"session 11 assignment2 "

ANUJ

output:

word_document: default

html_document:

df_print: paged

```{r}

#Variable Description

#age: age of client

#job : type of job

#marital : marital status

#education: highest educational achievement

#default: has credit in default?

#housing: has housing loan?

#loan: has personal loan?

#contact: contact communication type

#month: last contact month of year

#day_of_week: last contact day of the week

#duration: last contact duration, in seconds

#campaign: number of contacts performed during this campaign and for this client

#pdays: number of days that passed by after the client was last contacted from a previous campaign (999 means client was not previously contacted)

#previous: number of contacts performed before this campaign and for this client
```

```
#poutcome: outcome of the previous marketing campaign

#emp.var.rate: employment variation rate - quarterly indicator

#cons.price.idx: consumer price index - monthly indicator

#cons.conf.idx: consumer confidence index - monthly indicator

#euribor3m: euribor 3 month rate - daily indicator

#nr.employed: number of employees - quarterly indicator

#y - has the client subscribed a term deposit?


## The data set can be obtained from http://archive.ics.uci.edu/ml/datasets/Bank+Marketing

## DATASET UNDERSTANDING

library(readr)

bank_full <- read_delim("C:/Users/Seshan/Desktop/Bank/bank-full.csv",

";", escape_double = FALSE, trim_ws = TRUE)

#Lets look at dataset and generate initial understanding about the column types

str(bank_full)

#A deep check for NA in a particular column let say age

if(length(which(is.na(bank_full$age)==TRUE)>0)){

print("Missing Value found in the specified column")

} else

print("All okay: No Missing Value found in the specified column")


# Check another example say

if(length(which(is.na(bank_full$campaign)==TRUE)>0)){print("Missing Value found in the specified column")} else

print("All okay: No Missing Value found in the specified column")
```

```
head(bank_full) ## Displays first 6 rows for each variable

str(bank_full) ## Describes each variables

summary(bank_full) ## Provides basic statistical information of each variable

## DATA EXPLORATION - Check for Missing Data

## Option 1

is.na(bank_full) ## Displays True for a missing value

## Since it is a large dataset, graphical display of missing values will prove to be easier

##Option 2

require(Amelia)

missmap(bank_full,main="Missing Data - Bank ", col=c("red","grey"),legend=FALSE)

## No red colour stripes are visible. hence no missing values.

summary(bank_full) ## displays missing values if any under every variable
```

#The Pearson's chi-squared test of independence is one of the most basic and common hypothesis tests in the statistical analysis of categorical data. It is a significance test. Given two categorical random variables, X and Y, the chi-squared test of independence determines whether or not there exists a statistical dependence between them. Formally, it is a hypothesis test. The chi-squared test assumes a null hypothesis and an alternate hypothesis. The general practice is, if the p-value that comes out in the result is less than a pre-determined significance level, which is 0.05 usually, then we reject the null hypothesis.

#H0: The The two variables are independent

#H1: The The two variables are dependent

#The null hypothesis of the chi-squared test is that the two variables are independent and the alternate hypothesis is that they are related.

#To establish that two categorical variables (or predictors) are dependent, the chi-squared statistic must have a certain cutoff. This cutoff increases as the number of classes within the variable (or predictor) increases.

#i. Pearson's chi-squared test of independence (significance test)

Is there any association between Job and default?

with(bank_full, chisq.test(job, default))

with(bank_full, table(job, default))

OR

with(bank_full, prop.table(table(job,default)))

#Pearson's Chi-squared test

```
data:  job and default
X-squared = 60.343, df = 11, p-value = 8.008e-09

               default
job               no  yes
  admin.         5097   74
  blue-collar    9531  201
  entrepreneur   1432   55
  housemaid      1218   22
  management     9294  164
  retired        2238   26
  self-employed  1546   33
  services       4079   75
  student         935    3
  technician     7467  130
  unemployed     1273   30
  unknown         286    2
               default
job                      no          yes
  admin.         1.127381e-01 1.636770e-03
  blue-collar    2.108115e-01 4.445821e-03
  entrepreneur   3.167371e-02 1.216518e-03
  housemaid      2.694035e-02 4.866072e-04
  management     2.055694e-01 3.627436e-03
  retired        4.950123e-02 5.750813e-04
  self-employed  3.419522e-02 7.299109e-04
  services       9.022141e-02 1.658888e-03
  student        2.068081e-02 6.635553e-05
  technician     1.651589e-01 2.875406e-03
```

Type your text

```
p-value = 8.008e-09
```
#Pearson's Chi-squared test

#since the p-value is < 2.2e-16 is less than the cu$t-off value of 0.05, we can reject the null hypothesis in favor of alternative hypothesis and conclude, that the variables,(job & default- p-value = 8.008e-09) are dependent to each other.

b. Is there any significant difference in duration of last call between people having housing loan or not?

with(bank_additional_full, chisq.test(duration,housing))

with(bank_additional_full, table(duration,housing))

OR

with(bank_additional_full, prop.table(table(duration, housing)))

#data: duration and housing

#X-squared = 3162.3, df = 3086, p-value = 0.1657

#P value is above 0.05#

```
Chi-squared approximation may be incorrect
        Pearson's Chi-squared test

data:  duration and housing
X-squared = 3162.3, df = 3086, p-value = 0.1657

        housing
duration no unknown yes
    0     1       0   3
    1     2       0   1
    2     1       0   0
    3     2       0   1
    4     2       0  10
    5    16       0  14
    6    13       0  24
    7    22       1  31
    8    27       3  39
    9    33       2  42
    10   36       1  35
    11   34       2  45
    12   24       2  39
    13   44       0  33
    14   25       2  43
    15   34       1  33
    16   35       1  44
    17   34       1  41
    18   43       1  40
```

19	24	3	34
20	29	0	32
21	30	1	42
22	35	2	39
23	21	5	39
24	30	2	32
25	25	2	38
26	23	1	37
27	31	1	33
28	25	0	24
29	31	0	36
30	17	2	35
31	28	3	32
32	20	1	21
33	19	0	27
34	31	3	34
35	34	3	30
36	42	1	39
37	32	2	36
38	26	2	32
39	32	0	39
40	26	2	38
41	33	2	55
42	35	1	45
43	31	2	46
44	33	3	49
45	28	3	39
46	37	3	37
47	25	3	45
48	43	3	46
49	49	3	44
50	41	3	52
51	41	1	59
52	48	4	50
53	49	0	44
54	46	2	58
55	48	4	69
56	51	2	57
57	41	3	65
58	44	0	66
59	53	6	72
60	47	1	57
61	49	6	68
62	49	0	59
63	55	1	71
64	63	2	74
65	57	2	64
66	57	3	48
67	65	6	76
68	68	5	67
69	63	3	64
70	59	3	67
71	76	9	67
72	63	7	91
73	74	8	85
74	64	3	69
75	65	0	73

76	67	0	86
77	56	3	87
78	56	3	86
79	71	0	67
80	69	3	76
81	69	6	72
82	57	3	94
83	59	6	84
84	66	6	59
85	85	1	84
86	55	3	70
87	70	3	89
88	64	5	81
89	68	3	82
90	73	3	94
91	75	2	70
92	72	7	77
93	76	6	69
94	66	2	68
95	63	5	80
96	86	2	67
97	79	3	76
98	70	2	72
99	55	3	71
100	61	2	82
101	62	3	80
102	64	4	73
103	68	1	78
104	70	10	81
105	62	4	79
106	67	4	88
107	60	6	84
108	62	2	73
109	66	1	91
110	71	3	68
111	72	2	86
112	61	3	80
113	62	1	79
114	74	6	76
115	58	1	76
116	62	5	59
117	64	2	68
118	49	1	81
119	72	4	79
120	52	2	68
121	61	4	76
122	69	4	84
123	69	6	74
124	65	5	94
125	67	5	80
126	62	2	88
127	68	3	75
128	70	4	73
129	64	2	70
130	62	4	76
131	69	5	60
132	56	3	53

133	57	4	82
134	74	1	58
135	78	9	69
136	77	8	83
137	61	6	56
138	51	4	64
139	87	5	63
140	64	2	79
141	52	4	62
142	57	1	58
143	63	5	65
144	64	2	71
145	59	3	68
146	54	3	45
147	56	7	68
148	51	6	66
149	51	0	68
150	49	2	82
151	56	3	70
152	49	2	64
153	47	6	67
154	62	8	66
155	63	5	68
156	47	5	76
157	71	4	70
158	43	4	82
159	65	4	71
160	48	4	85
161	57	3	69
162	46	3	57
163	46	3	64
164	55	4	71
165	66	3	67
166	73	1	68
167	44	4	57
168	59	1	71
169	50	3	53
170	37	3	60
171	59	3	53
172	53	2	68
173	51	3	71
174	57	2	63
175	48	2	65
176	39	4	58
177	47	3	56
178	59	5	63
179	46	7	55
180	58	3	56
181	49	1	63
182	39	5	57
183	39	1	50
184	56	3	54
185	56	3	55
186	37	1	48
187	54	2	52
188	58	1	55
189	63	2	49

190	54	2	40
191	54	2	53
192	49	4	51
193	45	3	58
194	40	0	54
195	31	3	54
196	40	0	48
197	50	0	57
198	56	2	49
199	49	2	44
200	60	1	47
201	41	2	67
202	45	4	47
203	50	3	40
204	47	2	42
205	41	0	46
206	50	1	41
207	54	2	58
208	46	3	41
209	45	2	47
210	42	2	56
211	50	1	57
212	44	3	46
213	47	3	40
214	39	2	50
215	38	4	49
216	33	3	44
217	41	2	49
218	36	1	39
219	40	0	45
220	37	1	48
221	45	1	43
222	52	2	39
223	38	0	31
224	30	1	42
225	42	3	45
226	29	3	61
227	39	4	39
228	28	1	44
229	26	3	40
230	36	6	40
231	34	0	45
232	38	1	36
233	26	1	34
234	37	4	37
235	29	3	30
236	27	1	44
237	31	1	34
238	32	1	43
239	35	2	55
240	31	4	52
241	36	1	37
242	23	3	32
243	34	0	45
244	34	0	41
245	49	2	40
246	39	3	37

