	8.5	5.2	8.7
Mg	8.0	4.5	1.2	8.2	4.6	6.5
Al	12.1	13.2	9.8	12.1	11.1	12.2
Si	11.7	9.3	12.2	11.3	11.7	1.6
K	9.2	2.9	9.6	3.2	9.3	0.4
Ca	5.9	15.3	5.4	2.8	0.9	4.9
Ba	7.0	4.9	3.5	7.7	0.7	5.4
Fe	3.0	2.3	3.3	3.0	3.1	3.0

CLASSIFICATION ANALYSIS

Each observation was assigned to a class by using classification analysis. I tried all classification methods to get the best error rate possible. The lowest error rate, 14%, was achieved with "nearest neighbor classification" method.

The DISCRIM Procedure
Classification Summary for Calibration Data: WORK.GLASS
Resubstitution Summary using 5 Nearest Neighbors

Number of Observations and Percent Classified into Group

From Group	1	2	3	4	5	6	Total
1	50	6	12	0	1	1	70
	71.43	8.57	17.14	0.00	1.43	1.43	100.00
2	10	45	10	6	4	1	76
	13.16	59.21	13.16	7.89	5.26	1.32	100.00
3	0	0	17	0	0	0	17
	0.00	0.00	100.00	0.00	0.00	0.00	100.00
4	0	0	0	12	0	1	13
	0.00	0.00	0.00	92.31	0.00	7.69	100.00
5	0	0	0	0	9	0	9
	0.00	0.00	0.00	0.00	100.00	0.00	100.00
6	0	0	0	1	2	26	29
	0.00	0.00	0.00	3.45	6.90	89.66	100.00
Total	60	51	39	19	16	29	214
	28.04	23.83	18.22	8.88	7.48	13.55	100.00
Priors	0.16667	0.16667	0.16667	0.16667	0.16667	0.16667	

Error Count Estimates for Group

	1	2	3	4	5	6	Total
Rate	0.2857	0.4079	0.0000	0.0769	0.0000	0.1034	0.1457
Priors	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667	

PRINCIPAL COMPONENT ANALYSIS

According to Principal Component Analysis, first 4 variables (Refractive Index, Sodium, Magnesium and Aluminum) explains 94% of the variance and hence enough to retain as principal components.

Eigenvalues of the Covariance Matrix

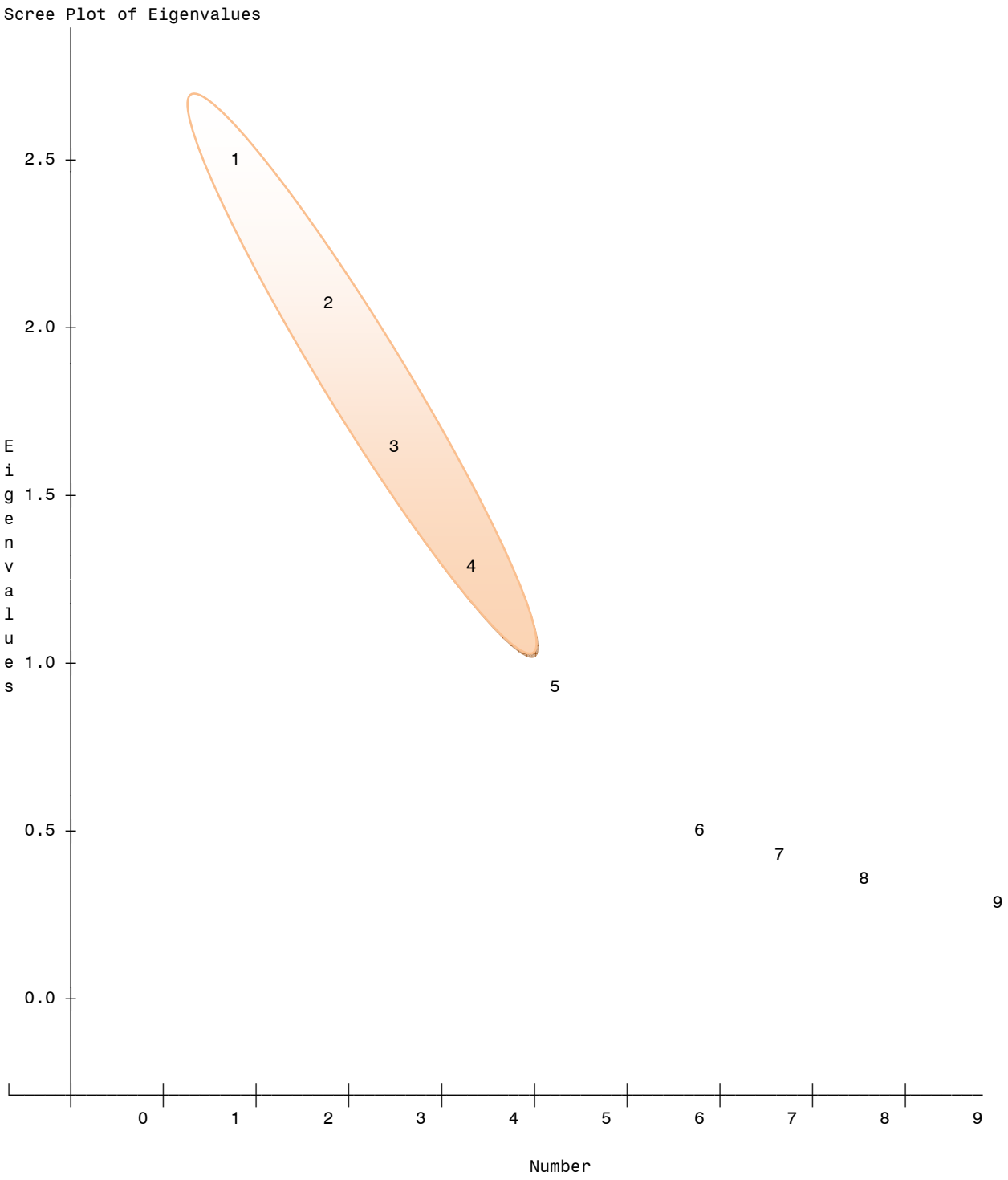
	Eigenvalue	Difference	Proportion	Cumulative
1	3.00200916	1.34283576	0.4762	0.4762
2	1.65917340	0.97959692	0.2632	0.7394
3	0.67957648	0.03641074	0.1078	0.8472
4	0.64316573	0.43470908	0.1020	0.9492
5	0.20845665	0.10729134	0.0331	0.9823
6	0.10116531	0.09216675	0.0160	0.9983
7	0.00899856	0.00752112	0.0014	0.9998
8	0.00147744	0.00147647	0.0002	1.0000
9	0.00000097		0.0000	1.0000

The elements at the diagonals of the covariance matrix, the variances, do not show extraordinary differences. Hence, it can be concluded that S would be appropriate to use in PC Analysis.

Covariance Matrix

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe
RI	0.000009	-0.00047	-0.00053	-0.00061	-0.00127	0.00057	0.00350	-0.00000	0.00004
Na	-0.000475	0.66684	-0.32242	0.06392	-0.04415	0.14171	-0.32010	0.13261	-0.01920
Mg	-0.000535	-0.32242	2.08054	-0.34696	-0.18537	0.00507	-0.91091	-0.35304	0.01167
Al	-0.000617	0.06392	-0.34696	0.24927	-0.00213	0.10613	-0.18444	0.11901	-0.00361
Si	-0.001275	-0.04415	-0.18537	-0.00213	0.59992	0.09766	-0.23008	-0.03934	-0.00710
K	-0.000574	-0.14171	0.00507	0.10613	-0.09766	0.42535	-0.29500	-0.01382	-0.00049
Ca	0.003502	-0.32010	-0.91091	-0.18444	-0.23008	-0.29500	2.02536	-0.07984	0.01732
Ba	-0.000000	0.13261	-0.35304	0.11901	-0.03934	-0.01382	-0.07984	0.24722	-0.00284
Fe	0.000042	-0.01920	0.01167	-0.00361	-0.00710	0.00049	0.01732	-0.00284	0.00949

VISUAL INSPECTION FOR PRINCIPAL COMPONENT ANALYSIS



FACTOR ANALYSIS

In order to find out the factors that represent s each variable, I applied Factor Analysis by using Principal Component Method. I set the number of factors to 2 and then applied Varimax and Oblique Rotation, respectively.

