hw1-stats506-lijiabao

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link of github: https://github.com/lijiabao203/stats506_rwork

doc: hw1-stats506-lijiabao.qmd and hw1-stats506-lijiabao.pdf

problem 1 - wine data

a: Import the data and label the data

Use function "read.table" to read "wine.data" and use "," as attribute "sep" to correctly read.

Save it as data_wine in format "data.frame".

Finally use function "names" to label the data.

	Class	Alcohol	Malic acid	Ash	Alcalinity of ash	Magnesium	Total phenols
1	1	14.23	1.71	2.43	15.6	127	2.80
2	1	13.20	1.78	2.14	11.2	100	2.65
3	1	13.16	2.36	2.67	18.6	101	2.80
4	1	14.37	1.95	2.50	16.8	113	3.85
5	1	13.24	2.59	2.87	21.0	118	2.80
6	1	14.20	1.76	2.45	15.2	112	3.27
7	1	14.39	1.87	2.45	14.6	96	2.50
8	1	14.06	2.15	2.61	17.6	121	2.60
9	1	14.83	1.64	2.17	14.0	97	2.80
10	1	13.86	1.35	2.27	16.0	98	2.98
11	1	14.10	2.16	2.30	18.0	105	2.95
12	1	14.12	1.48	2.32	16.8	95	2.20
13	1	13.75	1.73	2.41	16.0	89	2.60
14	1	14.75	1.73	2.39	11.4	91	3.10
15	1	14.38	1.87	2.38	12.0	102	3.30
16	1	13.63	1.81	2.70	17.2	112	2.85
17	1	14.30	1.92	2.72	20.0	120	2.80

18	1	13.83	1.57	2.62	20.0	115	2.95
19	1	14.19	1.59	2.48	16.5	108	3.30
20	1	13.64	3.10	2.56	15.2	116	2.70
21	1	14.06	1.63	2.28	16.0	126	3.00
22	1	12.93	3.80	2.65	18.6	102	2.41
23	1	13.71	1.86	2.36	16.6	101	2.61
24	1	12.85	1.60	2.52	17.8	95	2.48
25	1	13.50	1.81	2.61	20.0	96	2.53
26	1	13.05	2.05	3.22	25.0	124	2.63
27	1	13.39	1.77	2.62	16.1	93	2.85
28	1	13.30	1.72	2.14	17.0	94	2.40
29	1	13.87	1.90	2.80	19.4	107	2.95
30	1	14.02	1.68	2.21	16.0	96	2.65
31	1	13.73	1.50	2.70	22.5	101	3.00
32	1	13.58	1.66	2.36	19.1	106	2.86
33	1	13.68	1.83	2.36	17.2	104	2.42
34	1	13.76	1.53	2.70	19.5	132	2.95
35	1	13.51	1.80	2.65	19.0	110	2.35
36	1	13.48	1.81	2.41	20.5	100	2.70
37	1	13.28	1.64	2.84	15.5	110	2.60
38	1	13.05	1.65	2.55	18.0	98	2.45
39	1	13.07	1.50	2.10	15.5	98	2.40
40	1	14.22	3.99	2.51	13.2	128	3.00
41	1	13.56	1.71	2.31	16.2	117	3.15
42	1	13.41	3.84	2.12	18.8	90	2.45
43	1	13.88	1.89	2.59	15.0	101	3.25
44	1	13.24	3.98	2.29	17.5	103	2.64
45	1	13.05	1.77	2.10	17.0	107	3.00
46	1	14.21	4.04	2.44	18.9	111	2.85
47	1	14.38	3.59	2.28	16.0	102	3.25
48	1	13.90	1.68	2.12	16.0	101	3.10
49	1	14.10	2.02	2.40	18.8	103	2.75
50	1	13.94	1.73	2.27	17.4	108	2.88
51	1	13.05	1.73	2.04	12.4	92	2.72
52	1	13.83	1.65	2.60	17.2	94	2.45
53	1	13.82	1.75	2.42	14.0	111	3.88
54	1	13.77	1.90	2.68	17.1	115	3.00
55	1	13.74	1.67	2.25	16.4	118	2.60
56	1	13.56	1.73	2.46	20.5	116	2.96
57	1	14.22	1.70	2.30	16.3	118	3.20
58	1	13.29	1.97	2.68	16.8	102	3.00
59	1	13.72	1.43	2.50	16.7	108	3.40
60	2	12.37	0.94	1.36	10.6	88	1.98