247	31	2	52
248	24	3	43
249	33	2	41
250	40	1	39
251	34	1	48
252	36	1	43
253	31	1	33
254	27	4	41
255	38	1	33
256	25	1	39
257	36	3	32
258	29	1	38
259	33	2	36
260	23	0	38
261	29	1	32
262	35	3	34
263	37	1	36
264	31	0	30
265	23	0	43
266	26	0	32
267	33	1	38
268	35	4	32
269	23	0	31
270	38	1	18
271	27	5	25
272	26	5	36
273	23	0	37
274	23	1	32
275	21	1	34
276	23	2	24
277	33	1	29
278	27	1	25
279	19	2	22
280	27	0	30
281	30	0	31
282	21	4	31
283	31	1	30
284	27	0	26
285	29	1	30
286	19	0	29
287	25	0	21
288	24	2	31
289	23	2	28
290	29	1	26
291	29	2	28
292	18	0	35
293	28	0	34
294	24	1	35
295	35	4	28
296	33	1	23
297	28	3	32
298	29	1	25
299	22	1	24
300	18	0	28
301	35	2	25
302	20	1	25
303	16	0	23

```
    304  25       0  29
    305  26       1  35
    306  23       0  35
    307  18       0  19
    308  16       4  21
    309  16       1  27
    310  10       0  23
    311  24       5  16
    312  25       1  23
    313  20       3  27
    314  27       1  27
    315  18       2  19
    316  23       2  20
    317  21       3  33
    318  18       1  37
    319  28       2  16
    320  16       1  30
    321  14       0  21
    322  31       1  25
    323  20       1  27
    324  20       0  33
    325  17       0  25
    326  19       0  31
    327  24       1  16
    328  19       1  29
    329  25       1  34
    330  10       0  18
    331  18       1  16
    332  27       2  24
 [ reached getOption("max.print") -- omitted 1211 rows ]
        housing
duration           no      unknown          yes
    0    2.427892e-05 0.000000e+00 7.283675e-05
    1    4.855783e-05 0.000000e+00 2.427892e-05
    2    2.427892e-05 0.000000e+00 0.000000e+00
    3    4.855783e-05 0.000000e+00 2.427892e-05
    4    4.855783e-05 0.000000e+00 2.427892e-04
    5    3.884627e-04 0.000000e+00 3.399048e-04
    6    3.156259e-04 0.000000e+00 5.826940e-04
    7    5.341362e-04 2.427892e-05 7.526464e-04
    8    6.555307e-04 7.283675e-05 9.468777e-04
    9    8.012042e-04 4.855783e-05 1.019714e-03
    10   8.740410e-04 2.427892e-05 8.497621e-04
    11   8.254832e-04 4.855783e-05 1.092551e-03
    12   5.826940e-04 4.855783e-05 9.468777e-04
    13   1.068272e-03 0.000000e+00 8.012042e-04
    14   6.069729e-04 4.855783e-05 1.043993e-03
    15   8.254832e-04 2.427892e-05 8.012042e-04
    16   8.497621e-04 2.427892e-05 1.068272e-03
    17   8.254832e-04 2.427892e-05 9.954356e-04
    18   1.043993e-03 2.427892e-05 9.711566e-04
    19   5.826940e-04 7.283675e-05 8.254832e-04
    20   7.040886e-04 0.000000e+00 7.769253e-04
    21   7.283675e-04 2.427892e-05 1.019714e-03
    22   8.497621e-04 4.855783e-05 9.468777e-04
    23   5.098572e-04 1.213946e-04 9.468777e-04
    24   7.283675e-04 4.855783e-05 7.769253e-04
```

25	6.069729e-04	4.855783e-05	9.225988e-04
26	5.584151e-04	2.427892e-05	8.983199e-04
27	7.526464e-04	2.427892e-05	8.012042e-04
28	6.069729e-04	0.000000e+00	5.826940e-04
29	7.526464e-04	0.000000e+00	8.740410e-04
30	4.127416e-04	4.855783e-05	8.497621e-04
31	6.798097e-04	7.283675e-05	7.769253e-04
32	4.855783e-04	2.427892e-05	5.098572e-04
33	4.612994e-04	0.000000e+00	6.555307e-04
34	7.526464e-04	7.283675e-05	8.254832e-04
35	8.254832e-04	7.283675e-05	7.283675e-04
36	1.019714e-03	2.427892e-05	9.468777e-04
37	7.769253e-04	4.855783e-05	8.740410e-04
38	6.312518e-04	4.855783e-05	7.769253e-04
39	7.769253e-04	0.000000e+00	9.468777e-04
40	6.312518e-04	4.855783e-05	9.225988e-04
41	8.012042e-04	4.855783e-05	1.335340e-03
42	8.497621e-04	2.427892e-05	1.092551e-03
43	7.526464e-04	4.855783e-05	1.116830e-03
44	8.012042e-04	7.283675e-05	1.189667e-03
45	6.798097e-04	7.283675e-05	9.468777e-04
46	8.983199e-04	7.283675e-05	8.983199e-04
47	6.069729e-04	7.283675e-05	1.092551e-03
48	1.043993e-03	7.283675e-05	1.116830e-03
49	1.189667e-03	7.283675e-05	1.068272e-03
50	9.954356e-04	7.283675e-05	1.262504e-03
51	9.954356e-04	2.427892e-05	1.432456e-03
52	1.165388e-03	9.711566e-05	1.213946e-03
53	1.189667e-03	0.000000e+00	1.068272e-03
54	1.116830e-03	4.855783e-05	1.408177e-03
55	1.165388e-03	9.711566e-05	1.675245e-03
56	1.238225e-03	4.855783e-05	1.383898e-03
57	9.954356e-04	7.283675e-05	1.578130e-03
58	1.068272e-03	0.000000e+00	1.602408e-03
59	1.286783e-03	1.456735e-04	1.748082e-03
60	1.141109e-03	2.427892e-05	1.383898e-03
61	1.189667e-03	1.456735e-04	1.650966e-03
62	1.189667e-03	0.000000e+00	1.432456e-03
63	1.335340e-03	2.427892e-05	1.723803e-03
64	1.529572e-03	4.855783e-05	1.796640e-03
65	1.383898e-03	4.855783e-05	1.553851e-03
66	1.383898e-03	7.283675e-05	1.165388e-03
67	1.578130e-03	1.456735e-04	1.845198e-03
68	1.650966e-03	1.213946e-04	1.626687e-03
69	1.529572e-03	7.283675e-05	1.553851e-03
70	1.432456e-03	7.283675e-05	1.626687e-03
71	1.845198e-03	2.185102e-04	1.626687e-03
72	1.529572e-03	1.699524e-04	2.209381e-03
73	1.796640e-03	1.942313e-04	2.063708e-03
74	1.553851e-03	7.283675e-05	1.675245e-03
75	1.578130e-03	0.000000e+00	1.772361e-03
76	1.626687e-03	0.000000e+00	2.087987e-03
77	1.359619e-03	7.283675e-05	2.112266e-03
78	1.359619e-03	7.283675e-05	2.087987e-03
79	1.723803e-03	0.000000e+00	1.626687e-03
80	1.675245e-03	7.283675e-05	1.845198e-03
81	1.675245e-03	1.456735e-04	1.748082e-03

82	1.383898e-03	7.283675e-05	2.282218e-03
83	1.432456e-03	1.456735e-04	2.039429e-03
84	1.602408e-03	1.456735e-04	1.432456e-03
85	2.063708e-03	2.427892e-05	2.039429e-03
86	1.335340e-03	7.283675e-05	1.699524e-03
87	1.699524e-03	7.283675e-05	2.160824e-03
88	1.553851e-03	1.213946e-04	1.966592e-03
89	1.650966e-03	7.283675e-05	1.990871e-03
90	1.772361e-03	7.283675e-05	2.282218e-03
91	1.820919e-03	4.855783e-05	1.699524e-03
92	1.748082e-03	1.699524e-04	1.869477e-03
93	1.845198e-03	1.456735e-04	1.675245e-03
94	1.602408e-03	4.855783e-05	1.650966e-03
95	1.529572e-03	1.213946e-04	1.942313e-03
96	2.087987e-03	4.855783e-05	1.626687e-03
97	1.918034e-03	7.283675e-05	1.845198e-03
98	1.699524e-03	4.855783e-05	1.748082e-03
99	1.335340e-03	7.283675e-05	1.723803e-03
100	1.481014e-03	4.855783e-05	1.990871e-03
101	1.505293e-03	7.283675e-05	1.942313e-03
102	1.553851e-03	9.711566e-05	1.772361e-03
103	1.650966e-03	2.427892e-05	1.893755e-03
104	1.699524e-03	2.427892e-04	1.966592e-03
105	1.505293e-03	9.711566e-05	1.918034e-03
106	1.626687e-03	9.711566e-05	2.136545e-03
107	1.456735e-03	1.456735e-04	2.039429e-03
108	1.505293e-03	4.855783e-05	1.772361e-03
109	1.602408e-03	2.427892e-05	2.209381e-03
110	1.723803e-03	7.283675e-05	1.650966e-03
111	1.748082e-03	4.855783e-05	2.087987e-03
112	1.481014e-03	7.283675e-05	1.942313e-03
113	1.505293e-03	2.427892e-05	1.918034e-03
114	1.796640e-03	1.456735e-04	1.845198e-03
115	1.408177e-03	2.427892e-05	1.845198e-03
116	1.505293e-03	1.213946e-04	1.432456e-03
117	1.553851e-03	4.855783e-05	1.650966e-03
118	1.189667e-03	2.427892e-05	1.966592e-03
119	1.748082e-03	9.711566e-05	1.918034e-03
120	1.262504e-03	4.855783e-05	1.650966e-03
121	1.481014e-03	9.711566e-05	1.845198e-03
122	1.675245e-03	9.711566e-05	2.039429e-03
123	1.675245e-03	1.456735e-04	1.796640e-03
124	1.578130e-03	1.213946e-04	2.282218e-03
125	1.626687e-03	1.213946e-04	1.942313e-03
126	1.505293e-03	4.855783e-05	2.136545e-03
127	1.650966e-03	7.283675e-05	1.820919e-03
128	1.699524e-03	9.711566e-05	1.772361e-03
129	1.553851e-03	4.855783e-05	1.699524e-03
130	1.505293e-03	9.711566e-05	1.845198e-03
131	1.675245e-03	1.213946e-04	1.456735e-03
132	1.359619e-03	7.283675e-05	1.286783e-03
133	1.383898e-03	9.711566e-05	1.990871e-03
134	1.796640e-03	2.427892e-05	1.408177e-03
135	1.893755e-03	2.185102e-04	1.675245e-03
136	1.869477e-03	1.942313e-04	2.015150e-03
137	1.481014e-03	1.456735e-04	1.359619e-03
138	1.238225e-03	9.711566e-05	1.553851e-03