Principle Component Loadings:

	Factor1	Factor2
RI	-0.86392	0.40904
Na	0.40904	0.38709
Mg	-0.17571	-0.84986
Al	0.67936	0.42269
Si	0.36263	-0.22207
K	0.34759	-0.22046
Ca	-0.78014	0.4945
Ba	0.39676	0.69400
Fe	-0.29450	-0.08883

Varimax Rotated Loadings:

	Factor1	Factor2
RI	0.94430	-0.14824
Na	-0.12018	0.55019
Mg	-0.33318	-0.80133
Al	-0.32356	0.73178
Si	-0.42473	0.02059
K	-0.41138	0.01346
Ca	0.92317	-0.03043
Ba	0.06274	0.79694
Fe	0.19340	-0.23920

Oblique Rotated Loadings:

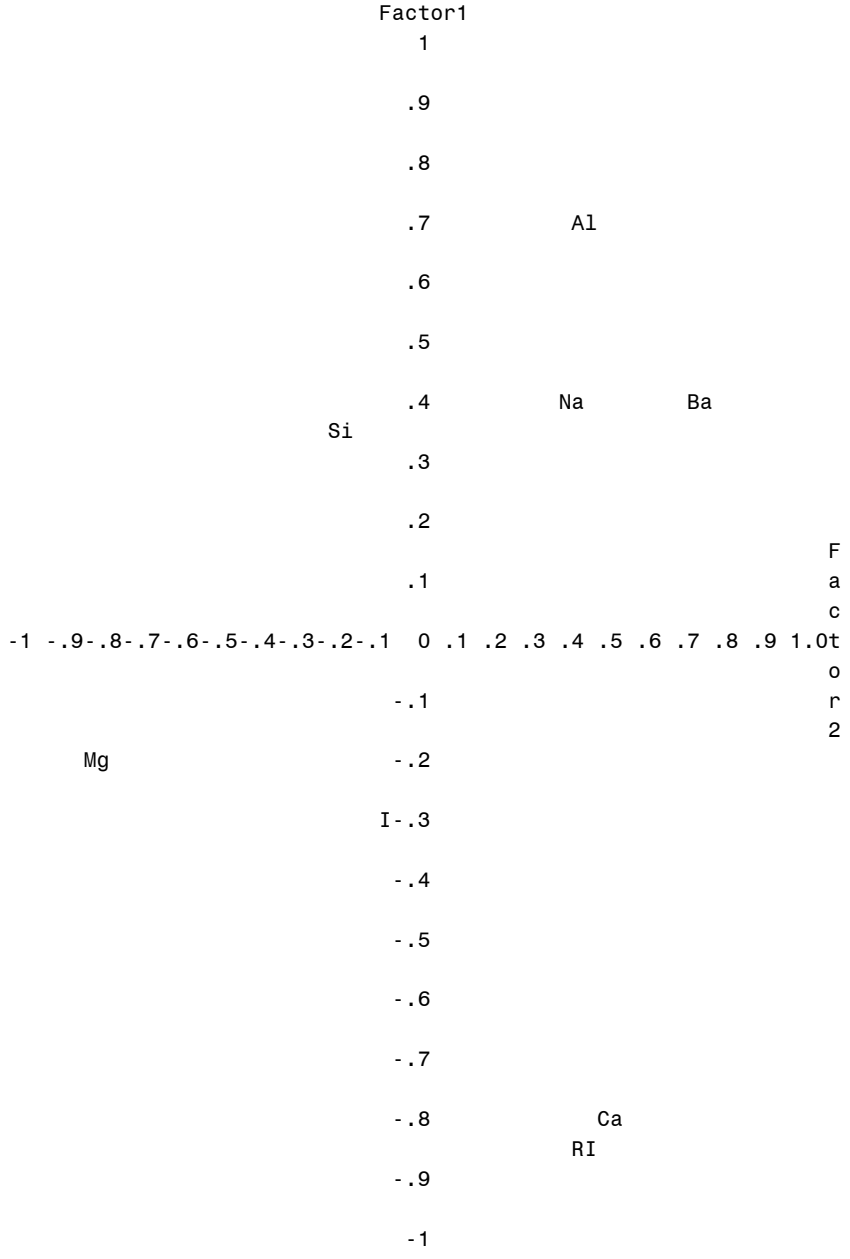
	Factor1	Factor2
RI	0.95419	-0.01768
Na	-0.14902	0.53051
Mg	-0.29236	-0.84247
Al	-0.36230	0.68311
Si	-0.42678	-0.03787
K	-0.41304	-0.04313
Ca	0.92690	0.09654
Ba	0.02152	0.80096
Fe	0.20627	-0.21125

The complexity cannot be brought to 1 for any of the variables after both rotations; however, we could say that both rotations would increase the difference between loadings for each variable.

The angle between the oblique axes is 94^0. Since it's almost perpendicular, then we might conclude that varimax and oblique rotations basically do the same improvement; there is no need to apply both.

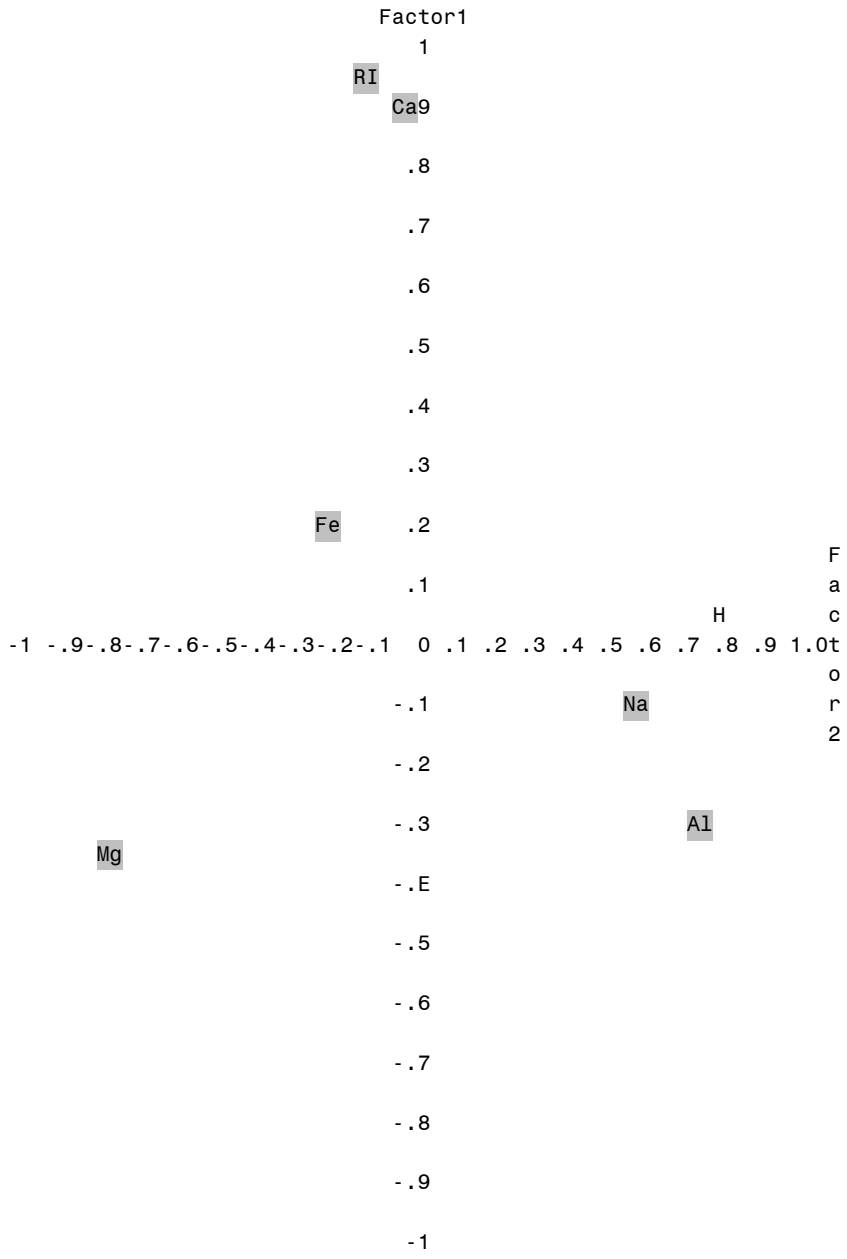
The FACTOR Procedure
Initial Factor Method: Principal Components