61	2	12.33	1.10	2.28	16.0	101	2.05
62	2	12.64	1.36	2.02	16.8	100	2.02
63	2	13.67	1.25	1.92	18.0	94	2.10
64	2	12.37	1.13	2.16	19.0	87	3.50
65	2	12.17	1.45	2.53	19.0	104	1.89
66	2	12.37	1.21	2.56	18.1	98	2.42
67	2	13.11	1.01	1.70	15.0	78	2.98
68	2	12.37	1.17	1.92	19.6	78	2.11
69	2	13.34	0.94	2.36	17.0	110	2.53
70	2	12.21	1.19	1.75	16.8	151	1.85
71	2	12.29	1.61	2.21	20.4	103	1.10
72	2	13.86	1.51	2.67	25.0	86	2.95
73	2	13.49	1.66	2.24	24.0	87	1.88
74	2	12.99	1.67	2.60	30.0	139	3.30
75	2	11.96	1.09	2.30	21.0	101	3.38
76	2	11.66	1.88	1.92	16.0	97	1.61
77	2	13.03	0.90	1.71	16.0	86	1.95
78	2	11.84	2.89	2.23	18.0	112	1.72
79	2	12.33	0.99	1.95	14.8	136	1.90
80	2	12.70	3.87	2.40	23.0	101	2.83
81	2	12.00	0.92	2.00	19.0	86	2.42
82	2	12.72	1.81	2.20	18.8	86	2.20
83	2	12.08	1.13	2.51	24.0	78	2.00
84	2	13.05	3.86	2.32	22.5	85	1.65
85	2	11.84	0.89	2.58	18.0	94	2.20
86	2	12.67	0.98	2.24	18.0	99	2.20
87	2	12.16	1.61	2.31	22.8	90	1.78
88	2	11.65	1.67	2.62	26.0	88	1.92
89	2	11.64	2.06	2.46	21.6	84	1.95
90	2	12.08	1.33	2.30	23.6	70	2.20
91	2	12.08	1.83	2.32	18.5	81	1.60
92	2	12.00	1.51	2.42	22.0	86	1.45
93	2	12.69	1.53	2.26	20.7	80	1.38
94	2	12.29	2.83	2.22	18.0	88	2.45
95	2	11.62	1.99	2.28	18.0	98	3.02
96	2	12.47	1.52	2.20	19.0	162	2.50
97	2	11.81	2.12	2.74	21.5	134	1.60
98	2	12.29	1.41	1.98	16.0	85	2.55
99	2	12.37	1.07	2.10	18.5	88	3.52
100	2	12.29	3.17	2.21	18.0	88	2.85
101	2	12.08	2.08	1.70	17.5	97	2.23
102	2	12.60	1.34	1.90	18.5	88	1.45
103	2	12.34	2.45	2.46	21.0	98	2.56

104	2	11.82	1.72	1.88	19.5	86	2.50
105	2	12.51	1.73	1.98	20.5	85	2.20
106	2	12.42	2.55	2.27	22.0	90	1.68
107	2	12.25	1.73	2.12	19.0	80	1.65
108	2	12.72	1.75	2.28	22.5	84	1.38
109	2	12.22	1.29	1.94	19.0	92	2.36
110	2	11.61	1.35	2.70	20.0	94	2.74
111	2	11.46	3.74	1.82	19.5	107	3.18
112	2	12.52	2.43	2.17	21.0	88	2.55
113	2	11.76	2.68	2.92	20.0	103	1.75
114	2	11.41	0.74	2.50	21.0	88	2.48
115	2	12.08	1.39	2.50	22.5	84	2.56
116	2	11.03	1.51	2.20	21.5	85	2.46
117	2	11.82	1.47	1.99	20.8	86	1.98
118	2	12.42	1.61	2.19	22.5	108	2.00
119	2	12.77	3.43	1.98	16.0	80	1.63
120	2	12.00	3.43	2.00	19.0	87	2.00
121	2	11.45	2.40	2.42	20.0	96	2.90
122	2	11.56	2.05	3.23	28.5	119	3.18
123	2	12.42	4.43	2.73	26.5	102	2.20
124	2	13.05	5.80	2.13	21.5	86	2.62
125	2	11.87	4.31	2.39	21.0	82	2.86
126	2	12.07	2.16	2.17	21.0	85	2.60
127	2	12.43	1.53	2.29	21.5	86	2.74
128	2	11.79	2.13	2.78	28.5	92	2.13
129	2	12.37	1.63	2.30	24.5	88	2.22
130	2	12.04	4.30	2.38	22.0	80	2.10
131	3	12.86	1.35	2.32	18.0	122	1.51
132	3	12.88	2.99	2.40	20.0	104	1.30
133	3	12.81	2.31	2.40	24.0	98	1.15
134	3	12.70	3.55	2.36	21.5	106	1.70
135	3	12.51	1.24	2.25	17.5	85	2.00
136	3	12.60	2.46	2.20	18.5	94	1.62
137	3	12.25	4.72	2.54	21.0	89	1.38
138	3	12.53	5.51	2.64	25.0	96	1.79
139	3	13.49	3.59	2.19	19.5	88	1.62
140	3	12.84	2.96	2.61	24.0	101	2.32
141	3	12.93	2.81	2.70	21.0	96	1.54
142	3	13.36	2.56	2.35	20.0	89	1.40
143	3	13.52	3.17	2.72	23.5	97	1.55
144	3	13.62	4.95	2.35	20.0	92	2.00
145	3	12.25	3.88	2.20	18.5	112	1.38
146	3	13.16	3.57	2.15	21.0	102	1.50