139	2.112266e-03	1.213946e-04	1.529572e-03
140	1.553851e-03	4.855783e-05	1.918034e-03
141	1.262504e-03	9.711566e-05	1.505293e-03
142	1.383898e-03	2.427892e-05	1.408177e-03
143	1.529572e-03	1.213946e-04	1.578130e-03
144	1.553851e-03	4.855783e-05	1.723803e-03
145	1.432456e-03	7.283675e-05	1.650966e-03
146	1.311061e-03	7.283675e-05	1.092551e-03
147	1.359619e-03	1.699524e-04	1.650966e-03
148	1.238225e-03	1.456735e-04	1.602408e-03
149	1.238225e-03	0.000000e+00	1.650966e-03
150	1.189667e-03	4.855783e-05	1.990871e-03
151	1.359619e-03	7.283675e-05	1.699524e-03
152	1.189667e-03	4.855783e-05	1.553851e-03
153	1.141109e-03	1.456735e-04	1.626687e-03
154	1.505293e-03	1.942313e-04	1.602408e-03
155	1.529572e-03	1.213946e-04	1.650966e-03
156	1.141109e-03	1.213946e-04	1.845198e-03
157	1.723803e-03	9.711566e-05	1.699524e-03
158	1.043993e-03	9.711566e-05	1.990871e-03
159	1.578130e-03	9.711566e-05	1.723803e-03
160	1.165388e-03	9.711566e-05	2.063708e-03
161	1.383898e-03	7.283675e-05	1.675245e-03
162	1.116830e-03	7.283675e-05	1.383898e-03
163	1.116830e-03	7.283675e-05	1.553851e-03
164	1.335340e-03	9.711566e-05	1.723803e-03
165	1.602408e-03	7.283675e-05	1.626687e-03
166	1.772361e-03	2.427892e-05	1.650966e-03
167	1.068272e-03	9.711566e-05	1.383898e-03
168	1.432456e-03	2.427892e-05	1.723803e-03
169	1.213946e-03	7.283675e-05	1.286783e-03
170	8.983199e-04	7.283675e-05	1.456735e-03
171	1.432456e-03	7.283675e-05	1.286783e-03
172	1.286783e-03	4.855783e-05	1.650966e-03
173	1.238225e-03	7.283675e-05	1.723803e-03
174	1.383898e-03	4.855783e-05	1.529572e-03
175	1.165388e-03	4.855783e-05	1.578130e-03
176	9.468777e-04	9.711566e-05	1.408177e-03
177	1.141109e-03	7.283675e-05	1.359619e-03
178	1.432456e-03	1.213946e-04	1.529572e-03
179	1.116830e-03	1.699524e-04	1.335340e-03
180	1.408177e-03	7.283675e-05	1.359619e-03
181	1.189667e-03	2.427892e-05	1.529572e-03
182	9.468777e-04	1.213946e-04	1.383898e-03
183	9.468777e-04	2.427892e-05	1.213946e-03
184	1.359619e-03	7.283675e-05	1.311061e-03
185	1.359619e-03	7.283675e-05	1.335340e-03
186	8.983199e-04	2.427892e-05	1.165388e-03
187	1.311061e-03	4.855783e-05	1.262504e-03
188	1.408177e-03	2.427892e-05	1.335340e-03
189	1.529572e-03	4.855783e-05	1.189667e-03
190	1.311061e-03	4.855783e-05	9.711566e-04
191	1.311061e-03	4.855783e-05	1.286783e-03
192	1.189667e-03	9.711566e-05	1.238225e-03
193	1.092551e-03	7.283675e-05	1.408177e-03
194	9.711566e-04	0.000000e+00	1.311061e-03
195	7.526464e-04	7.283675e-05	1.311061e-03

```
   196  9.711566e-04 0.000000e+00 1.165388e-03
   197  1.213946e-03 0.000000e+00 1.383898e-03
   198  1.359619e-03 4.855783e-05 1.189667e-03
   199  1.189667e-03 4.855783e-05 1.068272e-03
   200  1.456735e-03 2.427892e-05 1.141109e-03
   201  9.954356e-04 4.855783e-05 1.626687e-03
   202  1.092551e-03 9.711566e-05 1.141109e-03
   203  1.213946e-03 7.283675e-05 9.711566e-04
   204  1.141109e-03 4.855783e-05 1.019714e-03
   205  9.954356e-04 0.000000e+00 1.116830e-03
   206  1.213946e-03 2.427892e-05 9.954356e-04
   207  1.311061e-03 4.855783e-05 1.408177e-03
   208  1.116830e-03 7.283675e-05 9.954356e-04
   209  1.092551e-03 4.855783e-05 1.141109e-03
   210  1.019714e-03 4.855783e-05 1.359619e-03
   211  1.213946e-03 2.427892e-05 1.383898e-03
   212  1.068272e-03 7.283675e-05 1.116830e-03
   213  1.141109e-03 7.283675e-05 9.711566e-04
   214  9.468777e-04 4.855783e-05 1.213946e-03
   215  9.225988e-04 9.711566e-05 1.189667e-03
   216  8.012042e-04 7.283675e-05 1.068272e-03
   217  9.954356e-04 4.855783e-05 1.189667e-03
   218  8.740410e-04 2.427892e-05 9.468777e-04
   219  9.711566e-04 0.000000e+00 1.092551e-03
   220  8.983199e-04 2.427892e-05 1.165388e-03
   221  1.092551e-03 2.427892e-05 1.043993e-03
   222  1.262504e-03 4.855783e-05 9.468777e-04
   223  9.225988e-04 0.000000e+00 7.526464e-04
   224  7.283675e-04 2.427892e-05 1.019714e-03
   225  1.019714e-03 7.283675e-05 1.092551e-03
   226  7.040886e-04 7.283675e-05 1.481014e-03
   227  9.468777e-04 9.711566e-05 9.468777e-04
   228  6.798097e-04 2.427892e-05 1.068272e-03
   229  6.312518e-04 7.283675e-05 9.711566e-04
   230  8.740410e-04 1.456735e-04 9.711566e-04
   231  8.254832e-04 0.000000e+00 1.092551e-03
   232  9.225988e-04 2.427892e-05 8.740410e-04
   233  6.312518e-04 2.427892e-05 8.254832e-04
   234  8.983199e-04 9.711566e-05 8.983199e-04
   235  7.040886e-04 7.283675e-05 7.283675e-04
   236  6.555307e-04 2.427892e-05 1.068272e-03
   237  7.526464e-04 2.427892e-05 8.254832e-04
   238  7.769253e-04 2.427892e-05 1.043993e-03
   239  8.497621e-04 4.855783e-05 1.335340e-03
   240  7.526464e-04 9.711566e-05 1.262504e-03
   241  8.740410e-04 2.427892e-05 8.983199e-04
   242  5.584151e-04 7.283675e-05 7.769253e-04
   243  8.254832e-04 0.000000e+00 1.092551e-03
   244  8.254832e-04 0.000000e+00 9.954356e-04
   245  1.189667e-03 4.855783e-05 9.711566e-04
   246  9.468777e-04 7.283675e-05 8.983199e-04
   247  7.526464e-04 4.855783e-05 1.262504e-03
   248  5.826940e-04 7.283675e-05 1.043993e-03
   249  8.012042e-04 4.855783e-05 9.954356e-04
   250  9.711566e-04 2.427892e-05 9.468777e-04
   251  8.254832e-04 2.427892e-05 1.165388e-03
   252  8.740410e-04 2.427892e-05 1.043993e-03
```

253	7.526464e-04	2.427892e-05	8.012042e-04
254	6.555307e-04	9.711566e-05	9.954356e-04
255	9.225988e-04	2.427892e-05	8.012042e-04
256	6.069729e-04	2.427892e-05	9.468777e-04
257	8.740410e-04	7.283675e-05	7.769253e-04
258	7.040886e-04	2.427892e-05	9.225988e-04
259	8.012042e-04	4.855783e-05	8.740410e-04
260	5.584151e-04	0.000000e+00	9.225988e-04
261	7.040886e-04	2.427892e-05	7.769253e-04
262	8.497621e-04	7.283675e-05	8.254832e-04
263	8.983199e-04	2.427892e-05	8.740410e-04
264	7.526464e-04	0.000000e+00	7.283675e-04
265	5.584151e-04	0.000000e+00	1.043993e-03
266	6.312518e-04	0.000000e+00	7.769253e-04
267	8.012042e-04	2.427892e-05	9.225988e-04
268	8.497621e-04	9.711566e-05	7.769253e-04
269	5.584151e-04	0.000000e+00	7.526464e-04
270	9.225988e-04	2.427892e-05	4.370205e-04
271	6.555307e-04	1.213946e-04	6.069729e-04
272	6.312518e-04	1.213946e-04	8.740410e-04
273	5.584151e-04	0.000000e+00	8.983199e-04
274	5.584151e-04	2.427892e-05	7.769253e-04
275	5.098572e-04	2.427892e-05	8.254832e-04
276	5.584151e-04	4.855783e-05	5.826940e-04
277	8.012042e-04	2.427892e-05	7.040886e-04
278	6.555307e-04	2.427892e-05	6.069729e-04
279	4.612994e-04	4.855783e-05	5.341362e-04
280	6.555307e-04	0.000000e+00	7.283675e-04
281	7.283675e-04	0.000000e+00	7.526464e-04
282	5.098572e-04	9.711566e-05	7.526464e-04
283	7.526464e-04	2.427892e-05	7.283675e-04
284	6.555307e-04	0.000000e+00	6.312518e-04
285	7.040886e-04	2.427892e-05	7.283675e-04
286	4.612994e-04	0.000000e+00	7.040886e-04
287	6.069729e-04	0.000000e+00	5.098572e-04
288	5.826940e-04	4.855783e-05	7.526464e-04
289	5.584151e-04	4.855783e-05	6.798097e-04
290	7.040886e-04	2.427892e-05	6.312518e-04
291	7.040886e-04	4.855783e-05	6.798097e-04
292	4.370205e-04	0.000000e+00	8.497621e-04
293	6.798097e-04	0.000000e+00	8.254832e-04
294	5.826940e-04	2.427892e-05	8.497621e-04
295	8.497621e-04	9.711566e-05	6.798097e-04
296	8.012042e-04	2.427892e-05	5.584151e-04
297	6.798097e-04	7.283675e-05	7.769253e-04
298	7.040886e-04	2.427892e-05	6.069729e-04
299	5.341362e-04	2.427892e-05	5.826940e-04
300	4.370205e-04	0.000000e+00	6.798097e-04
301	8.497621e-04	4.855783e-05	6.069729e-04
302	4.855783e-04	2.427892e-05	6.069729e-04
303	3.884627e-04	0.000000e+00	5.584151e-04
304	6.069729e-04	0.000000e+00	7.040886e-04
305	6.312518e-04	2.427892e-05	8.497621e-04
306	5.584151e-04	0.000000e+00	8.497621e-04
307	4.370205e-04	0.000000e+00	4.612994e-04
308	3.884627e-04	9.711566e-05	5.098572e-04
309	3.884627e-04	2.427892e-05	6.555307e-04

```
    310  2.427892e-04 0.000000e+00 5.584151e-04
    311  5.826940e-04 1.213946e-04 3.884627e-04
    312  6.069729e-04 2.427892e-05 5.584151e-04
    313  4.855783e-04 7.283675e-05 6.555307e-04
    314  6.555307e-04 2.427892e-05 6.555307e-04
    315  4.370205e-04 4.855783e-05 4.612994e-04
    316  5.584151e-04 4.855783e-05 4.855783e-04
    317  5.098572e-04 7.283675e-05 8.012042e-04
    318  4.370205e-04 2.427892e-05 8.983199e-04
    319  6.798097e-04 4.855783e-05 3.884627e-04
    320  3.884627e-04 2.427892e-05 7.283675e-04
    321  3.399048e-04 0.000000e+00 5.098572e-04
    322  7.526464e-04 2.427892e-05 6.069729e-04
    323  4.855783e-04 2.427892e-05 6.555307e-04
    324  4.855783e-04 0.000000e+00 8.012042e-04
    325  4.127416e-04 0.000000e+00 6.069729e-04
    326  4.612994e-04 0.000000e+00 7.526464e-04
    327  5.826940e-04 2.427892e-05 3.884627e-04
    328  4.612994e-04 2.427892e-05 7.040886e-04
    329  6.069729e-04 2.427892e-05 8.254832e-04
    330  2.427892e-04 0.000000e+00 4.370205e-04
    331  4.370205e-04 2.427892e-05 3.884627e-04
    332  6.555307e-04 4.855783e-05 5.826940e-04
 [ reached getOption("max.print") -- omitted 1211 rows ]
```

Is there any association between consumer price index and consumer?