Plot of Factor Pattern for Factor1 and Factor2



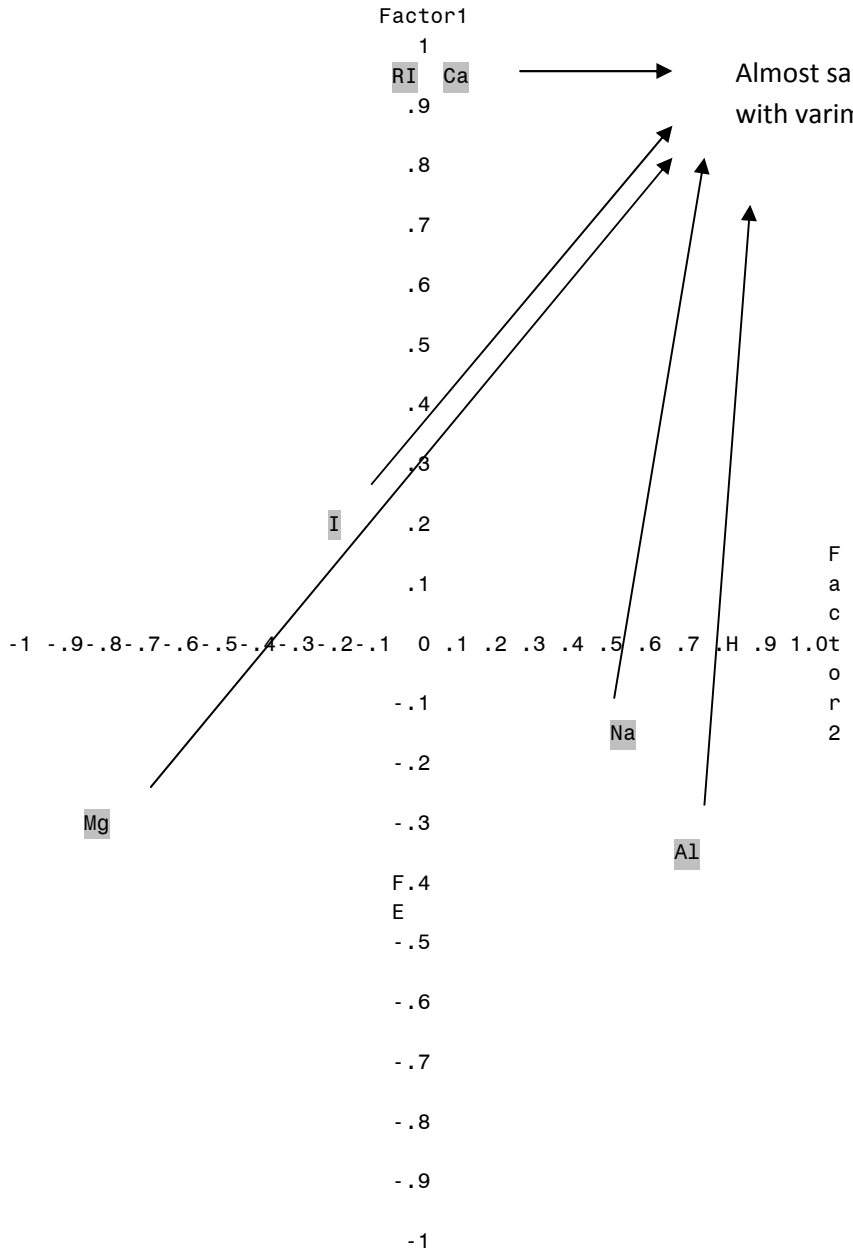
The FACTOR Procedure
Rotation Method: Varimax

Plot of Factor Pattern for Factor1 and Factor2



The FACTOR Procedure
Rotation Method: Harris-Kaiser (hkpower = 0)

Plot of Factor Pattern for Factor1 and Factor2
Factor Axis Correlation = -0.0854 Angle = 94.9009



Almost same configuration with varimax rotation

Varimax Rotated Loadings:

	Factor1	Factor2
RI	0.94430	-0.14824
Na	-0.12018	0.55019
Mg	-0.33318	-0.80133
Al	-0.32356	0.73178
Si	-0.42473	0.02059
K	-0.41138	0.01346
Ca	0.92317	-0.03043
Ba	0.06274	0.79694
Fe	0.19340	-0.23920

Factor 1 represents RI, Si, K and Ca; whereas factor 2 represents Na, Mg, Al, Ba and Fe.

CONCLUSION

We now know that the variables in this analysis have significant effect for each type of glass. Hence, we can confidently use glass particles collected from crime scene for further analysis.

We also determined the contribution of each variable to the determination of the type of glass. Hence, once we know the configurations of each variable in the glass sample, we can confidently identify which group it belongs to.

We also understand that we don't need all 9 variables in order to determine the type of glass. As long as we have 4 variables out of 9, we can determine the type confidently.

We then achieved to reduce the variables even further by determining two factors representing all 9 variables.

SAS OUTPUT – MANOVA ANALYSIS

The SAS System

The GLM Procedure
Multivariate Analysis of Variance

E = Error SSCP Matrix

	RI	Na	Mg	Al	Si
RI	0.0018912537	-0.039519836	-0.210841641	-0.105952425	-0.253414906
Na	-0.039519836	84.23257149	13.438999715	-5.363368978	-28.63103809
Mg	-0.210841641	13.438999715	172.05968224	3.4646807243	-13.25586877
Al	-0.105952425	-5.363368978	3.4646807243	28.56366415	-5.867515663
Si	-0.253414906	-28.63103809	-13.25586877	-5.867515663	119.75898719
K	-0.139535812	-12.13991223	12.139539107	16.902598449	-13.53719335
Ca	0.7244187369	-49.01156498	-179.6339612	-42.32441283	-43.04958769
Ba	0.034959456	-0.256096551	-7.920217561	3.895242899	-16.91551894
Fe	0.0065045899	-1.608516668	-1.387637472	0.0799176578	-0.725831925