147	3	13.88	5.04	2.23	20.0	80	0.98
148	3	12.87	4.61	2.48	21.5	86	1.70
149	3	13.32	3.24	2.38	21.5	92	1.93
150	3	13.08	3.90	2.36	21.5	113	1.41
151	3	13.50	3.12	2.62	24.0	123	1.40
152	3	12.79	2.67	2.48	22.0	112	1.48
153	3	13.11	1.90	2.75	25.5	116	2.20
154	3	13.23	3.30	2.28	18.5	98	1.80
155	3	12.58	1.29	2.10	20.0	103	1.48
156	3	13.17	5.19	2.32	22.0	93	1.74
157	3	13.84	4.12	2.38	19.5	89	1.80
158	3	12.45	3.03	2.64	27.0	97	1.90
159	3	14.34	1.68	2.70	25.0	98	2.80
160	3	13.48	1.67	2.64	22.5	89	2.60
161	3	12.36	3.83	2.38	21.0	88	2.30
162	3	13.69	3.26	2.54	20.0	107	1.83
163	3	12.85	3.27	2.58	22.0	106	1.65
164	3	12.96	3.45	2.35	18.5	106	1.39
165	3	13.78	2.76	2.30	22.0	90	1.35
166	3	13.73	4.36	2.26	22.5	88	1.28
167	3	13.45	3.70	2.60	23.0	111	1.70
168	3	12.82	3.37	2.30	19.5	88	1.48
169	3	13.58	2.58	2.69	24.5	105	1.55
170	3	13.40	4.60	2.86	25.0	112	1.98
171	3	12.20	3.03	2.32	19.0	96	1.25
172	3	12.77	2.39	2.28	19.5	86	1.39
173	3	14.16	2.51	2.48	20.0	91	1.68
174	3	13.71	5.65	2.45	20.5	95	1.68
175	3	13.40	3.91	2.48	23.0	102	1.80
176	3	13.27	4.28	2.26	20.0	120	1.59
177	3	13.17	2.59	2.37	20.0	120	1.65
178	3	14.13	4.10	2.74	24.5	96	2.05

	Flavanoids	Nonflavanoid phenols	Proanthocyanins	Color intensity	Hue
1	3.06	0.28	2.29	5.640000	1.040
2	2.76	0.26	1.28	4.380000	1.050
3	3.24	0.30	2.81	5.680000	1.030
4	3.49	0.24	2.18	7.800000	0.860
5	2.69	0.39	1.82	4.320000	1.040
6	3.39	0.34	1.97	6.750000	1.050
7	2.52	0.30	1.98	5.250000	1.020
8	2.51	0.31	1.25	5.050000	1.060
9	2.98	0.29	1.98	5.200000	1.080
10	3.15	0.22	1.85	7.220000	1.010

11	3.32	0.22	2.38	5.750000	1.250
12	2.43	0.26	1.57	5.000000	1.170
13	2.76	0.29	1.81	5.600000	1.150
14	3.69	0.43	2.81	5.400000	1.250
15	3.64	0.29	2.96	7.500000	1.200
16	2.91	0.30	1.46	7.300000	1.280
17	3.14	0.33	1.97	6.200000	1.070
18	3.40	0.40	1.72	6.600000	1.130
19	3.93	0.32	1.86	8.700000	1.230
20	3.03	0.17	1.66	5.100000	0.960
21	3.17	0.24	2.10	5.650000	1.090
22	2.41	0.25	1.98	4.500000	1.030
23	2.88	0.27	1.69	3.800000	1.110
24	2.37	0.26	1.46	3.930000	1.090
25	2.61	0.28	1.66	3.520000	1.120
26	2.68	0.47	1.92	3.580000	1.130
27	2.94	0.34	1.45	4.800000	0.920
28	2.19	0.27	1.35	3.950000	1.020
29	2.97	0.37	1.76	4.500000	1.250
30	2.33	0.26	1.98	4.700000	1.040
31	3.25	0.29	2.38	5.700000	1.190
32	3.19	0.22	1.95	6.900000	1.090
33	2.69	0.42	1.97	3.840000	1.230
34	2.74	0.50	1.35	5.400000	1.250
35	2.53	0.29	1.54	4.200000	1.100
36	2.98	0.26	1.86	5.100000	1.040
37	2.68	0.34	1.36	4.600000	1.090
38	2.43	0.29	1.44	4.250000	1.120
39	2.64	0.28	1.37	3.700000	1.180
40	3.04	0.20	2.08	5.100000	0.890
41	3.29	0.34	2.34	6.130000	0.950
42	2.68	0.27	1.48	4.280000	0.910
43	3.56	0.17	1.70	5.430000	0.880
44	2.63	0.32	1.66	4.360000	0.820
45	3.00	0.28	2.03	5.040000	0.880
46	2.65	0.30	1.25	5.240000	0.870
47	3.17	0.27	2.19	4.900000	1.040
48	3.39	0.21	2.14	6.100000	0.910
49	2.92	0.32	2.38	6.200000	1.070
50	3.54	0.32	2.08	8.900000	1.120
51	3.27	0.17	2.91	7.200000	1.120
52	2.99	0.22	2.29	5.600000	1.240
53	3.74	0.32	1.87	7.050000	1.010