#Is there any association between consumer price index and consumer?

with(bank_additional_full, chisq.test(cons.price.idx,cons.conf.idx))

with(bank_additional_full, table(cons.price.idx,cons.conf.idx))

OR

with(bank_additional_full, prop.table(table(cons.price.idx,cons.conf.idx)))

#p-value < 2.2e-16 and it is very much less than 0.05.we can reject the null hypothesis in favor of alternative hypothesis and conclude, that the variables, (job & Marital-p-value < 2.2e-16),(con.price.idx , consumer- are dependent to each other.

```
Chi-squared approximation may be incorrect
        Pearson's Chi-squared test

data:  cons.price.idx and cons.conf.idx
X-squared = 1029700, df = 625, p-value < 2.2e-16

               cons.conf.idx
cons.price.idx -50.8  -50 -49.5 -47.1 -46.2 -45.9 -42.7  -42 -41.8 -40.8 -
40.4
```

```
          92.201     0    0     0     0     0     0     0    0     0     0
0
          92.379     0    0     0     0     0     0     0    0     0     0
0
          92.431     0    0     0     0     0     0     0    0     0     0
0
          92.469     0    0     0     0     0     0     0    0     0     0
0
          92.649     0    0     0     0     0     0     0    0     0     0
0
          92.713     0    0     0     0     0     0     0    0     0     0
0
          92.756     0    0     0     0     0    10     0    0     0     0
0
          92.843     0  282     0     0     0     0     0    0     0     0
0
          92.893     0    0     0     0  5794     0     0    0     0     0
0
          92.963     0    0     0     0     0     0     0    0     0   715
0
          93.075     0    0     0  2458     0     0     0    0     0     0
0
          93.2       0    0     0     0     0     0     0 3616     0     0
0
          93.369     0    0     0     0     0     0     0    0     0     0
0
          93.444     0    0     0     0     0     0     0    0     0     0
0
          93.749     0    0     0     0     0     0     0    0     0     0
0
          93.798     0    0     0     0     0     0     0    0     0     0
67
          93.876     0    0     0     0     0     0     0    0     0     0
0
          93.918     0    0     0     0     0     0  6685    0     0     0
0
          93.994     0    0     0     0     0     0     0    0     0     0
0
          94.027     0    0     0     0     0     0     0    0     0     0
0
          94.055     0    0     0     0     0     0     0    0     0     0
0
          94.199     0    0     0     0     0     0     0    0     0     0
0
          94.215     0    0     0     0     0     0     0    0     0     0
0
          94.465     0    0     0     0     0     0     0    0  4374     0
0
          94.601     0    0   204     0     0     0     0    0     0     0
0
          94.767   128    0     0     0     0     0     0    0     0     0
0
                cons.conf.idx
cons.price.idx -40.3  -40 -39.8 -38.3 -37.5 -36.4 -36.1 -34.8 -34.6 -33.6  -
33
          92.201     0    0     0     0     0     0     0     0     0     0
0
          92.379     0    0     0     0     0     0     0     0     0     0
0
          92.431     0    0     0     0     0     0     0     0     0     0
0
          92.469     0    0     0     0     0     0     0     0     0   178
0
```

```
          92.649     0    0      0      0      0      0      0      0      0      0
0
          92.713     0    0      0      0      0      0      0      0      0      0
172
          92.756     0    0      0      0      0      0      0      0      0      0
0
          92.843     0    0      0      0      0      0      0      0      0      0
0
          92.893     0    0      0      0      0      0      0      0      0      0
0
          92.963     0    0      0      0      0      0      0      0      0      0
0
          93.075     0    0      0      0      0      0      0      0      0      0
0
          93.2       0    0      0      0      0      0      0      0      0      0
0
          93.369     0    0      0      0      0      0      0    264      0      0
0
          93.444     0    0      0      0      0      0   5175      0      0      0
0
          93.749     0    0      0      0      0      0      0      0    174      0
0
          93.798     0    0      0      0      0      0      0      0      0      0
0
          93.876     0  212      0      0      0      0      0      0      0      0
0
          93.918     0    0      0      0      0      0      0      0      0      0
0
          93.994     0    0      0      0      0   7763      0      0      0      0
0
          94.027     0    0      0    233      0      0      0      0      0      0
0
          94.055     0    0    229      0      0      0      0      0      0      0
0
          94.199     0    0      0      0    303      0      0      0      0      0
0
          94.215   311    0      0      0      0      0      0      0      0      0
0
          94.465     0    0      0      0      0      0      0      0      0      0
0
          94.601     0    0      0      0      0      0      0      0      0      0
0
          94.767     0    0      0      0      0      0      0      0      0      0
0
                cons.conf.idx
cons.price.idx -31.4 -30.1 -29.8 -26.9
          92.201   770     0      0      0
          92.379     0     0    267      0
          92.431     0     0      0    447
          92.469     0     0      0      0
          92.649     0   357      0      0
          92.713     0     0      0      0
          92.756     0     0      0      0
          92.843     0     0      0      0
          92.893     0     0      0      0
          92.963     0     0      0      0
          93.075     0     0      0      0
          93.2       0     0      0      0
          93.369     0     0      0      0
          93.444     0     0      0      0
          93.749     0     0      0      0
          93.798     0     0      0      0
          93.876     0     0      0      0
          93.918     0     0      0      0
```

```
        93.994     0     0     0     0
        94.027     0     0     0     0
        94.055     0     0     0     0
        94.199     0     0     0     0
        94.215     0     0     0     0
        94.465     0     0     0     0
        94.601     0     0     0     0
        94.767     0     0     0     0
              cons.conf.idx
cons.price.idx        -50.8          -50        -49.5        -47.1        -
46.2
        92.201 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.379 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.431 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.469 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.649 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.713 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.756 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.843 0.0000000000 0.0068466544 0.0000000000 0.0000000000
0.0000000000
        92.893 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.1406720404
        92.963 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.075 0.0000000000 0.0000000000 0.0000000000 0.0596775760
0.0000000000
        93.2   0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.369 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.444 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.749 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.798 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.876 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.918 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.994 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.027 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.055 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.199 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.215 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.465 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.601 0.0000000000 0.0000000000 0.0049528989 0.0000000000
0.0000000000
        94.767 0.0031077013 0.0000000000 0.0000000000 0.0000000000
0.0000000000
              cons.conf.idx
```

```
cons.price.idx        -45.9        -42.7          -42        -41.8        -
40.8
        92.201 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.379 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.431 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.469 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.649 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.713 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.756 0.0002427892 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.843 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.893 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.963 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0173594251
        93.075 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.2   0.0000000000 0.0000000000 0.0877925609 0.0000000000
0.0000000000
        93.369 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.444 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.749 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.798 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.876 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.918 0.0000000000 0.1623045547 0.0000000000 0.0000000000
0.0000000000
        93.994 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.027 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.055 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.199 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.215 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.465 0.0000000000 0.0000000000 0.0000000000 0.1061959794
0.0000000000
        94.601 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.767 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
             cons.conf.idx
cons.price.idx        -40.4        -40.3          -40        -39.8        -
38.3
        92.201 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.379 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.431 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
```

```
        92.469 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.649 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.713 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.756 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.843 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.893 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.963 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.075 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.2   0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.369 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.444 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.749 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.798 0.0016266874 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.876 0.0000000000 0.0000000000 0.0051471302 0.0000000000
0.0000000000
        93.918 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.994 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.027 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0056569875
        94.055 0.0000000000 0.0000000000 0.0000000000 0.0055598718
0.0000000000
        94.199 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.215 0.0000000000 0.0075507429 0.0000000000 0.0000000000
0.0000000000
        94.465 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.601 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.767 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
             cons.conf.idx
cons.price.idx        -37.5        -36.4        -36.1        -34.8        -
34.6
        92.201 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.379 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.431 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.469 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.649 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.713 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.756 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
```

```
        92.843 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.893 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.963 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.075 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.2   0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.369 0.0000000000 0.0000000000 0.0000000000 0.0064096339
0.0000000000
        93.444 0.0000000000 0.0000000000 0.1256433913 0.0000000000
0.0000000000
        93.749 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0042245314
        93.798 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.876 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.918 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.994 0.0000000000 0.1884772264 0.0000000000 0.0000000000
0.0000000000
        94.027 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.055 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.199 0.0073565116 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.215 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.465 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.601 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.767 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
             cons.conf.idx
cons.price.idx        -33.6          -33        -31.4        -30.1        -
29.8
        92.201 0.0000000000 0.0000000000 0.0186947655 0.0000000000
0.0000000000
        92.379 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0064824706
        92.431 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.469 0.0043216471 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.649 0.0000000000 0.0000000000 0.0000000000 0.0086675731
0.0000000000
        92.713 0.0000000000 0.0041759736 0.0000000000 0.0000000000
0.0000000000
        92.756 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.843 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.893 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        92.963 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.075 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
```

```
        93.2   0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.369 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.444 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.749 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.798 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.876 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.918 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        93.994 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.027 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.055 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.199 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.215 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.465 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.601 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
        94.767 0.0000000000 0.0000000000 0.0000000000 0.0000000000
0.0000000000
              cons.conf.idx
cons.price.idx        -26.9
        92.201 0.0000000000
        92.379 0.0000000000
        92.431 0.0108526755
        92.469 0.0000000000
        92.649 0.0000000000
        92.713 0.0000000000
        92.756 0.0000000000
        92.843 0.0000000000
        92.893 0.0000000000
        92.963 0.0000000000
        93.075 0.0000000000
        93.2   0.0000000000
        93.369 0.0000000000
        93.444 0.0000000000
        93.749 0.0000000000
        93.798 0.0000000000
        93.876 0.0000000000
        93.918 0.0000000000
        93.994 0.0000000000
        94.027 0.0000000000
        94.055 0.0000000000
        94.199 0.0000000000
        94.215 0.0000000000
        94.465 0.0000000000
        94.601 0.0000000000
        94.767 0.0000000000
```