E = Error SSCP Matrix

	K	Ca	Ba	Fe
RI	-0.139535812	0.7244187369	0.034959456	0.0065045899
Na	-12.13991223	-49.01156498	-0.256096551	-1.608516668
Mg	12.139539107	-179.6339612	-7.920217561	-1.387637472
Al	16.902598449	-42.32441283	3.895242899	0.0799176578
Si	-13.53719335	-43.04958769	-16.91551894	-0.725831925
K	74.858365306	-79.16351373	-0.167603069	-0.665612659
Ca	-79.16351373	402.64275817	-6.090583762	3.0494743505
Ba	-0.167603069	-6.090583762	27.187586262	0.6121395166
Fe	-0.665612659	3.0494743505	0.6121395166	1.8985651581

H = Type III SSCP Matrix for Group

	RI	Na	Mg	Al	Si
RI	0.0000731477	-0.06183817	0.0967569829	-0.025594967	-0.018162178
Na	-0.06183817	57.804639725	-82.11491467	18.979525988	19.226267999
Mg	0.0967569829	-82.11491467	271.09542103	-77.36874007	-26.22903777
Al	-0.025594967	18.979525988	-77.36874007	24.530883981	5.4125343543
Si	-0.018162178	19.226267999	-26.22903777	5.4125343543	8.0242258953
K	0.017263627	-18.04494198	-11.0583835	5.7048926722	-7.264717867
Ca	0.0216133865	-19.17103222	-14.39109255	3.0366020818	-5.958504829
Ba	-0.03508361	28.502218046	-67.27877777	21.453958036	8.5360095903
Fe	0.0025090792	-2.481859033	3.8741384065	-0.850877471	-0.788469944

H = Type III SSCP Matrix for Group

	K	Ca	Ba	Fe
RI	0.017263627	0.0216133865	-0.03508361	0.0025090792
Na	-18.04494198	-19.17103222	28.502218046	-2.481859033
Mg	-11.0583835	-14.39109255	-67.27877777	3.8741384065
Al	5.7048926722	3.0366020818	21.453958036	-0.850877471
Si	-7.264717867	-5.958504829	8.5360095903	-0.788469944
K	15.742080022	16.327300183	-2.776117491	0.5611285472
Ca	16.327300183	28.760167533	-10.91713586	0.6416817243
Ba	-2.776117491	-10.91713586	25.47176327	-1.21780961
Fe	0.5611285472	0.6416817243	-1.21780961	0.1237208232

MANOVA Test Criteria and F Approximations for the Hypothesis of No Overall Group Effect
H = Type III SSCP Matrix for Group
E = Error SSCP Matrix

S=5 M=1.5 N=99

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.07850316	15.29	45	897.75	<.0001
Pillai's Trace	1.53233866	10.02	45	1020	<.0001
Hotelling-Lawley Trace	5.49207855	24.24	45	611.62	<.0001
Roy's Greatest Root	4.47344105	101.40	9	204	<.0001

NOTE: F Statistic for Roy's Greatest Root is an upper bound.

SAS OUTPUT CLASSIFICATION ANALYSIS

The DISCRIM Procedure
Classification Summary for Calibration Data: WORK.GLASS
Cross-validation Summary using Linear Discriminant Function

Number of Observations and Percent Classified into Group

From Group	1	2	3	4	5	6	Total
1	45	14	11	0	0	0	70
	64.29	20.00	15.71	0.00	0.00	0.00	100.00
2	17	37	12	6	3	1	76
	22.37	48.68	15.79	7.89	3.95	1.32	100.00
3	5	3	9	0	0	0	17
	29.41	17.65	52.94	0.00	0.00	0.00	100.00
4	0	5	1	6	0	1	13
	0.00	38.46	7.69	46.15	0.00	7.69	100.00
5	1	1	0	0	6	1	9
	11.11	11.11	0.00	0.00	66.67	11.11	100.00
6	0	1	1	2	1	24	29
	0.00	3.45	3.45	6.90	3.45	82.76	100.00
Total	68	61	34	14	10	27	214
	31.78	28.50	15.89	6.54	4.67	12.62	100.00
Priors	0.16667	0.16667	0.16667	0.16667	0.16667	0.16667	

Error Count Estimates for Group

	1	2	3	4	5	6	Total
Rate	0.3571	0.5132	0.4706	0.5385	0.3333	0.1724	0.3975
Priors	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667	

Cross-validation Summary using Quadratic Discriminant Function
er of Observations and Percent Classified into Group

From Group	1	2	3	4	5	6	Tota
1	59	7	4	0	0	0	70
	84.29	10.00	5.71	0.00	0.00	0.00	100.00
2	46	21	6	0	1	2	76
	60.53	27.63	7.89	0.00	1.32	2.63	100.00
3	9	1	6	0	1	0	17
	52.94	5.88	35.29	0.00	5.88	0.00	100.00
4	0	7	0	5	0	1	13
	0.00	53.85	0.00	38.46	0.00	7.69	100.00
5	0	0	0	0	7	2	9
	0.00	0.00	0.00	0.00	77.78	22.22	100.00
6	1	2	0	0	0	26	29
	3.45	6.90	0.00	0.00	0.00	89.66	100.00
Total	115	38	16	5	9	31	214
	53.74	17.76	7.48	2.34	4.21	14.49	100.00
Priors	0.16667	0.16667	0.16667	0.16667	0.16667	0.16667	

	1	2	3	4	5	6	Total
Rate	0.1571	0.7237	0.6471	0.6154	0.2222	0.1034	0.4115
Priors	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667	

SAS OUTPUT - PRINCIPAL COMPONENT ANALYSIS

The SAS System
The PRINCOMP Procedure

Observations	214
Variables	9

Simple Statistics

	RI	Na	Mg	Al	Si
Mean	1.518365421	13.40785047	2.684532710	1.444906542	72.65093458
StD	0.003036864	0.81660356	1.442407845	0.499269646	0.77454579

Simple Statistics

	K	Ca	Ba	Fe
Mean	0.4970560748	8.956962617	0.1750467290	0.0570093458
StD	0.6521918456	1.423153487	0.4972192606	0.0974387006

Covariance Matrix

	RI	Na	Mg	Al	Si
RI	0.000009223	-0.000475859	-0.000535609	-0.000617593	-0.001275010
Na	-0.000475859	0.666841367	-0.322422136	0.063925620	-0.044153850
Mg	-0.000535609	-0.322422136	2.080540391	-0.346967415	-0.185375148
Al	-0.000617593	0.063925620	-0.346967415	0.249270179	-0.002136062
Si	-0.001275010	-0.044153850	-0.185375148	-0.002136062	0.599921188
K	-0.000574048	-0.141712931	0.005075848	0.106138456	-0.097661555
Ca	0.003502498	-0.320106090	-0.910915745	-0.184449816	-0.230084941
Ba	-0.000000583	0.132610899	-0.353046926	0.119010333	-0.039340419
Fe	0.000042318	-0.019203642	0.011673713	-0.003619530	-0.007109398

Covariance Matrix

	K	Ca	Ba	Fe
RI	-0.000574048	0.003502498	-0.000000583	0.000042318
Na	-0.141712931	-0.320106090	0.132610899	-0.019203642
Mg	0.005075848	-0.910915745	-0.353046926	0.011673713
Al	0.106138456	-0.184449816	0.119010333	-0.003619530
Si	-0.097661555	-0.230084941	-0.039340419	-0.007109398
K	0.425354203	-0.295005697	-0.013820284	-0.000490536
Ca	-0.295005697	2.025365848	-0.079848449	0.017329371
Ba	-0.013820284	-0.079848449	0.247226993	-0.002843522
Fe	-0.000490536	0.017329371	-0.002843522	0.009494300

