CS 584-04: Machine Learning

Fall 2018 Assignment 4

Question 1 (60 points)

a) (5 points). How many observations and variables did you use in your Principal Component analysis?

Shape of data: [46 rows x 12 columns]

46 observations and 12 variables are used

b) (5 points). Generate the scatter plot matrix for the variables. Put the histograms on the diagonal.

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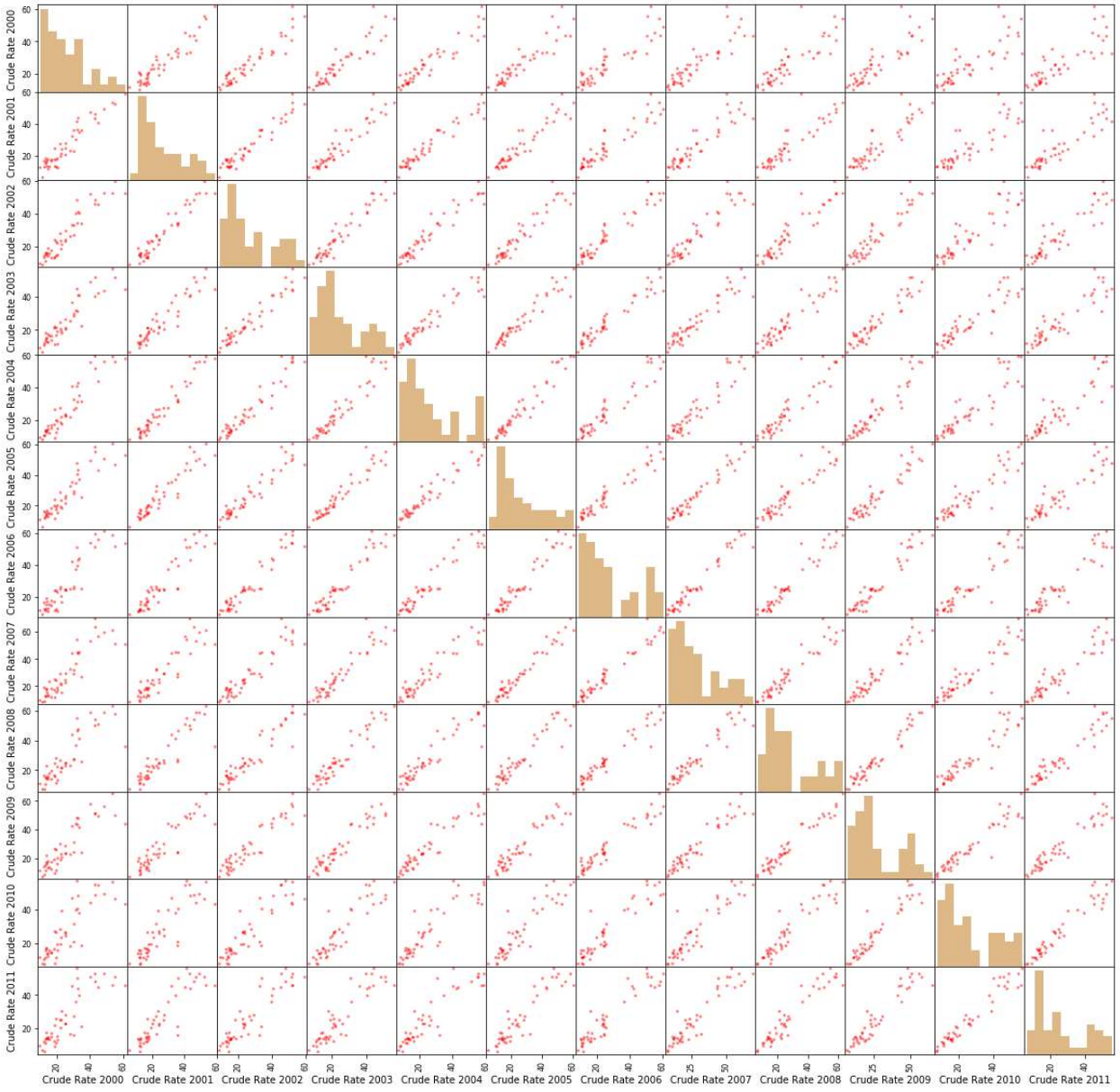
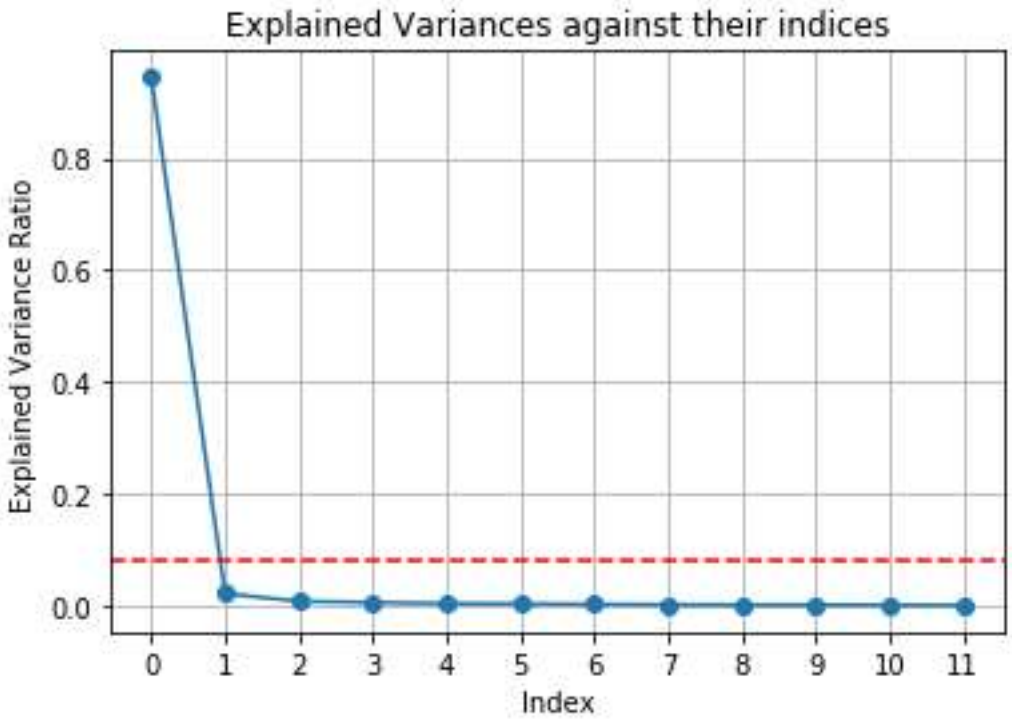
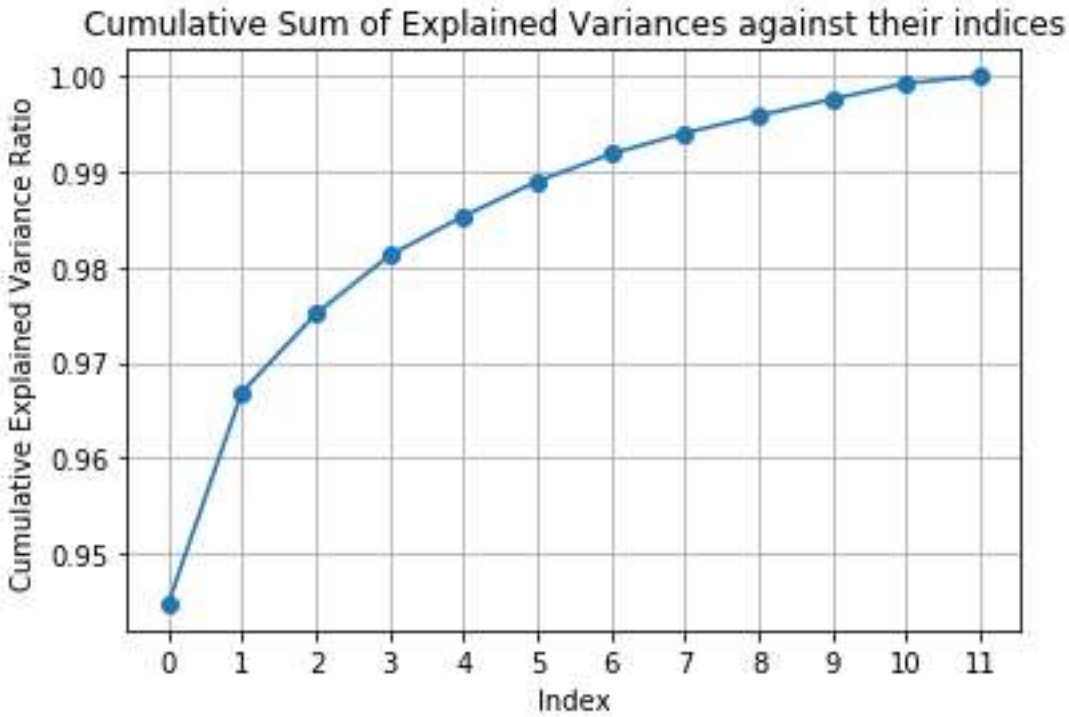


