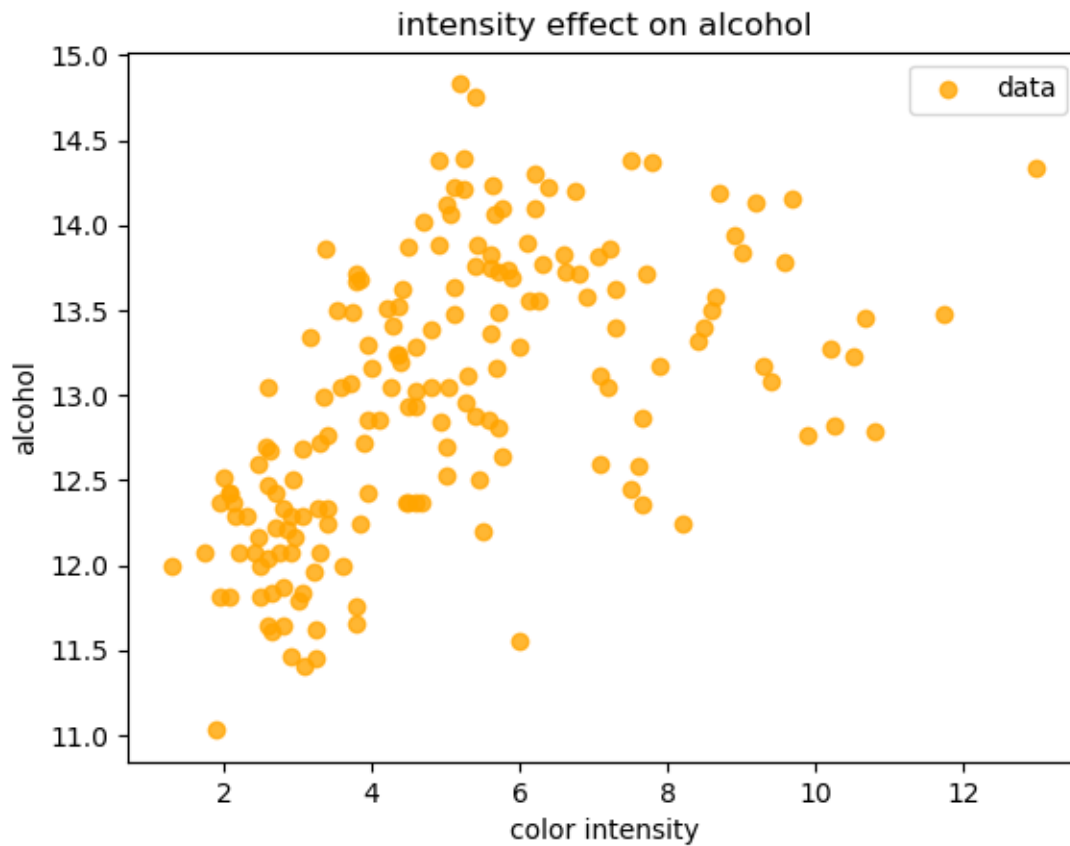


PART 1 A:



Part 1 B:

```
Correlation coefficient r1 is 0.09439694091041398
Correlation coefficient r2 is 0.21154459643174453
Correlation coefficient r3 is -0.31023513689108523
Correlation coefficient r4 is 0.27079822591147995
Correlation coefficient r5 is 0.28910112258745674
Correlation coefficient r6 is 0.23681492790034603
Correlation coefficient r7 is -0.15592946668732893
Correlation coefficient r8 is 0.1366979117694798
Correlation coefficient r9 is 0.5463641950837035
Correlation coefficient r10 is -0.07174719733015461
Correlation coefficient r11 is 0.07234318740052215
Correlation coefficient r12 is 0.6437200371782138
```

Part 1 C:

```
Correlation coefficient r1 is 0.09447001626963034
Correlation coefficient r2 is 0.2114698333576402
Correlation coefficient r3 is -0.31031956108507847
Correlation coefficient r4 is 0.27087191815081346
Correlation coefficient r5 is 0.2891797955885271
Correlation coefficient r6 is 0.2367312339072004
```

Correlation coefficient r7 is -0.15600103531377485
Correlation coefficient r8 is 0.1366164290258553
Correlation coefficient r9 is 0.5464523485959681
Correlation coefficient r10 is -0.07167506544973068
Correlation coefficient r11 is 0.07227045633454028
Correlation coefficient r12 is 0.6436400638551414

Part 1 D:

With standardization

Correlation coefficient r1 is 0.1811432407474255
Correlation coefficient r2 is 0.046585482241052946
Correlation coefficient r3 is -0.1554451257063471
Correlation coefficient r4 is 7.351778757149871e-05
Correlation coefficient r5 is 0.04015215228483619
Correlation coefficient r6 is 0.011227317165077159
Correlation coefficient r7 is -0.03185518238485736
Correlation coefficient r8 is -0.10751447699472086
Correlation coefficient r9 is 0.4655692109519123
Correlation coefficient r10 is 0.06106298349031655
Correlation coefficient r11 is 0.14062593288194877
Correlation coefficient r12 is 0.394051792558225
Y-intercept is 7.625138753543523e-15