Is the employment variation rate consistent across job types?

```
#
with(bank_additional_full, chisq.test( job,emp.var.rate))
with(bank_additional_full, table( job,emp.var.rate) )
# OR
with(bank_additional_full, prop.table(table( job,emp.var.rate)))

#p-value < 2.2e-16 is very much less than 0.05
```

```
        Pearson's Chi-squared test

data:  job and emp.var.rate
X-squared = 4676.8, df = 99, p-value < 2.2e-16

               emp.var.rate
job             -3.4   -3 -2.9 -1.8 -1.7 -1.1 -0.2 -0.1  1.1  1.4
  admin.         321   47  562 2231  246  187    3  940 1601 4284
  blue-collar     64    9   99 2519   58   33    3  575 2295 3599
  entrepreneur    24    1   38  306   14    7    0  265  289  512
  housemaid       32    9   41  120   18   16    1   70  229  524
  management      98   12  121  593   47   38    0  522  553  940
  retired        193   33  181  338   96   83    0   72  215  509
  self-employed   40    6   60  287   24   12    0  187  253  552
  services        32    2   88 1040   47   40    0  311  932 1477
  student         62   20  144  311   72   73    0   21   66  106
  technician     145   22  234 1243  110  115    2  575 1060 3237
  unemployed      44    9   76  164   31   28    1  141  171  349
  unknown         16    2   19   32   10    3    0    4   99  145
               emp.var.rate
job                    -3.4           -3         -2.9         -1.8         -
1.7
  admin.         7.793532e-03 1.141109e-03 1.364475e-02 5.416626e-02
5.972613e-03
  blue-collar    1.553851e-03 2.185102e-04 2.403613e-03 6.115859e-02
1.408177e-03
  entrepreneur   5.826940e-04 2.427892e-05 9.225988e-04 7.429348e-03
3.399048e-04
  housemaid      7.769253e-04 2.185102e-04 9.954356e-04 2.913470e-03
4.370205e-04
  management     2.379334e-03 2.913470e-04 2.937749e-03 1.439740e-02
1.141109e-03
  retired        4.685831e-03 8.012042e-04 4.394484e-03 8.206274e-03
2.330776e-03
  self-employed  9.711566e-04 1.456735e-04 1.456735e-03 6.968049e-03
5.826940e-04
  services       7.769253e-04 4.855783e-05 2.136545e-03 2.525007e-02
1.141109e-03
  student        1.505293e-03 4.855783e-04 3.496164e-03 7.550743e-03
1.748082e-03
  technician     3.520443e-03 5.341362e-04 5.681266e-03 3.017869e-02
2.670681e-03
  unemployed     1.068272e-03 2.185102e-04 1.845198e-03 3.981742e-03
7.526464e-04
```

```
  unknown       3.884627e-04 4.855783e-05 4.612994e-04 7.769253e-04
2.427892e-04
              emp.var.rate
job                   -1.1         -0.2         -0.1          1.1
1.4
  admin.        4.540157e-03 7.283675e-05 2.282218e-02 3.887054e-02
1.040109e-01
  blue-collar   8.012042e-04 7.283675e-05 1.396038e-02 5.572011e-02
8.737982e-02
  entrepreneur  1.699524e-04 0.000000e+00 6.433913e-03 7.016607e-03
1.243081e-02
  housemaid     3.884627e-04 2.427892e-05 1.699524e-03 5.559872e-03
1.272215e-02
  management    9.225988e-04 0.000000e+00 1.267359e-02 1.342624e-02
2.282218e-02
  retired       2.015150e-03 0.000000e+00 1.748082e-03 5.219967e-03
1.235797e-02
  self-employed 2.913470e-04 0.000000e+00 4.540157e-03 6.142566e-03
1.340196e-02
  services      9.711566e-04 0.000000e+00 7.550743e-03 2.262795e-02
3.585996e-02
  student       1.772361e-03 0.000000e+00 5.098572e-04 1.602408e-03
2.573565e-03
  technician    2.792075e-03 4.855783e-05 1.396038e-02 2.573565e-02
7.859085e-02
  unemployed    6.798097e-04 2.427892e-05 3.423327e-03 4.151695e-03
8.473342e-03
  unknown       7.283675e-05 0.000000e+00 9.711566e-05 2.403613e-03
3.520443e-03
```

Is the employment variation rate same across education?
Which group is more confident?

```
with(bank_additional_full, chisq.test( education,emp.var.rate))
with(bank_additional_full, table( education, emp.var.rate) )
# OR
with(bank_additional_full, prop.table(table( education,emp.var.rate)))
```

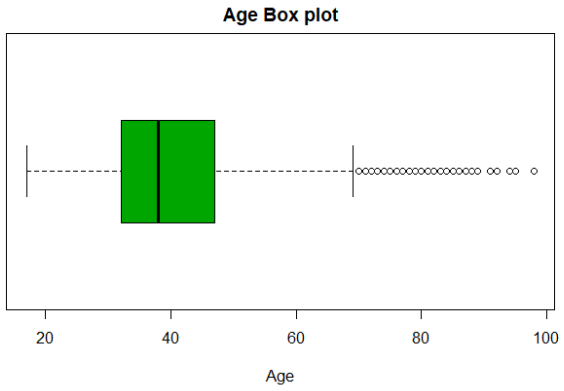
```
Pearson's Chi-squared test

data:  education and emp.var.rate
X-squared = 1451.6, df = 63, p-value < 2.2e-16

                    emp.var.rate
education            -3.4   -3 -2.9 -1.8 -1.7 -1.1 -0.2 -0.1  1.1  1.4
  basic.4y            141   17  106  843   75   59    3  238  993 1701
  basic.6y             36    0   35  584   18    9    0  154  592  864
  basic.9y             69   16  110 1628   53   27    0  504 1428 2210
  high.school         216   36  358 2366  183  143    4  809 1857 3543
  illiterate            0    0    3    3    0    0    0    3    2    7
  professional.course 131   19  196 1041   93  113    3  470  887 2290
  university.degree   411   70  758 2403  301  242    0 1414 1627 4942
```

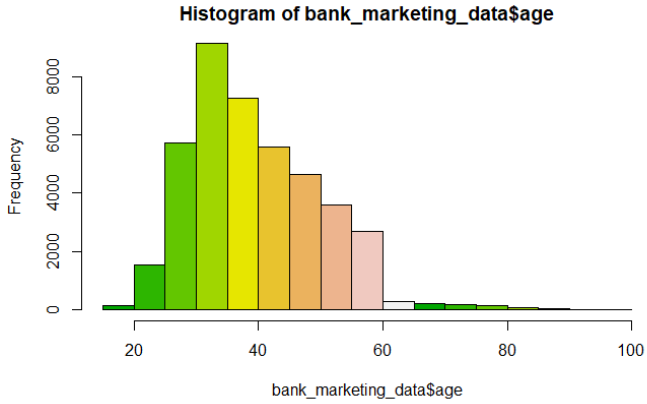
```
  unknown               67   14   97  316   50   42    0   91  377  677
                   emp.var.rate
education                  -3.4           -3         -2.9         -1.8
  basic.4y          3.423327e-03 4.127416e-04 2.573565e-03 2.046713e-02
  basic.6y          8.740410e-04 0.000000e+00 8.497621e-04 1.417889e-02
  basic.9y          1.675245e-03 3.884627e-04 2.670681e-03 3.952608e-02
  high.school       5.244246e-03 8.740410e-04 8.691852e-03 5.744392e-02
  illiterate        0.000000e+00 0.000000e+00 7.283675e-05 7.283675e-05
  professional.course 3.180538e-03 4.612994e-04 4.758668e-03 2.527435e-02
  university.degree 9.978635e-03 1.699524e-03 1.840342e-02 5.834224e-02
  unknown           1.626687e-03 3.399048e-04 2.355055e-03 7.672138e-03
                   emp.var.rate
education                  -1.7         -1.1         -0.2         -0.1
  basic.4y          1.820919e-03 1.432456e-03 7.283675e-05 5.778382e-03
  basic.6y          4.370205e-04 2.185102e-04 0.000000e+00 3.738953e-03
  basic.9y          1.286783e-03 6.555307e-04 0.000000e+00 1.223657e-02
  high.school       4.443042e-03 3.471885e-03 9.711566e-05 1.964164e-02
  illiterate        0.000000e+00 0.000000e+00 0.000000e+00 7.283675e-05
  professional.course 2.257939e-03 2.743518e-03 7.283675e-05 1.141109e-02
  university.degree 7.307954e-03 5.875498e-03 0.000000e+00 3.433039e-02
  unknown           1.213946e-03 1.019714e-03 0.000000e+00 2.209381e-03
                   emp.var.rate
education                   1.1          1.4
  basic.4y          2.410896e-02 4.129844e-02
  basic.6y          1.437312e-02 2.097698e-02
  basic.9y          3.467029e-02 5.365640e-02
  high.school       4.508595e-02 8.602020e-02
  illiterate        4.855783e-05 1.699524e-04
  professional.course 2.153540e-02 5.559872e-02
  university.degree 3.950180e-02 1.199864e-01
  unknown           9.153151e-03 1.643683e-02
```

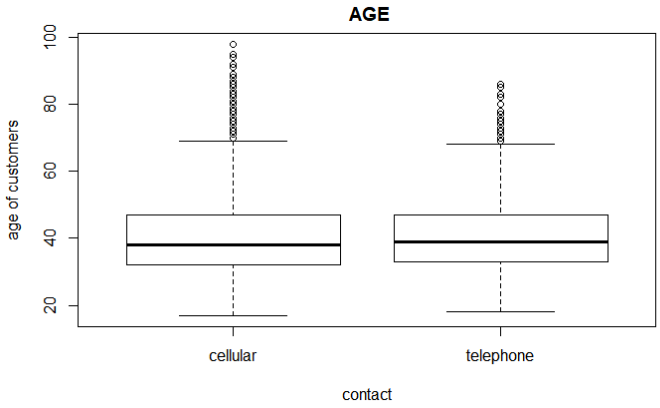
```
bank_marketing_data <- read_delim("C:/Users/Seshan/Desktop/bank_marketing_data.csv",
";", escape_double = FALSE, trim_ws = TRUE)
head(bank_marketing_data)

# We look at difference between mean and median in summary if it's more there might be
outliers
boxplot(bank_marketing_data$age, main="Age Box plot",yaxt="n", xlab="Age",
horizontal=TRUE, col=terrain.colors(2))
# By plotting histogram we can ensure if there are outliers or not
## DATA VISUALISATION
## Use Box plots (Only for continuous variables)- To Check Ouliers
boxplot(bank_marketing_data$age~bank_marketing_data$contact, main=" AGE",ylab="age of
customers",xlab="contact")
boxplot(bank_marketing_data$age~bank_marketing_data$job, main=" AGE",ylab="age of
customers",xlab="job")
boxplot(bank_marketing_data$age~bank_marketing_data$education, main=" AGE",ylab="age
of customers",xlab="education")
boxplot(bank_marketing_data$age~bank_marketing_data$marital, main=" AGE",ylab="age of
customers",xlab="marital")
```