54	2.79	0.39	1.68	6.300000	1.130
55	2.90	0.21	1.62	5.850000	0.920
56	2.78	0.20	2.45	6.250000	0.980
57	3.00	0.26	2.03	6.380000	0.940
58	3.23	0.31	1.66	6.000000	1.070
59	3.67	0.19	2.04	6.800000	0.890
60	0.57	0.28	0.42	1.950000	1.050
61	1.09	0.63	0.41	3.270000	1.250
62	1.41	0.53	0.62	5.750000	0.980
63	1.79	0.32	0.73	3.800000	1.230
64	3.10	0.19	1.87	4.450000	1.220
65	1.75	0.45	1.03	2.950000	1.450
66	2.65	0.37	2.08	4.600000	1.190
67	3.18	0.26	2.28	5.300000	1.120
68	2.00	0.27	1.04	4.680000	1.120
69	1.30	0.55	0.42	3.170000	1.020
70	1.28	0.14	2.50	2.850000	1.280
71	1.02	0.37	1.46	3.050000	0.906
72	2.86	0.21	1.87	3.380000	1.360
73	1.84	0.27	1.03	3.740000	0.980
74	2.89	0.21	1.96	3.350000	1.310
75	2.14	0.13	1.65	3.210000	0.990
76	1.57	0.34	1.15	3.800000	1.230
77	2.03	0.24	1.46	4.600000	1.190
78	1.32	0.43	0.95	2.650000	0.960
79	1.85	0.35	2.76	3.400000	1.060
80	2.55	0.43	1.95	2.570000	1.190
81	2.26	0.30	1.43	2.500000	1.380
82	2.53	0.26	1.77	3.900000	1.160
83	1.58	0.40	1.40	2.200000	1.310
84	1.59	0.61	1.62	4.800000	0.840
85	2.21	0.22	2.35	3.050000	0.790
86	1.94	0.30	1.46	2.620000	1.230
87	1.69	0.43	1.56	2.450000	1.330
88	1.61	0.40	1.34	2.600000	1.360
89	1.69	0.48	1.35	2.800000	1.000
90	1.59	0.42	1.38	1.740000	1.070
91	1.50	0.52	1.64	2.400000	1.080
92	1.25	0.50	1.63	3.600000	1.050
93	1.46	0.58	1.62	3.050000	0.960
94	2.25	0.25	1.99	2.150000	1.150
95	2.26	0.17	1.35	3.250000	1.160
96	2.27	0.32	3.28	2.600000	1.160

97	0.99	0.14	1.56	2.500000	0.950
98	2.50	0.29	1.77	2.900000	1.230
99	3.75	0.24	1.95	4.500000	1.040
100	2.99	0.45	2.81	2.300000	1.420
101	2.17	0.26	1.40	3.300000	1.270
102	1.36	0.29	1.35	2.450000	1.040
103	2.11	0.34	1.31	2.800000	0.800
104	1.64	0.37	1.42	2.060000	0.940
105	1.92	0.32	1.48	2.940000	1.040
106	1.84	0.66	1.42	2.700000	0.860
107	2.03	0.37	1.63	3.400000	1.000
108	1.76	0.48	1.63	3.300000	0.880
109	2.04	0.39	2.08	2.700000	0.860
110	2.92	0.29	2.49	2.650000	0.960
111	2.58	0.24	3.58	2.900000	0.750
112	2.27	0.26	1.22	2.000000	0.900
113	2.03	0.60	1.05	3.800000	1.230
114	2.01	0.42	1.44	3.080000	1.100
115	2.29	0.43	1.04	2.900000	0.930
116	2.17	0.52	2.01	1.900000	1.710
117	1.60	0.30	1.53	1.950000	0.950
118	2.09	0.34	1.61	2.060000	1.060
119	1.25	0.43	0.83	3.400000	0.700
120	1.64	0.37	1.87	1.280000	0.930
121	2.79	0.32	1.83	3.250000	0.800
122	5.08	0.47	1.87	6.000000	0.930
123	2.13	0.43	1.71	2.080000	0.920
124	2.65	0.30	2.01	2.600000	0.730
125	3.03	0.21	2.91	2.800000	0.750
126	2.65	0.37	1.35	2.760000	0.860
127	3.15	0.39	1.77	3.940000	0.690
128	2.24	0.58	1.76	3.000000	0.970
129	2.45	0.40	1.90	2.120000	0.890
130	1.75	0.42	1.35	2.600000	0.790
131	1.25	0.21	0.94	4.100000	0.760
132	1.22	0.24	0.83	5.400000	0.740
133	1.09	0.27	0.83	5.700000	0.660
134	1.20	0.17	0.84	5.000000	0.780
135	0.58	0.60	1.25	5.450000	0.750
136	0.66	0.63	0.94	7.100000	0.730
137	0.47	0.53	0.80	3.850000	0.750
138	0.60	0.63	1.10	5.000000	0.820
139	0.48	0.58	0.88	5.700000	0.810