Without standardization

Correlation coefficient r1 is 0.27043714562661786
Correlation coefficient r2 is 0.19172370973076824
Correlation coefficient r3 is 0.16846850328271612
Correlation coefficient r4 is 0.03841977525508051
Correlation coefficient r5 is 0.2559896342272888
Correlation coefficient r6 is 0.054106109292116435
Correlation coefficient r7 is 0.11700665412544228
Correlation coefficient r8 is -0.004711156419202506
Correlation coefficient r9 is 0.2127309635218259
Correlation coefficient r10 is 0.2851280927489394
Correlation coefficient r11 is 0.5151416530965677
Correlation coefficient r12 is 0.0013518207139527902
Y-intercept is 0.27520427930106656

Part 1 E:

t for b1 is 2.1594032790191453
uncorrected p-value for b1 is 0.01613150100360472
corrected p-value for b1 is 0.19357801204325664

t for b2 is 0.5553441723298066
uncorrected p-value for b2 is 0.28970570662859685
corrected p-value for b2 is 3.476468479543162

t for b3 is -1.8530568006446577
uncorrected p-value for b3 is 0.032830076923678855
corrected p-value for b3 is 0.39396092308414626

t for b4 is 0.0008764033970744976

uncorrected p-value for b4 is 0.49965089501986537
corrected p-value for b4 is 5.995810740238385

t for b5 is 0.47865263393651447
uncorrected p-value for b5 is 0.31640971268054463
corrected p-value for b5 is 3.7969165521665356

t for b6 is 0.13384051980531947
uncorrected p-value for b6 is 0.4468458954549235
corrected p-value for b6 is 5.362150745459082

t for b7 is -0.37974469823871454
uncorrected p-value for b7 is 0.3523116292575937
corrected p-value for b7 is 4.227739551091124

t for b8 is -1.2816769381317827
uncorrected p-value for b8 is 0.10087705451207243
corrected p-value for b8 is 1.2105246541448693

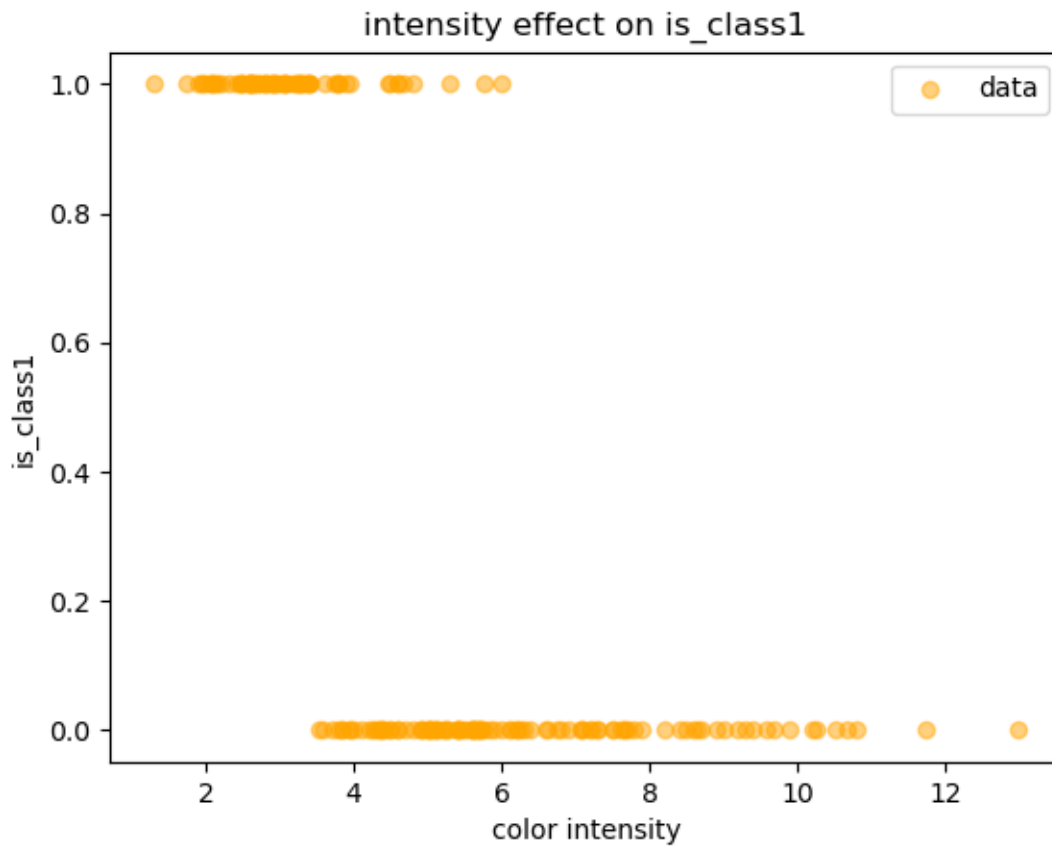
t for b9 is 5.550036957446916
uncorrected p-value for b9 is 5.591143137362309e-08
corrected p-value for b9 is 6.709371764834771e-07