Barplots for Categorical Variables
```
barplot(table(bank_marketing_data$job),col="red",main="JOB")
barplot(table(bank_marketing_data$marital),col="green",main="Marital")
barplot(table(bank_marketing_data$education),col="red",main="Education")
barplot(table(bank_marketing_data$emp.var.rate ),col="red",main="emp.var.rate")
hist(bank_marketing_data$age,col=terrain.colors(10))
```

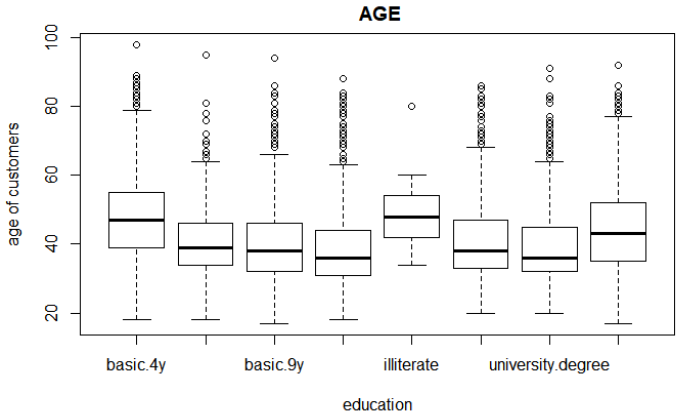
#Correlation Analysis What we saw in the box plot can be emphasized by correlation plot, It can tell if predictor is a good predictor or not a good predictor. This analysis can help us decide if we can drop some columns/predictors depending upon its correlation with the outcome variable.
```
library(psych)
pairs.panels(bank_marketing_data[, c(1:8,17)])
pairs.panels(bank_marketing_data[, c(9:17)])
pairs.panels(bank_marketing_data[, c(1:8,19)])
```

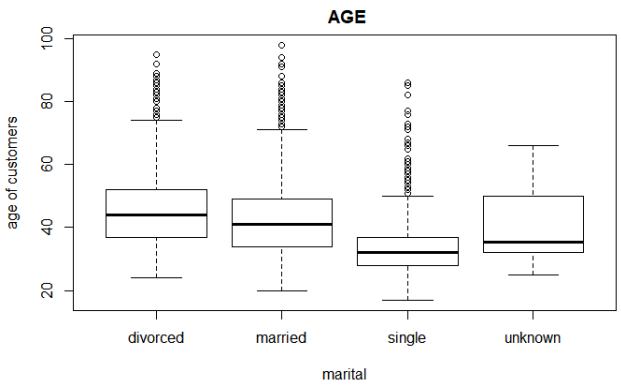


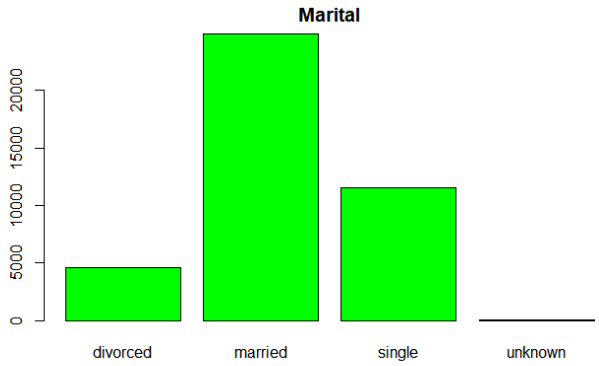


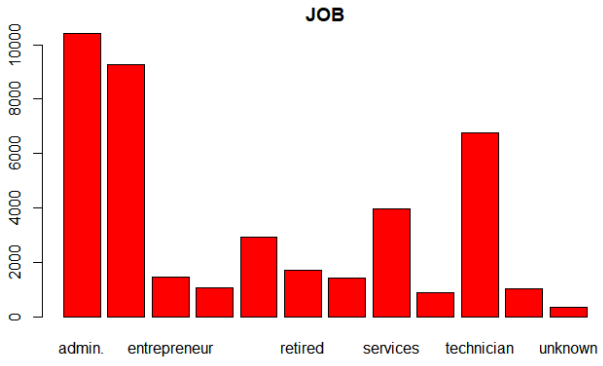

AGE
age of customers
20
40
60
80
100
cellular
telephone
contact

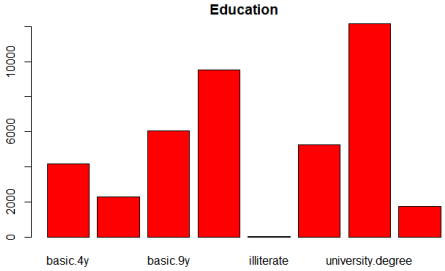

AGE
age of customers
20
40
60
80
100
admin.
entrepreneur
retired
services
technician
unknown
job

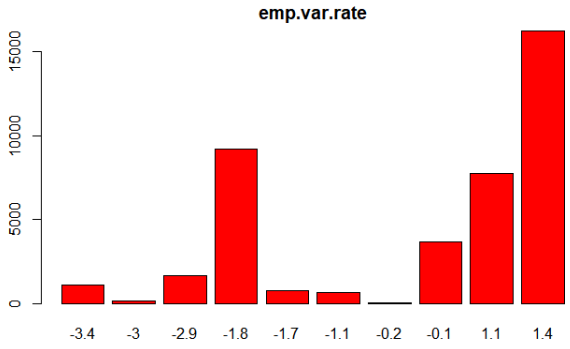

AGE
age of customers
20
40
60
80
100
basic.4y
basic.9y
illiterate
university.degree
education