140	0.60	0.53	0.81	4.920000	0.890
141	0.50	0.53	0.75	4.600000	0.770
142	0.50	0.37	0.64	5.600000	0.700
143	0.52	0.50	0.55	4.350000	0.890
144	0.80	0.47	1.02	4.400000	0.910
145	0.78	0.29	1.14	8.210000	0.650
146	0.55	0.43	1.30	4.000000	0.600
147	0.34	0.40	0.68	4.900000	0.580
148	0.65	0.47	0.86	7.650000	0.540
149	0.76	0.45	1.25	8.420000	0.550
150	1.39	0.34	1.14	9.400000	0.570
151	1.57	0.22	1.25	8.600000	0.590
152	1.36	0.24	1.26	10.800000	0.480
153	1.28	0.26	1.56	7.100000	0.610
154	0.83	0.61	1.87	10.520000	0.560
155	0.58	0.53	1.40	7.600000	0.580
156	0.63	0.61	1.55	7.900000	0.600
157	0.83	0.48	1.56	9.010000	0.570
158	0.58	0.63	1.14	7.500000	0.670
159	1.31	0.53	2.70	13.000000	0.570
160	1.10	0.52	2.29	11.750000	0.570
161	0.92	0.50	1.04	7.650000	0.560
162	0.56	0.50	0.80	5.880000	0.960
163	0.60	0.60	0.96	5.580000	0.870
164	0.70	0.40	0.94	5.280000	0.680
165	0.68	0.41	1.03	9.580000	0.700
166	0.47	0.52	1.15	6.620000	0.780
167	0.92	0.43	1.46	10.680000	0.850
168	0.66	0.40	0.97	10.260000	0.720
169	0.84	0.39	1.54	8.660000	0.740
170	0.96	0.27	1.11	8.500000	0.670
171	0.49	0.40	0.73	5.500000	0.660
172	0.51	0.48	0.64	9.899999	0.570
173	0.70	0.44	1.24	9.700000	0.620
174	0.61	0.52	1.06	7.700000	0.640
175	0.75	0.43	1.41	7.300000	0.700
176	0.69	0.43	1.35	10.200000	0.590
177	0.68	0.53	1.46	9.300000	0.600
178	0.76	0.56	1.35	9.200000	0.610

	OD280/OD315 of diluted wines	Proline
1	3.92	1065
2	3.40	1050
3	3.17	1185

4	3.45	1480
5	2.93	735
6	2.85	1450
7	3.58	1290
8	3.58	1295
9	2.85	1045
10	3.55	1045
11	3.17	1510
12	2.82	1280
13	2.90	1320
14	2.73	1150
15	3.00	1547
16	2.88	1310
17	2.65	1280
18	2.57	1130
19	2.82	1680
20	3.36	845
21	3.71	780
22	3.52	770
23	4.00	1035
24	3.63	1015
25	3.82	845
26	3.20	830
27	3.22	1195
28	2.77	1285
29	3.40	915
30	3.59	1035
31	2.71	1285
32	2.88	1515
33	2.87	990
34	3.00	1235
35	2.87	1095
36	3.47	920
37	2.78	880
38	2.51	1105
39	2.69	1020
40	3.53	760
41	3.38	795
42	3.00	1035
43	3.56	1095
44	3.00	680
45	3.35	885
46	3.33	1080

47	3.44	1065
48	3.33	985
49	2.75	1060
50	3.10	1260
51	2.91	1150
52	3.37	1265
53	3.26	1190
54	2.93	1375
55	3.20	1060
56	3.03	1120
57	3.31	970
58	2.84	1270
59	2.87	1285
60	1.82	520
61	1.67	680
62	1.59	450
63	2.46	630
64	2.87	420
65	2.23	355
66	2.30	678
67	3.18	502
68	3.48	510
69	1.93	750
70	3.07	718
71	1.82	870
72	3.16	410
73	2.78	472
74	3.50	985
75	3.13	886
76	2.14	428
77	2.48	392
78	2.52	500
79	2.31	750
80	3.13	463
81	3.12	278
82	3.14	714
83	2.72	630
84	2.01	515
85	3.08	520
86	3.16	450
87	2.26	495
88	3.21	562
89	2.75	680

90	3.21	625
91	2.27	480
92	2.65	450
93	2.06	495
94	3.30	290
95	2.96	345
96	2.63	937
97	2.26	625
98	2.74	428
99	2.77	660
100	2.83	406
101	2.96	710
102	2.77	562
103	3.38	438
104	2.44	415
105	3.57	672
106	3.30	315
107	3.17	510
108	2.42	488
109	3.02	312
110	3.26	680
111	2.81	562
112	2.78	325
113	2.50	607
114	2.31	434
115	3.19	385
116	2.87	407
117	3.33	495
118	2.96	345
119	2.12	372
120	3.05	564
121	3.39	625
122	3.69	465
123	3.12	365
124	3.10	380
125	3.64	380
126	3.28	378
127	2.84	352
128	2.44	466
129	2.78	342
130	2.57	580
131	1.29	630
132	1.42	530