The SAS System
The PRINCOMP Procedure

Total Variance 6.3040236932

Eigenvalues of the Covariance Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	3.00200916	1.34283576	0.4762	0.4762
2	1.65917340	0.97959692	0.2632	0.7394
3	0.67957648	0.03641074	0.1078	0.8472
4	0.64316573	0.43470908	0.1020	0.9492
5	0.20845665	0.10729134	0.0331	0.9823
6	0.10116531	0.09216675	0.0160	0.9983
7	0.00899856	0.00752112	0.0014	0.9998
8	0.00147744	0.00147647	0.0002	1.0000
9	0.00000097		0.0000	1.0000

Eigenvectors

	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7	Prin8	Prin9
RI	0.000928	-.001523	0.001377	-.000311	0.000713	0.001822	-.000333	0.004122	0.999987
Na	0.017225	0.398798	0.654935	0.346600	-.398382	-.015568	-.037690	0.362243	-.001396
Mg	-.723535	-.543051	0.131199	0.098693	0.076849	-.047760	-.074953	0.375275	-.001845
Al	0.046335	0.258841	-.055652	-.270894	0.313526	-.780387	-.074804	0.376133	-.000034
Si	-.007694	0.194092	-.691951	0.570087	-.103320	0.060293	-.058730	0.375118	-.000170
K	-.078404	0.103827	-.218565	-.677701	-.508016	0.265187	-.060376	0.379436	-.001384
Ca	0.679717	-.616725	0.078778	0.053946	-.065743	-.028893	-.073805	0.371357	-.003118
Ba	0.076358	0.223545	0.133876	-.097128	0.680657	0.560066	-.078920	0.365561	-.002984
Fe	0.000906	-.016784	-.007213	-.011099	0.026747	-.000937	0.984173	0.173868	-.000427

SAS OUTPUT - FACTOR ANALYSIS

The FACTOR Procedure

Initial Factor Method: Principal Components

Eigenvectors

	1	2
RI	-0.54518	0.28568
Na	0.25813	0.27035
Mg	-0.11088	-0.59356
Al	0.42871	0.29521
Si	0.22884	-0.15510
K	0.21934	-0.15397
Ca	-0.49231	0.34538
Ba	0.25038	0.48470
Fe	-0.18584	-0.06204

Factor Pattern

	Factor1	Factor2
RI	-0.86392	0.40904
Na	0.40904	0.38709
Mg	-0.17571	-0.84986
Al	0.67936	0.42269
Si	0.36263	-0.22207
K	0.34759	-0.22046
Ca	-0.78014	0.49452
Ba	0.39676	0.69400
Fe	-0.29450	-0.08883

The FACTOR Procedure

Rotation Method: Varimax

Orthogonal Transformation Matrix

	1	2
1	-0.82651	0.56292
2	0.56292	0.82651

Rotated Factor Pattern

	Factor1	Factor2
RI	0.94430	-0.14824
Na	-0.12018	0.55019
Mg	-0.33318	-0.80133
Al	-0.32356	0.73178
Si	-0.42473	0.02059
K	-0.41138	0.01346
Ca	0.92317	-0.03043
Ba	0.06274	0.79694
Fe	0.19340	-0.23920

The FACTOR Procedure
Rotation Method: Harris-Kaiser (hkpower = 0)

Oblique Transformation Matrix

	1	2
1	-0.85766	0.44615
2	0.52132	0.89906

Inter-Factor Correlations

	Factor1	Factor2
Factor1	1.00000	-0.08543
Factor2	-0.08543	1.00000

Rotated Factor Pattern (Standardized Regression Coefficients)

	Factor1	Factor2
RI	0.95419	-0.01768
Na	-0.14902	0.53051
Mg	-0.29236	-0.84247
Al	-0.36230	0.68311
Si	-0.42678	-0.03787
K	-0.41304	-0.04313
Ca	0.92690	0.09654
Ba	0.02152	0.80096
Fe	0.20627	-0.21125

SAS CODES

```
Filename glass 'glass.csv';
Data glass;
infile glass firstobs=1 dlm=",";
  input Type$ Group RI Na Mg Al Si K Ca Ba Fe;

*Discriminant Function;
proc candisc data=glass out=cand;
  class Group;
run;

*Manova Analysis;
proc glm;
class Group;
Model RI Na Mg Al Si K Ca Ba Fe = Group;
Manova H=Group/PrintE PrintH;run;

*Linear Discriminant Function;
proc discrim Data=glass list crossvalidate;
   class Group;
   run;

*Classification using Hold-out Method;
proc discrim data=glass outstat=ftstat
           method=normal pool=yes list crossvalidate;
class group;
var RI Na Mg Al Si K Ca Ba Fe;
run;

*Classification using Nearest Neighbor Method;
proc discrim data=glass outstat=ftstat
           method=npar k=5 pool=yes list crossvalidate;
class group;
var RI Na Mg Al Si K Ca Ba Fe;
run;

*Classification using Quadratic Method-Unequal Variance Assumption;
proc discrim data=glass outstat=ftstat
           method=normal pool=no list crossvalidate;
class group;
var RI Na Mg Al Si K Ca Ba Fe;
run;

*Principal Component Analysis using S;
proc princomp data= glass cov out=S;
var RI Na Mg Al Si K Ca Ba Fe;
run;

*Factor Analysis using Principal Component Method, Varimax Rotation;
proc factor data=glass method=Prin nfact=2 scree ev plot score
rotate=varimax;
  var RI Na Mg Al Si K Ca Ba Fe;run;

*Factor Analysis using Principal Component Method, Oblique Rotation;
proc factor data=glass nfact=2 method=prin scree ev plot score rotate=hk;
var RI Na Mg Al Si K Ca Ba Fe;run;
```