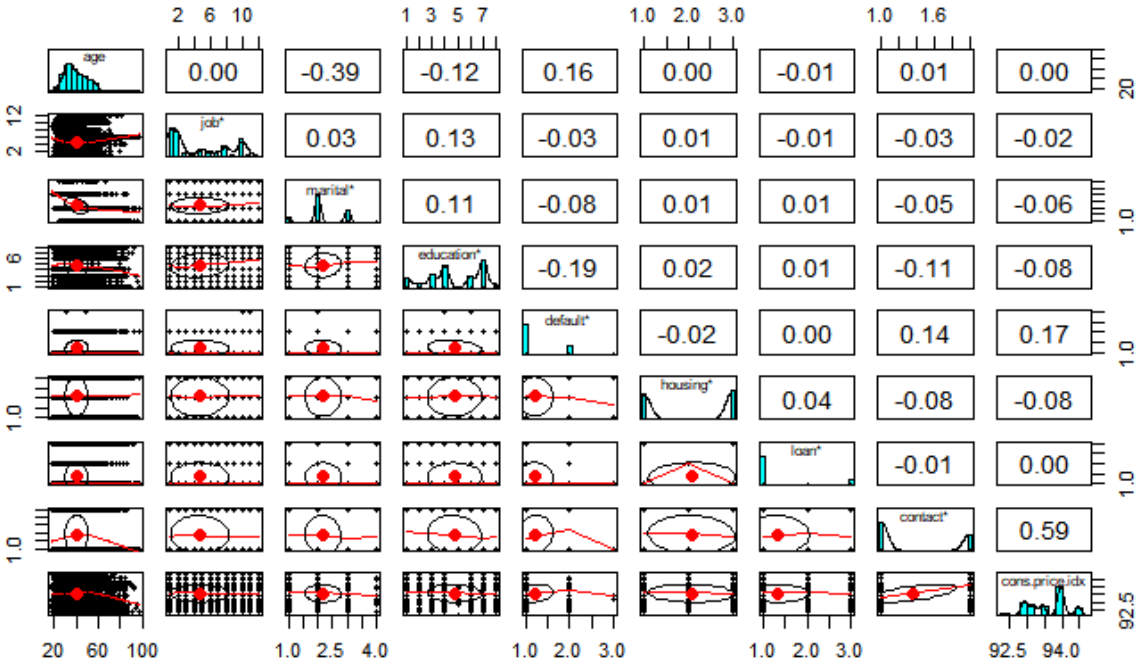

AGE
age of customers
20
40
60
80
100
divorced
married
single
unknown
marital

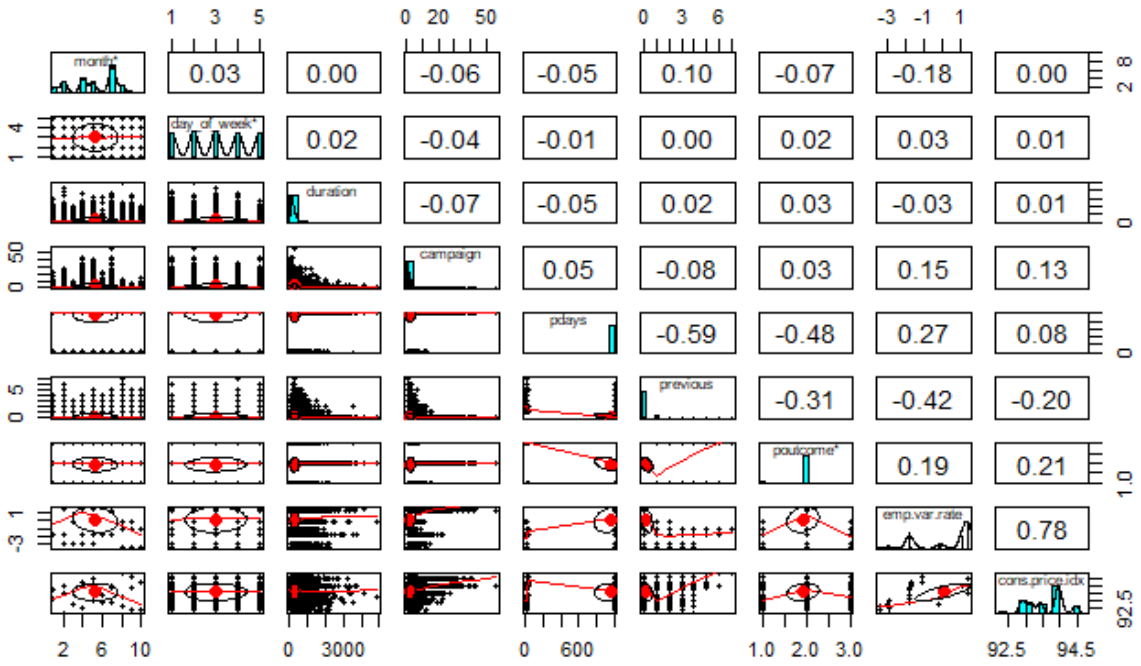

Marital
0
5000
10000
15000
20000
divorced
married
single
unknown

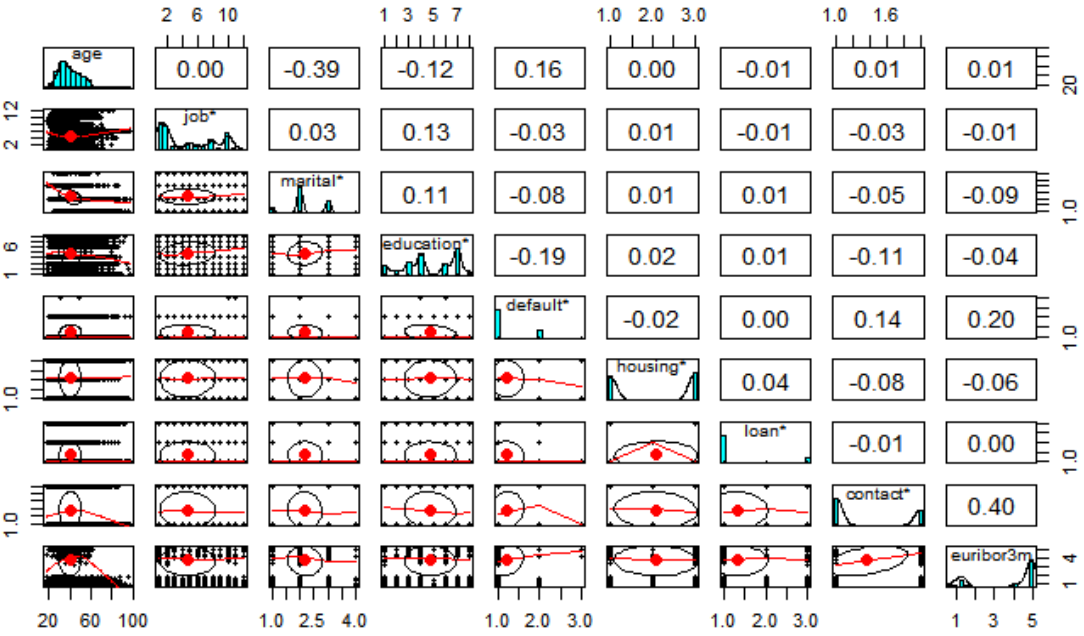

JOB
0
2000
4000
6000
8000
10000
admin.
entrepreneur
retired
services
technician
unknown


Education
0
2000
6000
10000
basic.4y
basic.9y
illiterate
university.degree


emp.var.rate
0
5000
10000
15000
-3.4
-3
-2.9
-1.8
-1.7
-1.1
-0.2
-0.1
1.1
1.4


age
job*
marital*
education*
default*
housing*
loan*
contact*
cons.price.idx
0.00
-0.39
-0.12
0.16
0.00
-0.01
0.01
0.00
0.03
0.13
-0.03
0.01
-0.01
-0.03
-0.02
0.11
-0.08
0.01
0.01
-0.05
-0.06
-0.19
0.02
0.01
-0.11
-0.08
-0.02
0.00
0.14
0.17
0.04
-0.08
-0.08
-0.01
0.00
0.59
20
60
100
1.0
2.5
4.0
92.5
94.0





Subset Selection/ Feature-space reduction: Features-space can be reduced by selecting subsets based upon correlation values obtained

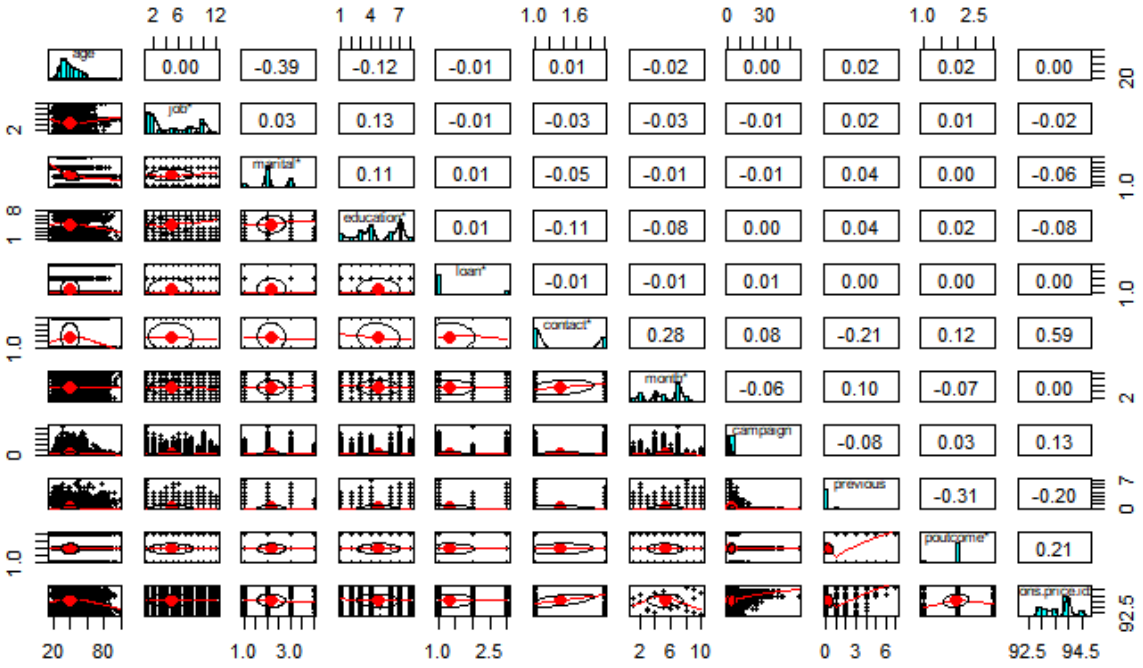
```
##################Subset Selection################## lib
bank_marketing_data_sub<-bank_marketing_data[, c(1:4,7:9,12,14,15,17)]
str(bank_marketing_data_sub)
pairs.panels(bank_marketing_data_sub)
```

#3.4. Data transformation and Binning We do data transformation and binning for better modeling. We convert categorical variable into numerical using binning.
##################Binning and Data Transformation##################
#bank_marketing_data_sub$age <- cut(bank_marketing_data_sub$age, c(1,20,40,60,100))

#bank_marketing_data_sub$is_divorced <- ifelse(bank_marketing_data_sub$marital == "divorced", 1, 0)
bank_marketing_data_sub$is_nr.employed <- ifelse(bank_marketing_data_sub$education == "employed", 1, 0)

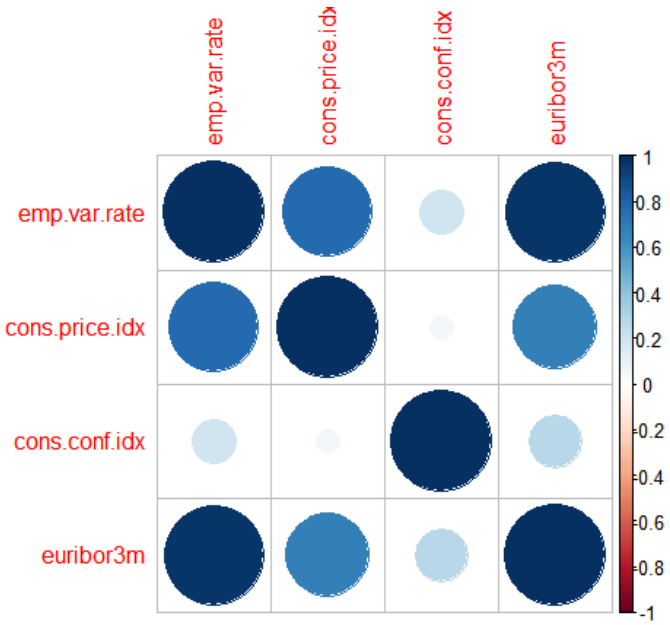
#bank_marketing_data_sub$is_single <- ifelse(bank_marketing_data_sub$marital == "single", 1, 0)
bank_marketing_data_sub$nr.employed <- NULL

str(bank_marketing_data_sub)