c) (5 points). Plot the Explained Variances against their indices. Add a horizontal reference line whose value is the reciprocal of the number of variables. Label the axes and add grid lines to the axes.



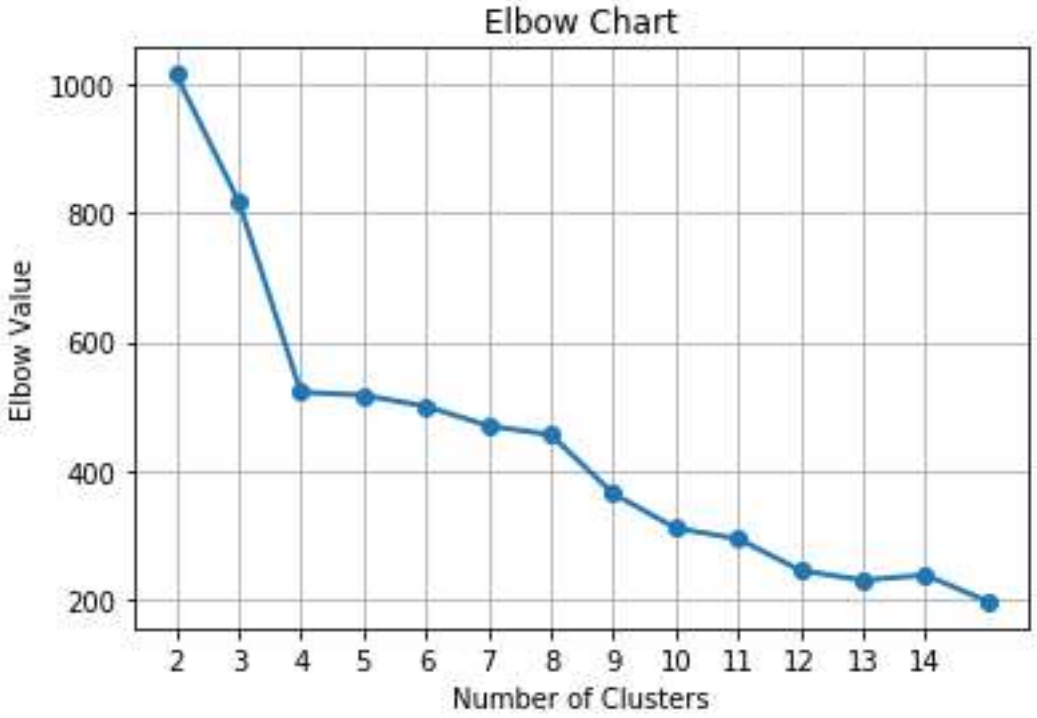
d) (5 points). Plot the Cumulative Sum of the Explained Variances against their indices. Label the axes and add grid lines to the axes.