DATASET

Type	Group	Ref_Index	Na	Mg	Al	Si	K	Ca	Ba	Fe
Building Windows_Float Processed	1	1.52101	13.64	4.49	1.1	71.78	0.06	8.75	0	0
Building Windows_Float Processed	1	1.51761	13.89	3.6	1.36	72.73	0.48	7.83	0	0
Building Windows_Float Processed	1	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0	0
Building Windows_Float Processed	1	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0	0
Building Windows_Float Processed	1	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0	0
Building Windows_Float Processed	1	1.51596	12.79	3.61	1.62	72.97	0.64	8.07	0	0.26
Building Windows_Float Processed	1	1.51743	13.3	3.6	1.14	73.09	0.58	8.17	0	0
Building Windows_Float Processed	1	1.51756	13.15	3.61	1.05	73.24	0.57	8.24	0	0
Building Windows_Float Processed	1	1.51918	14.04	3.58	1.37	72.08	0.56	8.3	0	0
Building Windows_Float Processed	1	1.51755	13	3.6	1.36	72.99	0.57	8.4	0	0.11
Building Windows_Float Processed	1	1.51571	12.72	3.46	1.56	73.2	0.67	8.09	0	0.24
Building Windows_Float Processed	1	1.51763	12.8	3.66	1.27	73.01	0.6	8.56	0	0
Building Windows_Float Processed	1	1.51589	12.88	3.43	1.4	73.28	0.69	8.05	0	0.24
Building Windows_Float Processed	1	1.51748	12.86	3.56	1.27	73.21	0.54	8.38	0	0.17
Building Windows_Float Processed	1	1.51763	12.61	3.59	1.31	73.29	0.58	8.5	0	0
Building Windows_Float Processed	1	1.51761	12.81	3.54	1.23	73.24	0.58	8.39	0	0
Building Windows_Float Processed	1	1.51784	12.68	3.67	1.16	73.11	0.61	8.7	0	0
Building Windows_Float Processed	1	1.52196	14.36	3.85	0.89	71.36	0.15	9.15	0	0
Building Windows_Float Processed	1	1.51911	13.9	3.73	1.18	72.12	0.06	8.89	0	0
Building Windows_Float Processed	1	1.51735	13.02	3.54	1.69	72.73	0.54	8.44	0	0.07
Building Windows_Float Processed	1	1.5175	12.82	3.55	1.49	72.75	0.54	8.52	0	0.19
Building Windows_Float Processed	1	1.51966	14.77	3.75	0.29	72.02	0.03	9	0	0
Building Windows_Float Processed	1	1.51736	12.78	3.62	1.29	72.79	0.59	8.7	0	0
Building Windows_Float Processed	1	1.51751	12.81	3.57	1.35	73.02	0.62	8.59	0	0
Building Windows_Float Processed	1	1.5172	13.38	3.5	1.15	72.85	0.5	8.43	0	0
Building Windows_Float Processed	1	1.51764	12.98	3.54	1.21	73	0.65	8.53	0	0
Building Windows_Float Processed	1	1.51793	13.21	3.48	1.41	72.64	0.59	8.43	0	0
Building Windows_Float Processed	1	1.51721	12.87	3.48	1.33	73.04	0.56	8.43	0	0
Building Windows_Float Processed	1	1.51768	12.56	3.52	1.43	73.15	0.57	8.54	0	0
Building Windows_Float Processed	1	1.51784	13.08	3.49	1.28	72.86	0.6	8.49	0	0
Building Windows_Float Processed	1	1.51768	12.65	3.56	1.3	73.08	0.61	8.69	0	0.14
Building Windows_Float Processed	1	1.51747	12.84	3.5	1.14	73.27	0.56	8.55	0	0
Building Windows_Float Processed	1	1.51775	12.85	3.48	1.23	72.97	0.61	8.56	0.09	0.22
Building Windows_Float Processed	1	1.51753	12.57	3.47	1.38	73.39	0.6	8.55	0	0.06
Building Windows_Float Processed	1	1.51783	12.69	3.54	1.34	72.95	0.57	8.75	0	0
Building Windows_Float Processed	1	1.51567	13.29	3.45	1.21	72.74	0.56	8.57	0	0
Building Windows_Float Processed	1	1.51909	13.89	3.53	1.32	71.81	0.51	8.78	0.11	0
Building Windows_Float Processed	1	1.51797	12.74	3.48	1.35	72.96	0.64	8.68	0	0
Building Windows_Float Processed	1	1.52213	14.21	3.82	0.47	71.77	0.11	9.57	0	0

Building Windows_Float Processed	1	1.52213	14.21	3.82	0.47	71.77	0.11	9.57	0	0
Building Windows_Float Processed	1	1.51793	12.79	3.5	1.12	73.03	0.64	8.77	0	0
Building Windows_Float Processed	1	1.51755	12.71	3.42	1.2	73.2	0.59	8.64	0	0
Building Windows_Float Processed	1	1.51779	13.21	3.39	1.33	72.76	0.59	8.59	0	0
Building Windows_Float Processed	1	1.5221	13.73	3.84	0.72	71.76	0.17	9.74	0	0
Building Windows_Float Processed	1	1.51786	12.73	3.43	1.19	72.95	0.62	8.76	0	0.3
Building Windows_Float Processed	1	1.519	13.49	3.48	1.35	71.95	0.55	9	0	0
Building Windows_Float Processed	1	1.51869	13.19	3.37	1.18	72.72	0.57	8.83	0	0.16
Building Windows_Float Processed	1	1.52667	13.99	3.7	0.71	71.57	0.02	9.82	0	0.1
Building Windows_Float Processed	1	1.52223	13.21	3.77	0.79	71.99	0.13	10.02	0	0
Building Windows_Float Processed	1	1.51898	13.58	3.35	1.23	72.08	0.59	8.91	0	0
Building Windows_Float Processed	1	1.5232	13.72	3.72	0.51	71.75	0.09	10.06	0	0.16
Building Windows_Float Processed	1	1.51926	13.2	3.33	1.28	72.36	0.6	9.14	0	0.11
Building Windows_Float Processed	1	1.51808	13.43	2.87	1.19	72.84	0.55	9.03	0	0
Building Windows_Float Processed	1	1.51837	13.14	2.84	1.28	72.85	0.55	9.07	0	0
Building Windows_Float Processed	1	1.51778	13.21	2.81	1.29	72.98	0.51	9.02	0	0.09
Building Windows_Float Processed	1	1.51769	12.45	2.71	1.29	73.7	0.56	9.06	0	0.24
Building Windows_Float Processed	1	1.51215	12.99	3.47	1.12	72.98	0.62	8.35	0	0.31
Building Windows_Float Processed	1	1.51824	12.87	3.48	1.29	72.95	0.6	8.43	0	0
Building Windows_Float Processed	1	1.51754	13.48	3.74	1.17	72.99	0.59	8.03	0	0
Building Windows_Float Processed	1	1.51754	13.39	3.66	1.19	72.79	0.57	8.27	0	0.11
Building Windows_Float Processed	1	1.51905	13.6	3.62	1.11	72.64	0.14	8.76	0	0
Building Windows_Float Processed	1	1.51977	13.81	3.58	1.32	71.72	0.12	8.67	0.69	0
Building Windows_Float Processed	1	1.52172	13.51	3.86	0.88	71.79	0.23	9.54	0	0.11
Building Windows_Float Processed	1	1.52227	14.17	3.81	0.78	71.35	0	9.69	0	0
Building Windows_Float Processed	1	1.52172	13.48	3.74	0.9	72.01	0.18	9.61	0	0.07
Building Windows_Float Processed	1	1.52099	13.69	3.59	1.12	71.96	0.09	9.4	0	0
Building Windows_Float Processed	1	1.52152	13.05	3.65	0.87	72.22	0.19	9.85	0	0.17
Building Windows_Float Processed	1	1.52152	13.05	3.65	0.87	72.32	0.19	9.85	0	0.17
Building Windows_Float Processed	1	1.52152	13.12	3.58	0.9	72.2	0.23	9.82	0	0.16
Building Windows_Float Processed	1	1.523	13.31	3.58	0.82	71.99	0.12	10.17	0	0.03
Building Windows_NOT_Float Processed	2	1.51574	14.86	3.67	1.74	71.87	0.16	7.36	0	0.12
Building Windows_NOT_Float Processed	2	1.51848	13.64	3.87	1.27	71.96	0.54	8.32	0	0.32
Building Windows_NOT_Float Processed	2	1.51593	13.09	3.59	1.52	73.1	0.67	7.83	0	0
Building Windows_NOT_Float Processed	2	1.51631	13.34	3.57	1.57	72.87	0.61	7.89	0	0
Building Windows_NOT_Float Processed	2	1.51596	13.02	3.56	1.54	73.11	0.72	7.9	0	0
Building Windows_NOT_Float Processed	2	1.5159	13.02	3.58	1.51	73.12	0.69	7.96	0	0