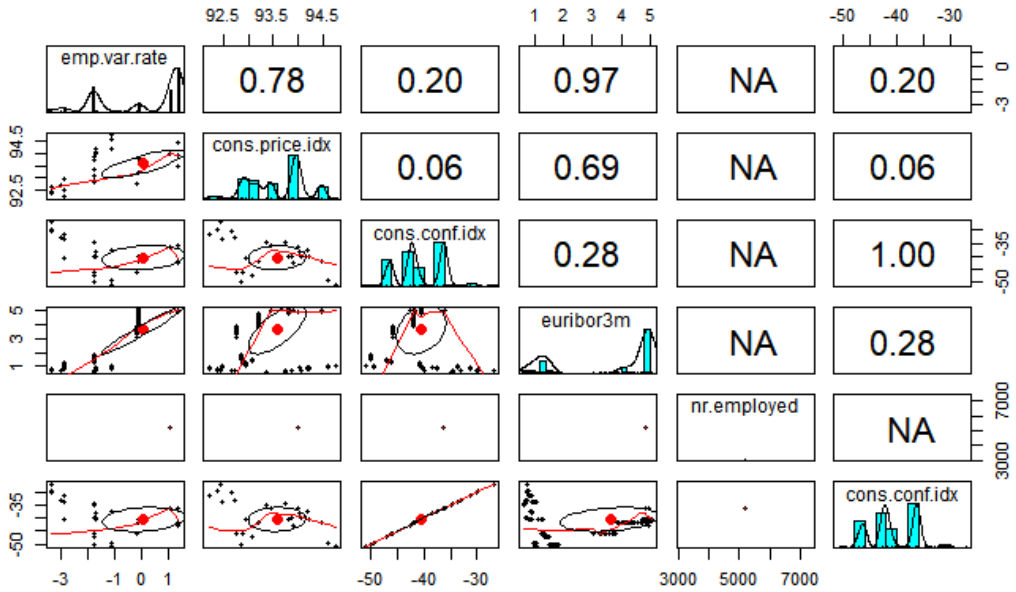


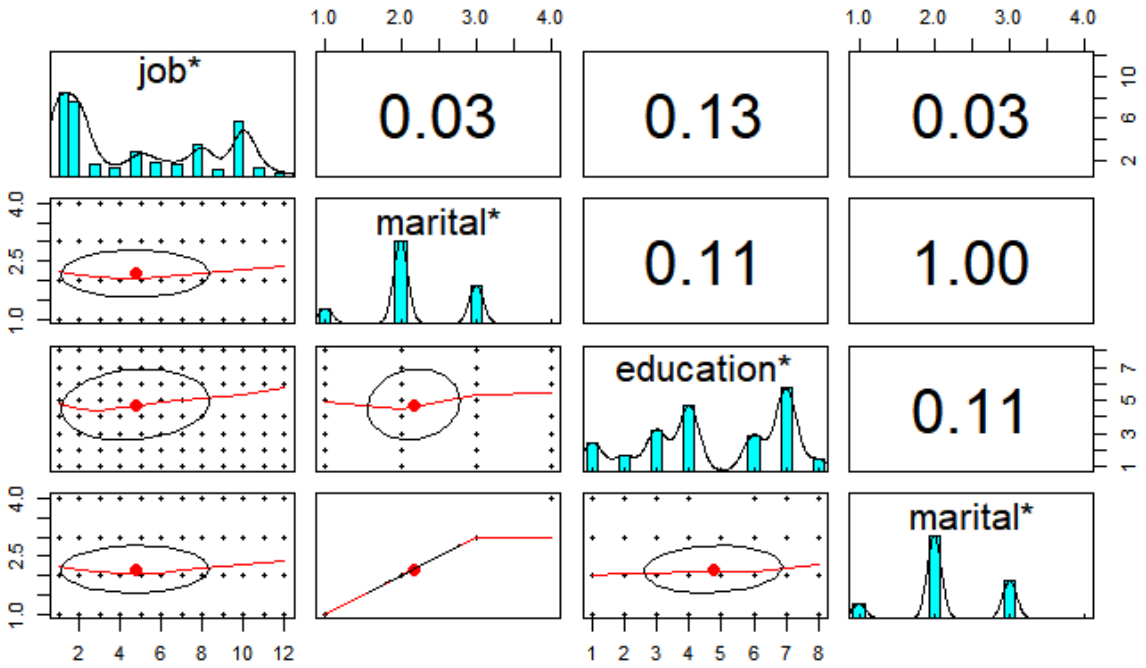
#scatter.smooth(x=bank_marketing_data$job, y=bank_marketing_data$emp.var.rate, main="emp.var.rate ~ job") # scatterplot
# load library
library(corrplot)
# load the data
data<-bank_marketing_data
data(bank_marketing_data_sub)
# calculate correlations
correlations <- cor(bank_marketing_data[,16:19])

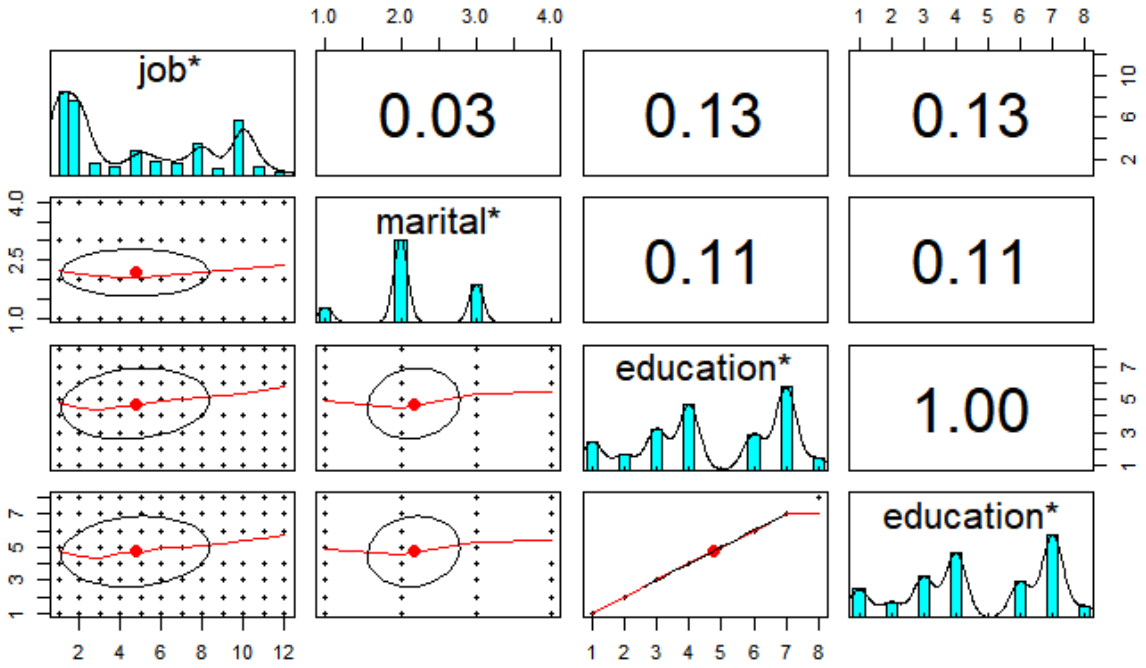
```
# create correlation plot
corrplot(correlations, method="circle")
```




```
airs.panels(bank_marketing_data[, c(16:20,18)])
pairs.panels(bank_marketing_data[, c(2:4,3)])
pairs.panels(bank_marketing_data[, c(2:4,4)])
```

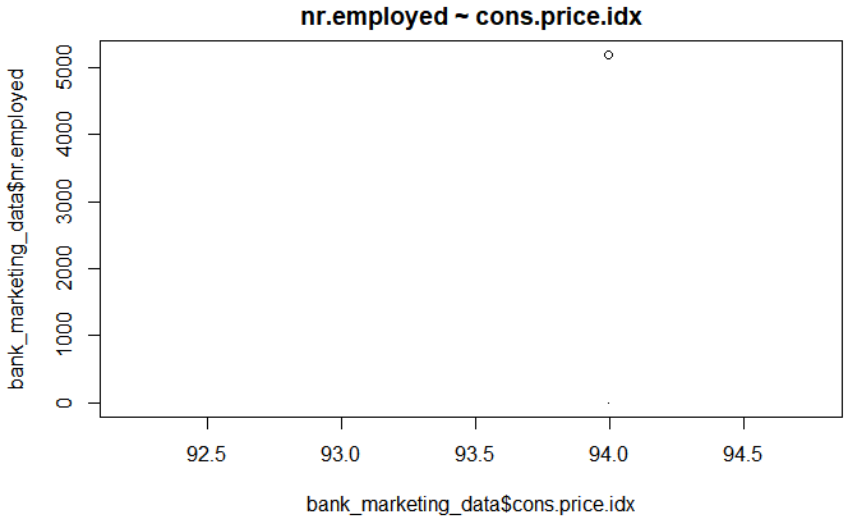




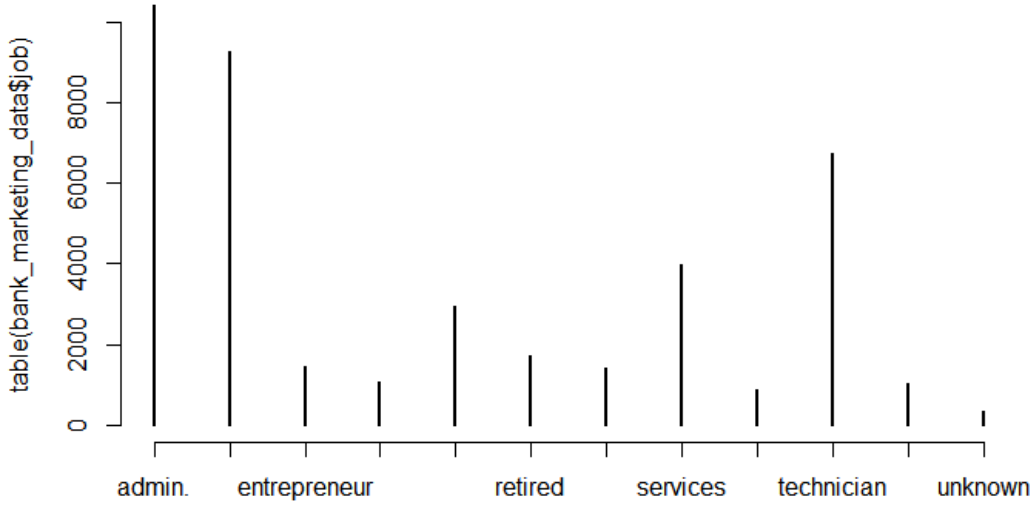


head(bank_marketing_data)

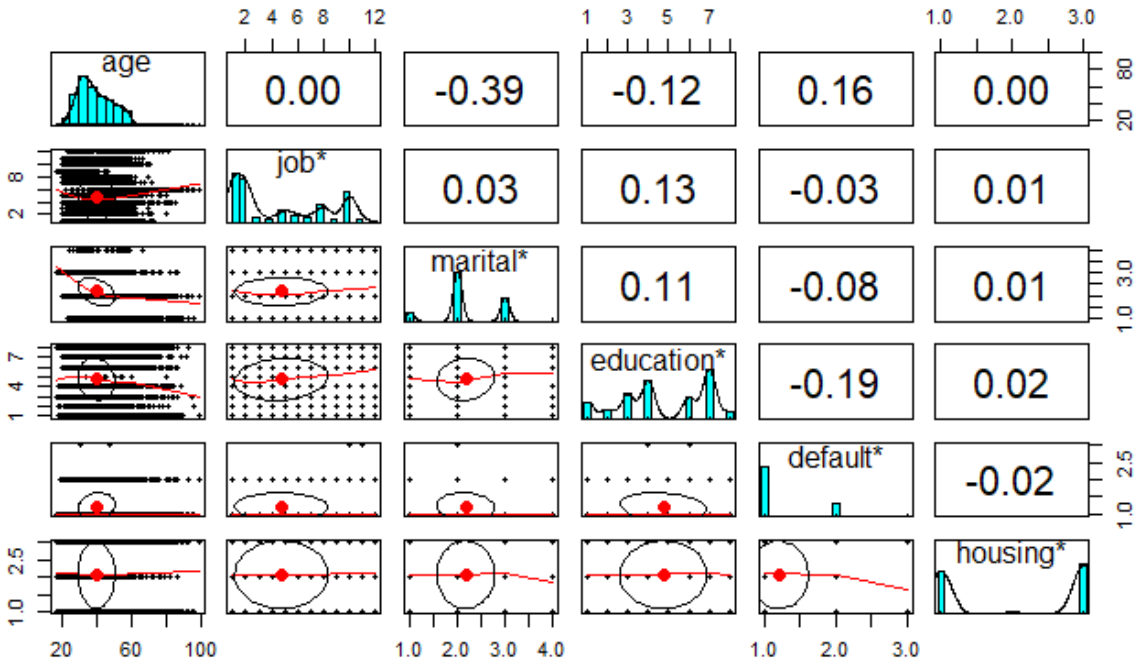
```
scatter.smooth(x=bank_marketing_data$cons.price.idx, y=bank_marketing_data$nr.employed,
main="nr.employed ~ cons.price.idx")
```




```
#cor(bank_marketing_data$age, bank_marketing_data$emp.var.rate)
head(bank_marketing_data)
table(bank_marketing_data$job)
table(bank_marketing_data$marital)
plot(table(bank_marketing_data$job))
```




```
library(psych)
pairs.panels(bank_marketing_data[,1:6])
```


age
job*
marital*
education*
default*
housing*
0.00
-0.39
-0.12
0.16
0.00
0.03
0.13
-0.03
0.01
0.11
-0.08
0.01
-0.19
0.02
-0.02