t for b10 is 0.727930041615729
uncorrected p-value for b10 is 0.23384407058632162
corrected p-value for b10 is 2.8061288470358594

t for b11 is 1.6763976360775272
uncorrected p-value for b11 is 0.04777701187927297
corrected p-value for b11 is 0.5733241425512756

t for b12 is 4.697479902880104
uncorrected p-value for b12 is 2.7591404393456642e-06
corrected p-value for b12 is 3.310968527214797e-05

Part 2 A:



Part 2 B:

```
coefficient 1 is -2.8981700375737787
coefficient 2 is -0.7264803553914191
coefficient 3 is -0.885109626560152
coefficient 4 is 0.37544458289293775
coefficient 5 is -0.7517237997556138
coefficient 6 is -0.09606751988138042
coefficient 7 is 0.0849558651012219
coefficient 8 is 0.02426086141715337
coefficient 9 is 0.11482239621047362
coefficient 10 is -5.061504127077002
coefficient 11 is 0.7312015386723899
coefficient 12 is 0.3818621982448787
coefficient 13 is -2.3464527063771605
```

Part 2 C:

With standardization

```
Correlation coefficient r1 is -14.645804677066748
Correlation coefficient r2 is -9.059981898187402
Correlation coefficient r3 is -21.921320847613508
Correlation coefficient r4 is 13.41213940686719
```

Correlation coefficient r5 is 5.8100723783149535
Correlation coefficient r6 is 1.6751932271818653
Correlation coefficient r7 is 10.608441976032129
Correlation coefficient r8 is 11.45936509026619
Correlation coefficient r9 is 3.874762843708146
Correlation coefficient r10 is -40.69895116968685
Correlation coefficient r11 is 13.284758096433038
Correlation coefficient r12 is -0.9882384270386172
Correlation coefficient r13 is -38.455677738303905
Y-intercept is -25.22761327559601

Without standardization

b1 is -1.5764110860585461e-06
b2 is -2.092810878910463e-06
b3 is -2.512722168587509e-07
b4 is 6.941884248692457e-06
b5 is -8.928706281886373e-06
b6 is 3.9713262440211603e-07
b7 is 9.801784106608602e-07
b8 is 5.1011473264204374e-08
b9 is 6.387308934711715e-07
b10 is -1.022905053970269e-05
b11 is 7.881704841021962e-07
b12 is 1.634253766557055e-06
b13 is -0.0010028347006521632
Y-intercept is 1.7998174228483685e-07

Part 3 A:

Xs: (142, 12) (36, 12) ; ys: (142,) (36,)

Part 3 B:

without L2 regularization penalty:

Mean-squared error for penalty 0 is 0.298581

Pearson correlation coefficient for penalty 0 is 0.8325640552314094

for penalty 0.01:

Mean-squared error for penalty 0.01 is 0.298576

Pearson correlation coefficient for penalty 0.01 is 0.832566829985159

for penalty 0.1:

Mean-squared error for penalty 0.1 is 0.298482

Pearson correlation coefficient for penalty 0.1 is 0.8326206386697771

for penalty 1:

Mean-squared error for penalty 1 is 0.298116

Pearson correlation coefficient for penalty 1 is 0.8328189893321997

for penalty 10:

Mean-squared error for penalty 10 is 0.300398
Pearson correlation coefficient for penalty 10 is 0.8313187068983718

for penalty 100:

Mean-squared error for penalty 100 is 0.359150
Pearson correlation coefficient for penalty 100 is 0.8325849488088384

Part 3 C:

Xs: (142, 13) (36, 13) ; ys: (142,) (36,)

Part 3 D:

without L2 regularization penalty:
Log loss is 0.11194198941234446
precision: 1.0
recall: 1.0
f1: 1.0
specificity: 1.0

for penalty 0.01:
Log loss is 0.9781842227091427
precision: 1.0
recall: 1.0
f1: 1.0
specificity: 1.0

for penalty 0.1:
Log loss is 3.1048497719484383
precision: 1.0
recall: 1.0
f1: 1.0
specificity: 1.0

for penalty 1:
Log loss is 8.084512250109356
precision: 0.9333333333333333
recall: 1.0
f1: 0.9655172413793104
specificity: 0.9545454545454546

for penalty 10:
Log loss is 18.697479302764492
precision: 0.9333333333333333
recall: 1.0
f1: 0.9655172413793104
specificity: 0.9545454545454546

for penalty 100:
Log loss is 31.036226481488047
precision: 0.9333333333333333
recall: 1.0

f1: 0.9655172413793104
specificity: 0.9545454545454546

best penalty is 0.01
precision: 1.0
recall: 1.0
f1: 1.0
specificity: 1.0