133	1.36	560
134	1.29	600
135	1.51	650
136	1.58	695
137	1.27	720
138	1.69	515
139	1.82	580
140	2.15	590
141	2.31	600
142	2.47	780
143	2.06	520
144	2.05	550
145	2.00	855
146	1.68	830
147	1.33	415
148	1.86	625
149	1.62	650
150	1.33	550
151	1.30	500
152	1.47	480
153	1.33	425
154	1.51	675
155	1.55	640
156	1.48	725
157	1.64	480
158	1.73	880
159	1.96	660
160	1.78	620
161	1.58	520
162	1.82	680
163	2.11	570
164	1.75	675
165	1.68	615
166	1.75	520
167	1.56	695
168	1.75	685
169	1.80	750
170	1.92	630
171	1.83	510
172	1.63	470
173	1.71	660
174	1.74	740
175	1.56	750

```
176                         1.56     835
177                         1.62     840
178                         1.60     560
```

b: Check the number of wines within each class

Firstly use "data_wine["Class"]" to get all classes of wine.

And use function "table" to check the number of wines within each class.

Compared with the number from wine.names, the number we got from R is correct.

```
Class
 1  2  3
59 71 48
```

c: problem sets

1 What is the correlation between alcohol content and color intensity?

From the table below, alcohol content is always bigger than color intensity.

Besides, we can use function "cor" to compute the correlation coefficient, which is 0.5463642. And we can use a scatter plot to verify the correlation. In fact, there is no direct relationship between these two attribute.

```
    Alcohol Color intensity
1     14.23        5.640000
2     13.20        4.380000
3     13.16        5.680000
4     14.37        7.800000
5     13.24        4.320000
6     14.20        6.750000
7     14.39        5.250000
8     14.06        5.050000
9     14.83        5.200000
10    13.86        7.220000
11    14.10        5.750000
12    14.12        5.000000
13    13.75        5.600000
14    14.75        5.400000
15    14.38        7.500000
16    13.63        7.300000
```

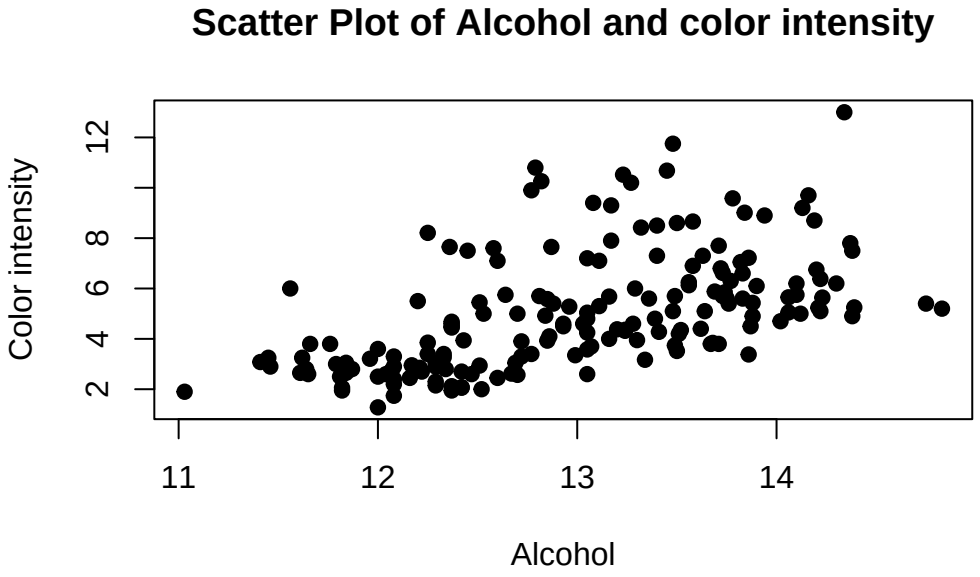
17	14.30	6.200000
18	13.83	6.600000
19	14.19	8.700000
20	13.64	5.100000
21	14.06	5.650000
22	12.93	4.500000
23	13.71	3.800000
24	12.85	3.930000
25	13.50	3.520000
26	13.05	3.580000
27	13.39	4.800000
28	13.30	3.950000
29	13.87	4.500000
30	14.02	4.700000
31	13.73	5.700000
32	13.58	6.900000
33	13.68	3.840000
34	13.76	5.400000
35	13.51	4.200000
36	13.48	5.100000
37	13.28	4.600000
38	13.05	4.250000
39	13.07	3.700000
40	14.22	5.100000
41	13.56	6.130000
42	13.41	4.280000
43	13.88	5.430000
44	13.24	4.360000
45	13.05	5.040000
46	14.21	5.240000
47	14.38	4.900000
48	13.90	6.100000
49	14.10	6.200000
50	13.94	8.900000
51	13.05	7.200000
52	13.83	5.600000
53	13.82	7.050000
54	13.77	6.300000
55	13.74	5.850000
56	13.56	6.250000
57	14.22	6.380000
58	13.29	6.000000
59	13.72	6.800000