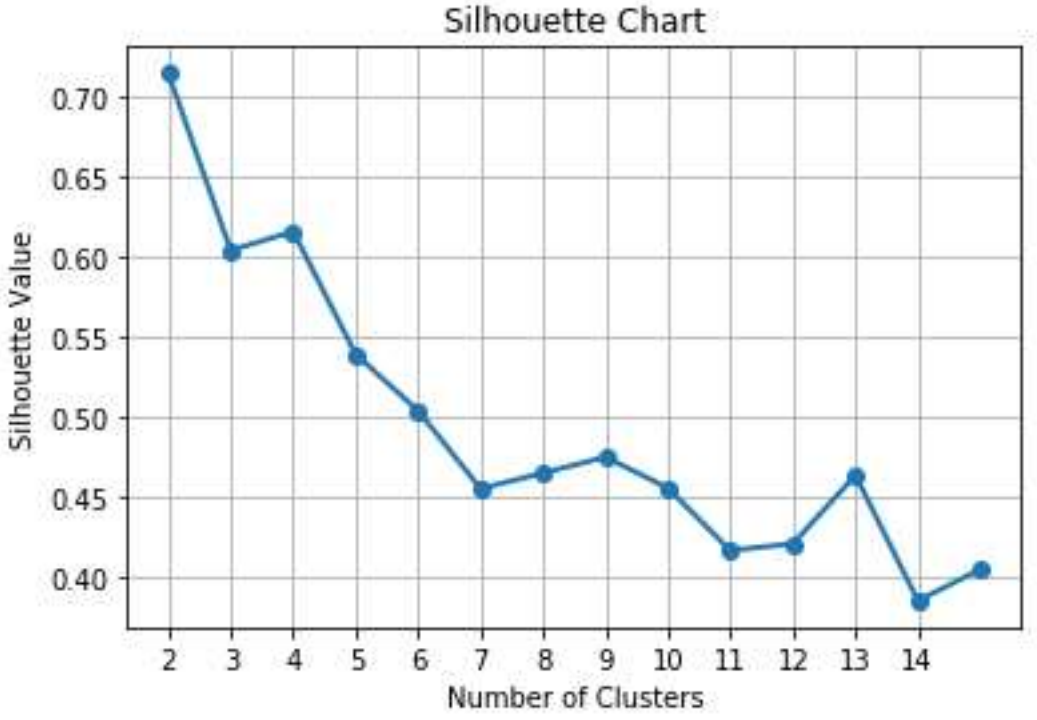


e) (5 points). What percentage of the total variance is explained by the first two principal components?

96.690181%

f) (5 points). Plot the Elbow and the Silhouette charts against the number of clusters.





g) (5 points). What is the number of clusters that you will choose based on the charts in f)?

4

h) (5 points). How many communities are in each cluster?

Cluster ID	count
0	18
2	14
3	9
1	5

i) (5 points). List the names of the communities in each cluster.

Cluster 0:

0	60601, 60602, 60603, 60604, 60605 & 60611	Downtown
1	60606, 60607 & 60661	West Loop
4	60610 & 60654	Near North Side
6	60613	Lake View
7	60614	Lincoln Park
11	60618	Avondale
18	60625	Albany Park
22	60630	Jefferson Park
23	60631	Edison Park
24	60632	Archer Heights
25	60634	Dunning
31	60641	Portage Park
34	60645	West Ridge
35	60646	Edgebrook
41	60655	Mount Greenwood
42	60656	Norwood Park
43	60657	Belmont Harbor
44	60659	North Park

Cluster 1:

5	60612	Near West Side
10	60617	South Chicago
27	60637	Woodlawn
32	60643	Beverly
38	60651	West Humboldt Park

Cluster 2:

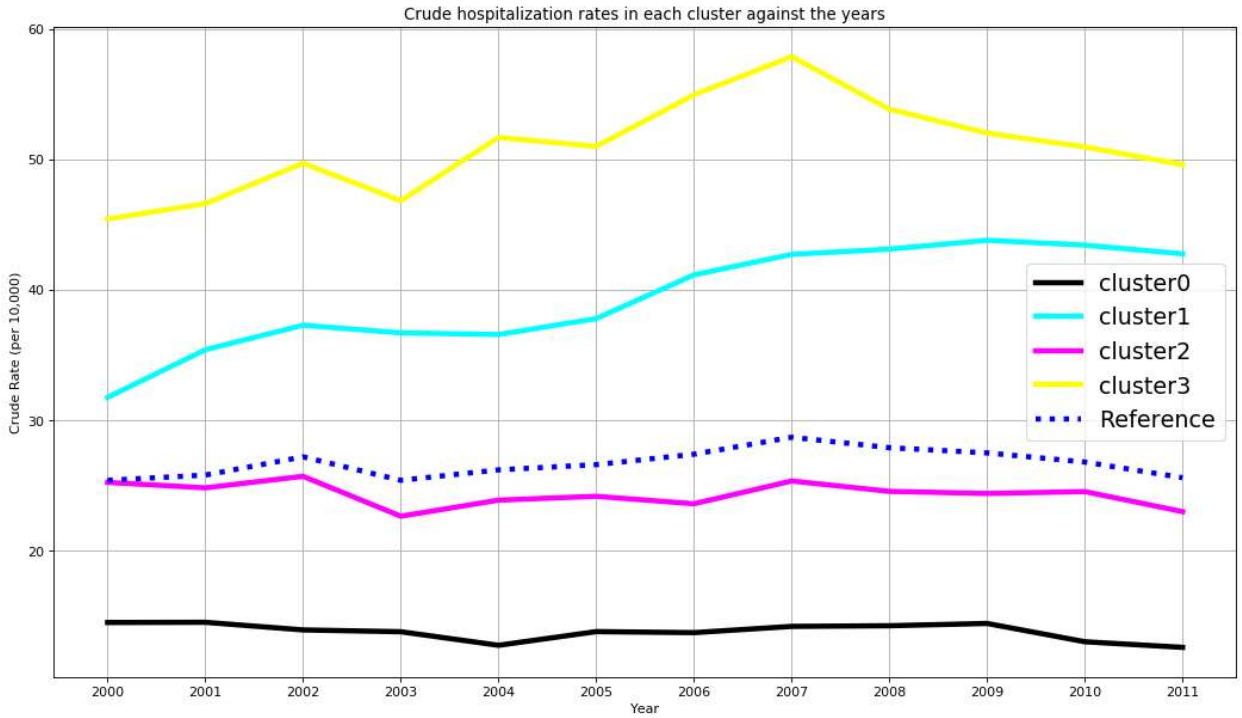
2	60608	Lower West Side
3	60609	New City
8	60615	Hyde Park
9	60616	Chinatown
15	60622 & 60642	West Town
16	60623	South Lawndale
19	60626	Rogers Park
21	60629	West Lawn
28	60638	Garfield Ridge
29	60639	Belmont Gardens
30	60640	Edgewater
36	60647	Bucktown
39	60652	Ashburn
45	60660	Edgewater Glen

Cluster 3:

12	60619	Chatham
13	60620	Auburn Gresham
14	60621	Englewood
17	60624	West Garfield Park
20	60628	Roseland
26	60636	West Englewood
33	60644	Austin
37	60649	South Shore
40	60653	Kenwood

j) (10 points). Plot the crude hospitalization rates in each cluster against the years. You also plot the Chicago's annual crude hospitalization rates (in the table below) against the years as the reference curve.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rate	25.4	25.8	27.2	25.4	26.2	26.6	27.4	28.7	27.9	27.5	26.8	25.6



k) (5 points) Based on the graph in j), what will you conclude about the trend of crude hospitalization rate in each cluster relative to the Chicago's rates?

Chicago's rates haven't increased nor decreased drastically albeit with a few fluctuations. All clusters see a rise in crude rate in the year 2007. Cluster 3 neighborhoods have the highest crude hospitalization rates followed by cluster 1, both of which are higher than the reference. Cluster 2 and cluster 0 have lower rates than the reference.