Building Windows_NOT_Float Processed	2	1.51645	13.44	3.61	1.54	72.39	0.66	8.03	0	0
Building Windows_NOT_Float Processed	2	1.51627	13	3.58	1.54	72.83	0.61	8.04	0	0
Building Windows_NOT_Float Processed	2	1.51613	13.92	3.52	1.25	72.88	0.37	7.94	0	0.14
Building Windows_NOT_Float Processed	2	1.5159	12.82	3.52	1.9	72.86	0.69	7.97	0	0
Building Windows_NOT_Float Processed	2	1.51592	12.86	3.52	2.12	72.66	0.69	7.97	0	0
Building Windows_NOT_Float Processed	2	1.51593	13.25	3.45	1.43	73.17	0.61	7.86	0	0
Building Windows_NOT_Float Processed	2	1.51646	13.41	3.55	1.25	72.81	0.68	8.1	0	0
Building Windows_NOT_Float Processed	2	1.51594	13.09	3.52	1.55	72.87	0.68	8.05	0	0.09
Building Windows_NOT_Float Processed	2	1.51409	14.25	3.09	2.08	72.28	1.1	7.08	0	0
Building Windows_NOT_Float Processed	2	1.51625	13.36	3.58	1.49	72.72	0.45	8.21	0	0
Building Windows_NOT_Float Processed	2	1.51569	13.24	3.49	1.47	73.25	0.38	8.03	0	0
Building Windows_NOT_Float Processed	2	1.51645	13.4	3.49	1.52	72.65	0.67	8.08	0	0.1
Building Windows_NOT_Float Processed	2	1.51618	13.01	3.5	1.48	72.89	0.6	8.12	0	0
Building Windows_NOT_Float Processed	2	1.5164	12.55	3.48	1.87	73.23	0.63	8.08	0	0.09
Building Windows_NOT_Float Processed	2	1.51841	12.93	3.74	1.11	72.28	0.64	8.96	0	0.22
Building Windows_NOT_Float Processed	2	1.51605	12.9	3.44	1.45	73.06	0.44	8.27	0	0
Building Windows_NOT_Float Processed	2	1.51588	13.12	3.41	1.58	73.26	0.07	8.39	0	0.19
Building Windows_NOT_Float Processed	2	1.5159	13.24	3.34	1.47	73.1	0.39	8.22	0	0
Building Windows_NOT_Float Processed	2	1.51629	12.71	3.33	1.49	73.28	0.67	8.24	0	0
Building Windows_NOT_Float Processed	2	1.5186	13.36	3.43	1.43	72.26	0.51	8.6	0	0
Building Windows_NOT_Float Processed	2	1.51841	13.02	3.62	1.06	72.34	0.64	9.13	0	0.15
Building Windows_NOT_Float Processed	2	1.51743	12.2	3.25	1.16	73.55	0.62	8.9	0	0.24
Building Windows_NOT_Float Processed	2	1.51689	12.67	2.88	1.71	73.21	0.73	8.54	0	0
Building Windows_NOT_Float	2	1.51811	12.96	2.96	1.43	72.92	0.6	8.79	0.14	0

Processed										
Building Windows_NOT_Float Processed	2	1.51655	12.75	2.85	1.44	73.27	0.57	8.79	0.11	0.22
Building Windows_NOT_Float Processed	2	1.5173	12.35	2.72	1.63	72.87	0.7	9.23	0	0
Building Windows_NOT_Float Processed	2	1.5182	12.62	2.76	0.83	73.81	0.35	9.42	0	0.2
Building Windows_NOT_Float Processed	2	1.52725	13.8	3.15	0.66	70.57	0.08	11.64	0	0
Building Windows_NOT_Float Processed	2	1.5241	13.83	2.9	1.17	71.15	0.08	10.79	0	0
Building Windows_NOT_Float Processed	2	1.52475	11.45	0	1.88	72.19	0.81	13.24	0	0.34
Building Windows_NOT_Float Processed	2	1.53125	10.73	0	2.1	69.81	0.58	13.3	3.15	0.28
Building Windows_NOT_Float Processed	2	1.53393	12.3	0	1	70.16	0.12	16.19	0	0.24
Building Windows_NOT_Float Processed	2	1.52222	14.43	0	1	72.67	0.1	11.52	0	0.08
Building Windows_NOT_Float Processed	2	1.51818	13.72	0	0.56	74.45	0	10.99	0	0
Building Windows_NOT_Float Processed	2	1.52664	11.23	0	0.77	73.21	0	14.68	0	0
Building Windows_NOT_Float Processed	2	1.52739	11.02	0	0.75	73.08	0	14.96	0	0
Building Windows_NOT_Float Processed	2	1.52777	12.64	0	0.67	72.02	0.06	14.4	0	0
Building Windows_NOT_Float Processed	2	1.51892	13.46	3.83	1.26	72.55	0.57	8.21	0	0.14
Building Windows_NOT_Float Processed	2	1.51847	13.1	3.97	1.19	72.44	0.6	8.43	0	0
Building Windows_NOT_Float Processed	2	1.51846	13.41	3.89	1.33	72.38	0.51	8.28	0	0
Building Windows_NOT_Float Processed	2	1.51829	13.24	3.9	1.41	72.33	0.55	8.31	0	0.1
Building Windows_NOT_Float Processed	2	1.51708	13.72	3.68	1.81	72.06	0.64	7.88	0	0
Building Windows_NOT_Float Processed	2	1.51673	13.3	3.64	1.53	72.53	0.65	8.03	0	0.29
Building Windows_NOT_Float Processed	2	1.51652	13.56	3.57	1.47	72.45	0.64	7.96	0	0
Building Windows_NOT_Float Processed	2	1.51844	13.25	3.76	1.32	72.4	0.58	8.42	0	0
Building Windows_NOT_Float Processed	2	1.51663	12.93	3.54	1.62	72.96	0.64	8.03	0	0.21
Building Windows_NOT_Float Processed	2	1.51687	13.23	3.54	1.48	72.84	0.56	8.1	0	0

Building Windows_NOT_Float Processed	2	1.51707	13.48	3.48	1.71	72.52	0.62	7.99	0	0
Building Windows_NOT_Float Processed	2	1.52177	13.2	3.68	1.15	72.75	0.54	8.52	0	0
Building Windows_NOT_Float Processed	2	1.51872	12.93	3.66	1.56	72.51	0.58	8.55	0	0.12
Building Windows_NOT_Float Processed	2	1.51667	12.94	3.61	1.26	72.75	0.56	8.6	0	0
Building Windows_NOT_Float Processed	2	1.52081	13.78	2.28	1.43	71.99	0.49	9.85	0	0.17
Building Windows_NOT_Float Processed	2	1.52068	13.55	2.09	1.67	72.18	0.53	9.57	0.27	0.17
Building Windows_NOT_Float Processed	2	1.5202	13.98	1.35	1.63	71.76	0.39	10.56	0	0.18
Building Windows_NOT_Float Processed	2	1.52177	13.75	1.01	1.36	72.19	0.33	11.14	0	0
Building Windows_NOT_Float Processed	2	1.52614	13.7	0	1.36	71.24	0.19	13.44	0	0.1
Building Windows_NOT_Float Processed	2	1.51813	13.43	3.98	1.18	72.49	0.58	8.15	0	0
Building Windows_NOT_Float Processed	2	1.518	13.71	3.93	1.54	71.81	0.54	8.21	0	0.15
Building Windows_NOT_Float Processed	2	1.51811	13.33	3.85	1.25	72.78	0.52	8.12	0	0
Building Windows_NOT_Float Processed	2	1.51789	13.19	3.9	1.3	72.33	0.55	8.44	0	0.28
Building Windows_NOT_Float Processed	2	1.51806	13	3.8	1.08	73.07	0.56	8.38	0	0.12
Building Windows_NOT_Float Processed	2	1.51711	12.89	3.62	1.57	72.96	0.61	8.11	0	0
Building Windows_NOT_Float Processed	2	1.51674	12.79	3.52	1.54	73.36	0.66	7.9	0	0
Building Windows_NOT_Float Processed	2	1.51674	12.87	3.56	1.64	73.14	0.65	7.99	0	0
Building Windows_NOT_Float Processed	2	1.5169	13.33	3.54	1.61	72.54	0.68	8.11	0	0
Building Windows_NOT_Float Processed	2	1.51851	13.2	3.63	1.07	72.83	0.57	8.41	0.09	0.17
Building Windows_NOT_Float Processed	2	1.51662	12.85	3.51	1.44	73.01	0.68	8.23	0.06	0.25
Building Windows_NOT_Float Processed	2	1.51709	13	3.47	1.79	72.72	0.66	8.18	0	0
Building Windows_NOT_Float Processed	2	1.5166	12.99	3.18	1.23	72.97	0.58	8.81	0	0.24
Building Windows_NOT_Float Processed	2	1.51839	12.85	3.67	1.24	72.57	0.62	8.68	0	0.35
Vehicle Window_Float Processed	3	1.51769	13.65	3.66	1.11	72.77	0.11	8.6	0	0