60	12.37	1.950000
61	12.33	3.270000
62	12.64	5.750000
63	13.67	3.800000
64	12.37	4.450000
65	12.17	2.950000
66	12.37	4.600000
67	13.11	5.300000
68	12.37	4.680000
69	13.34	3.170000
70	12.21	2.850000
71	12.29	3.050000
72	13.86	3.380000
73	13.49	3.740000
74	12.99	3.350000
75	11.96	3.210000
76	11.66	3.800000
77	13.03	4.600000
78	11.84	2.650000
79	12.33	3.400000
80	12.70	2.570000
81	12.00	2.500000
82	12.72	3.900000
83	12.08	2.200000
84	13.05	4.800000
85	11.84	3.050000
86	12.67	2.620000
87	12.16	2.450000
88	11.65	2.600000
89	11.64	2.800000
90	12.08	1.740000
91	12.08	2.400000
92	12.00	3.600000
93	12.69	3.050000
94	12.29	2.150000
95	11.62	3.250000
96	12.47	2.600000
97	11.81	2.500000
98	12.29	2.900000
99	12.37	4.500000
100	12.29	2.300000
101	12.08	3.300000
102	12.60	2.450000

103	12.34	2.800000
104	11.82	2.060000
105	12.51	2.940000
106	12.42	2.700000
107	12.25	3.400000
108	12.72	3.300000
109	12.22	2.700000
110	11.61	2.650000
111	11.46	2.900000
112	12.52	2.000000
113	11.76	3.800000
114	11.41	3.080000
115	12.08	2.900000
116	11.03	1.900000
117	11.82	1.950000
118	12.42	2.060000
119	12.77	3.400000
120	12.00	1.280000
121	11.45	3.250000
122	11.56	6.000000
123	12.42	2.080000
124	13.05	2.600000
125	11.87	2.800000
126	12.07	2.760000
127	12.43	3.940000
128	11.79	3.000000
129	12.37	2.120000
130	12.04	2.600000
131	12.86	4.100000
132	12.88	5.400000
133	12.81	5.700000
134	12.70	5.000000
135	12.51	5.450000
136	12.60	7.100000
137	12.25	3.850000
138	12.53	5.000000
139	13.49	5.700000
140	12.84	4.920000
141	12.93	4.600000
142	13.36	5.600000
143	13.52	4.350000
144	13.62	4.400000
145	12.25	8.210000

```
146   13.16        4.000000
147   13.88        4.900000
148   12.87        7.650000
149   13.32        8.420000
150   13.08        9.400000
151   13.50        8.600000
152   12.79       10.800000
153   13.11        7.100000
154   13.23       10.520000
155   12.58        7.600000
156   13.17        7.900000
157   13.84        9.010000
158   12.45        7.500000
159   14.34       13.000000
160   13.48       11.750000
161   12.36        7.650000
162   13.69        5.880000
163   12.85        5.580000
164   12.96        5.280000
165   13.78        9.580000
166   13.73        6.620000
167   13.45       10.680000
168   12.82       10.260000
169   13.58        8.660000
170   13.40        8.500000
171   12.20        5.500000
172   12.77        9.899999
173   14.16        9.700000
174   13.71        7.700000
175   13.40        7.300000
176   13.27       10.200000
177   13.17        9.300000
178   14.13        9.200000

        mean_of_Alcohol mean_of_color_intensity correlation_coefficient
             13.0006180               5.0580899               0.5463642
```




```
    Pearson's product-moment correlation

data:  (data_wine["Alcohol"])[[1]] and (data_wine["Color intensity"])[[1]]
t = 8.6542, df = 176, p-value = 3.056e-15
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.4341702 0.6418673
sample estimates:
      cor
0.5463642
```