Question 2 (40 points)

a) (5 points) What are the Class Probabilities?
Class A = 0 probability 0.21599581510081187
Class A = 1 probability 0.64046244338586
Class A = 2 probability 0.1435417415133281

b) (5 points) When group_size = 1, homeowner = 0, and married_couple = 0, what are the predicted probabilities Pr(A = 0), Pr(A = 1), and Pr(A = 2)?
Pr(A = 0) is **0.2697221048499267**

Pr(A = 1) is **0.5801329399401**
Pr(A = 2) is **0.15014495520997334**

c) (5 points) When group_size = 2, homeowner = 1, and married_couple = 1, what are the predicted probabilities Pr(A = 0), Pr(A = 1), and Pr(A = 2)?

Pr(A = 0) is **0.13827430813010222**
Pr(A = 1) is **0.7259545618746951**
Pr(A = 2) is **0.1357711299952027**

d) (5 points) When group_size = 3, homeowner = 1, and married_couple = 1, what are the predicted probabilities Pr(A = 0), Pr(A = 1), and Pr(A = 2)?

Pr(A = 0) is **0.19436967601795363**
Pr(A = 1) is **0.6404093169902023**
Pr(A = 2) is **0.16522100699184422**

e) (5 points) When group_size = 4, homeowner = 0, and married_couple = 0, what are the predicted probabilities Pr(A = 0), Pr(A = 1), and Pr(A = 2)?

Pr(A = 0) is **0.37549062583572096**
Pr(A = 1) is **0.4878096506845897**
Pr(A = 2) is **0.1366997234796893**

f) (10 points) What are the values of the predictors group_size, homeowner, and married_couple such that Prob(A = 1) attains its maximum?

Group Size = 2
Homeowner = 1
Married Couple = 1

g) (5 points) For the values of group_size, homeowner, and married_couple, what are the predicted probabilities Pr(A = 0), Pr(A = 1), and Pr(A = 2)?

The below data (predicted probabilities) for each of the values of the variables is in the format: (Pr(A = 0), Pr(A = 1), Pr(A = 2))

group_size= 1 homeowner= 0 married_couple= 0
(0.2697221048499267, 0.5801329399401, 0.15014495520997334)
group_size= 1 homeowner= 0 married_couple= 1
(0.2327894062536048, 0.6142181021428793, 0.152992491603516)
group_size= 1 homeowner= 1 married_couple= 0
(0.1940380809567132, 0.6696585761357657, 0.13630334290752105)
group_size= 1 homeowner= 1 married_couple= 1

(0.16493516175037906, 0.6982776295037999, 0.13678720874582112)
group_size= 2 homeowner= 0 married_couple= 0
(0.23114351470080471, 0.6165180049554043, 0.15233848034379088)
group_size= 2 homeowner= 0 married_couple= 1
(0.19801576122393472, 0.6479063332453118, 0.15407790553075348)
group_size= 2 homeowner= 1 married_couple= 0
(0.1636276819009433, 0.700287393833978, 0.1360849242650787)
group_size= 2 homeowner= 1 married_couple= 1
(0.13827430813010222, 0.7259545618746951, 0.1357711299952027)
group_size= 3 homeowner= 0 married_couple= 0
(0.3082195887875182, 0.5159236953280671, 0.17585671588441468)
group_size= 3 homeowner= 0 married_couple= 1
(0.268311240184029, 0.5509504199790198, 0.18073833983695112)
group_size= 3 homeowner= 1 married_couple= 0
(0.2269720106552963, 0.6096113185495722, 0.16341667079513142)
group_size= 3 homeowner= 1 married_couple= 1
(0.19436967601795363, 0.6404093169902023, 0.16522100699184422)
group_size= 4 homeowner= 0 married_couple= 0
(0.37549062583572096, 0.4878096506845897, 0.1366997234796893)
group_size= 4 homeowner= 0 married_couple= 1
(0.33074366964210417, 0.5270978482121912, 0.1421584821457047)
group_size= 4 homeowner= 1 married_couple= 0
(0.28217290202526524, 0.5881960077903524, 0.12963109018438237)
group_size= 4 homeowner= 1 married_couple= 1
(0.24393054429629368, 0.6237655229384779, 0.13230393276522845)