Vehicle Window_Float Processed	3	1.5161	13.33	3.53	1.34	72.67	0.56	8.33	0	0
Vehicle Window_Float Processed	3	1.5167	13.24	3.57	1.38	72.7	0.56	8.44	0	0.1
Vehicle Window_Float Processed	3	1.51643	12.16	3.52	1.35	72.89	0.57	8.53	0	0
Vehicle Window_Float Processed	3	1.51665	13.14	3.45	1.76	72.48	0.6	8.38	0	0.17
Vehicle Window_Float Processed	3	1.52127	14.32	3.9	0.83	71.5	0	9.49	0	0
Vehicle Window_Float Processed	3	1.51779	13.64	3.65	0.65	73	0.06	8.93	0	0
Vehicle Window_Float Processed	3	1.5161	13.42	3.4	1.22	72.69	0.59	8.32	0	0
Vehicle Window_Float Processed	3	1.51694	12.86	3.58	1.31	72.61	0.61	8.79	0	0
Vehicle Window_Float Processed	3	1.51646	13.04	3.4	1.26	73.01	0.52	8.58	0	0
Vehicle Window_Float Processed	3	1.51655	13.41	3.39	1.28	72.64	0.52	8.65	0	0
Vehicle Window_Float Processed	3	1.52121	14.03	3.76	0.58	71.79	0.11	9.65	0	0
Vehicle Window_Float Processed	3	1.51776	13.53	3.41	1.52	72.04	0.58	8.79	0	0
Vehicle Window_Float Processed	3	1.51796	13.5	3.36	1.63	71.94	0.57	8.81	0	0.09
Vehicle Window_Float Processed	3	1.51832	13.33	3.34	1.54	72.14	0.56	8.99	0	0
Vehicle Window_Float Processed	3	1.51934	13.64	3.54	0.75	72.65	0.16	8.89	0.15	0.24
Vehicle Window_Float Processed	3	1.52211	14.19	3.78	0.91	71.36	0.23	9.14	0	0.37
Containers	4	1.51514	14.01	2.68	3.5	69.89	1.68	5.87	2.2	0
Containers	4	1.51915	12.73	1.85	1.86	72.69	0.6	10.09	0	0
Containers	4	1.52171	11.56	1.88	1.56	72.86	0.47	11.41	0	0
Containers	4	1.52151	11.03	1.71	1.56	73.44	0.58	11.62	0	0
Containers	4	1.51969	12.64	0	1.65	73.75	0.38	11.53	0	0
Containers	4	1.51666	12.86	0	1.83	73.88	0.97	10.17	0	0
Containers	4	1.51994	13.27	0	1.76	73.03	0.47	11.32	0	0
Containers	4	1.52369	13.44	0	1.58	72.22	0.32	12.24	0	0
Containers	4	1.51316	13.02	0	3.04	70.48	6.21	6.96	0	0
Containers	4	1.51321	13	0	3.02	70.7	6.21	6.93	0	0
Containers	4	1.52043	13.38	0	1.4	72.25	0.33	12.5	0	0
Containers	4	1.52058	12.85	1.61	2.17	72.18	0.76	9.7	0.24	0.51
Containers	4	1.52119	12.97	0.33	1.51	73.39	0.13	11.27	0	0.28
Tableware	5	1.51905	14	2.39	1.56	72.37	0	9.57	0	0
Tableware	5	1.51937	13.79	2.41	1.19	72.76	0	9.77	0	0
Tableware	5	1.51829	14.46	2.24	1.62	72.38	0	9.26	0	0
Tableware	5	1.51852	14.09	2.19	1.66	72.67	0	9.32	0	0
Tableware	5	1.51299	14.4	1.74	1.54	74.55	0	7.59	0	0
Tableware	5	1.51888	14.99	0.78	1.74	72.5	0	9.95	0	0
Tableware	5	1.51916	14.15	0	2.09	72.74	0	10.88	0	0
Tableware	5	1.51969	14.56	0	0.56	73.48	0	11.22	0	0
Tableware	5	1.51115	17.38	0	0.34	75.41	0	6.65	0	0
Headlamp	6	1.51131	13.69	3.2	1.81	72.81	1.76	5.43	1.19	0
Headlamp	6	1.51838	14.32	3.26	2.22	71.25	1.46	5.79	1.63	0
Headlamp	6	1.52315	13.44	3.34	1.23	72.38	0.6	8.83	0	0

Headlamp	6	1.52247	14.86	2.2	2.06	70.26	0.76	9.76	0	0
Headlamp	6	1.52365	15.79	1.83	1.31	70.43	0.31	8.61	1.68	0
Headlamp	6	1.51613	13.88	1.78	1.79	73.1	0	8.67	0.76	0
Headlamp	6	1.51602	14.85	0	2.38	73.28	0	8.76	0.64	0.09
Headlamp	6	1.51623	14.2	0	2.79	73.46	0.04	9.04	0.4	0.09
Headlamp	6	1.51719	14.75	0	2	73.02	0	8.53	1.59	0.08
Headlamp	6	1.51683	14.56	0	1.98	73.29	0	8.52	1.57	0.07
Headlamp	6	1.51545	14.14	0	2.68	73.39	0.08	9.07	0.61	0.05
Headlamp	6	1.51556	13.87	0	2.54	73.23	0.14	9.41	0.81	0.01
Headlamp	6	1.51727	14.7	0	2.34	73.28	0	8.95	0.66	0
Headlamp	6	1.51531	14.38	0	2.66	73.1	0.04	9.08	0.64	0
Headlamp	6	1.51609	15.01	0	2.51	73.05	0.05	8.83	0.53	0
Headlamp	6	1.51508	15.15	0	2.25	73.5	0	8.34	0.63	0
Headlamp	6	1.51653	11.95	0	1.19	75.18	2.7	8.93	0	0
Headlamp	6	1.51514	14.85	0	2.42	73.72	0	8.39	0.56	0
Headlamp	6	1.51658	14.8	0	1.99	73.11	0	8.28	1.71	0
Headlamp	6	1.51617	14.95	0	2.27	73.3	0	8.71	0.67	0
Headlamp	6	1.51732	14.95	0	1.8	72.99	0	8.61	1.55	0
Headlamp	6	1.51645	14.94	0	1.87	73.11	0	8.67	1.38	0
Headlamp	6	1.51831	14.39	0	1.82	72.86	1.41	6.47	2.88	0
Headlamp	6	1.5164	14.37	0	2.74	72.85	0	9.45	0.54	0
Headlamp	6	1.51623	14.14	0	2.88	72.61	0.08	9.18	1.06	0
Headlamp	6	1.51685	14.92	0	1.99	73.06	0	8.4	1.59	0
Headlamp	6	1.52065	14.36	0	2.02	73.42	0	8.44	1.64	0
Headlamp	6	1.51651	14.38	0	1.94	73.61	0	8.48	1.57	0
Headlamp	6	1.51711	14.23	0	2.08	73.36	0	8.62	1.67	0