2 Which class has the highest correlation? Which has the lowest?

Use function cor to get the classes with highest and lowest classes:

```
                               Class     Alcohol  Malic acid          Ash
Class                     1.00000000 -0.32822194  0.43777620 -0.049643221
Alcohol                  -0.32822194  1.00000000  0.09439694  0.211544596
Malic acid                0.43777620  0.09439694  1.00000000  0.164045470
Ash                      -0.04964322  0.21154460  0.16404547  1.000000000
Alcalinity of ash         0.51785911 -0.31023514  0.28850040  0.443367187
Magnesium                -0.20917939  0.27079823 -0.05457510  0.286586691
Total phenols            -0.71916334  0.28910112 -0.33516700  0.128979538
Flavanoids               -0.84749754  0.23681493 -0.41100659  0.115077279
```

```
Nonflavanoid phenols          0.48910916 -0.15592947  0.29297713  0.186230446
Proanthocyanins              -0.49912982  0.13669791 -0.22074619  0.009651935
Color intensity               0.26566757  0.54636420  0.24898534  0.258887259
Hue                          -0.61736921 -0.07174720 -0.56129569 -0.074666889
OD280/OD315 of diluted wines -0.78822959  0.07234319 -0.36871043  0.003911231
Proline                      -0.63371678  0.64372004 -0.19201056  0.223626264
                             Alcalinity of ash   Magnesium Total phenols
Class                              0.51785911 -0.20917939   -0.71916334
Alcohol                           -0.31023514  0.27079823    0.28910112
Malic acid                         0.28850040 -0.05457510   -0.33516700
Ash                                0.44336719  0.28658669    0.12897954
Alcalinity of ash                  1.00000000 -0.08333309   -0.32111332
Magnesium                         -0.08333309  1.00000000    0.21440123
Total phenols                     -0.32111332  0.21440123    1.00000000
Flavanoids                        -0.35136986  0.19578377    0.86456350
Nonflavanoid phenols               0.36192172 -0.25629405   -0.44993530
Proanthocyanins                   -0.19732684  0.23644061    0.61241308
Color intensity                    0.01873198  0.19995001   -0.05513642
Hue                               -0.27395522  0.05539820    0.43368134
OD280/OD315 of diluted wines      -0.27676855  0.06600394    0.69994936
Proline                           -0.44059693  0.39335085    0.49811488
                             Flavanoids Nonflavanoid phenols Proanthocyanins
Class                        -0.8474975            0.4891092    -0.499129824
Alcohol                       0.2368149           -0.1559295     0.136697912
Malic acid                   -0.4110066            0.2929771    -0.220746187
Ash                           0.1150773            0.1862304     0.009651935
Alcalinity of ash            -0.3513699            0.3619217    -0.197326836
Magnesium                     0.1957838           -0.2562940     0.236440610
Total phenols                 0.8645635           -0.4499353     0.612413084
Flavanoids                    1.0000000           -0.5378996     0.652691769
Nonflavanoid phenols         -0.5378996            1.0000000    -0.365845099
Proanthocyanins               0.6526918           -0.3658451     1.000000000
Color intensity              -0.1723794            0.1390570    -0.025249931
Hue                           0.5434786           -0.2626396     0.295544253
OD280/OD315 of diluted wines  0.7871939           -0.5032696     0.519067096
Proline                       0.4941931           -0.3113852     0.330416700
                             Color intensity         Hue
Class                             0.26566757 -0.61736921
Alcohol                           0.54636420 -0.07174720
Malic acid                        0.24898534 -0.56129569
Ash                               0.25888726 -0.07466689
Alcalinity of ash                 0.01873198 -0.27395522
Magnesium                         0.19995001  0.05539820
```

```
Total phenols                   -0.05513642  0.43368134
Flavanoids                      -0.17237940  0.54347857
Nonflavanoid phenols             0.13905701 -0.26263963
Proanthocyanins                 -0.02524993  0.29554425
Color intensity                  1.00000000 -0.52181319
Hue                             -0.52181319  1.00000000
OD280/OD315 of diluted wines    -0.42881494  0.56546829
Proline                          0.31610011  0.23618345
                            OD280/OD315 of diluted wines    Proline
Class                                       -0.788229589 -0.6337168
Alcohol                                      0.072343187  0.6437200
Malic acid                                  -0.368710428 -0.1920106
Ash                                          0.003911231  0.2236263
Alcalinity of ash                           -0.276768549 -0.4405969
Magnesium                                    0.066003936  0.3933508
Total phenols                                0.699949365  0.4981149
Flavanoids                                   0.787193902  0.4941931
Nonflavanoid phenols                        -0.503269596 -0.3113852
Proanthocyanins                              0.519067096  0.3304167
Color intensity                             -0.428814942  0.3161001
Hue                                          0.565468293  0.2361834
OD280/OD315 of diluted wines                 1.000000000  0.3127611
Proline                                      0.312761075  1.0000000
```

So Nonflavanoid phenols and Proanthocyanins have highest correlation based on cor value 0.864563500095115; OD280/OD315 of diluted wines and Ash have thelowest correlation based on cor value 0.003911231.

3 What is the alcohol content of the wine with the highest color intensity?

```
  Color intensity
9             5.2
```

4 What percentage of wines had a higher content of proanthocyanins compare to ash?

The percent is about 8.42%:

```
[1] 0.08426966
```

d: Create a table identifying the average value of each variable, providing one row for the overall average, and one row per class with class averages. (This table does not need to be "fancy" but should clearly identify what each value represents.)

```
                Alcohol                  Malic acid
          13.0006180                   2.3363483
                Ash            Alcalinity of ash
           2.3665169                  19.4949438
           Magnesium               Total phenols
          99.7415730                   2.2951124
          Flavanoids         Nonflavanoid phenols
           2.0292697                   0.3618539
      Proanthocyanins              Color intensity
           1.5908989                   5.0580899
                 Hue OD280/OD315 of diluted wines
           0.9574494                   2.6116854
             Proline
        746.8932584
```

e: Carry out a series of t-tests to examine whether the level of phenols differs across the three classes. Present the R output and interpret the results. (You may use an existing R function to carry out the t-test, or for minor extra credit, manually write your own calculation of the t-test p-values.)

Use the R function: t.test(), and devide classes into 3 groups: 12, 23, 13

```
    Welch Two Sample t-test

data:  Tp by Class
t = 7.4206, df = 119.14, p-value = 1.889e-11
alternative hypothesis: true difference in means between group 1 and group 2 is not equal to
95 percent confidence interval:
 0.4261870 0.7364055
sample estimates:
mean in group 1 mean in group 2
       2.840169        2.258873


    Welch Two Sample t-test

data:  Tp by Class
```