Machine Learning: Classification Algorithms- Report

1. **Random Forest Algorithm:**

(i)What will be the overall performance of the algorithm?

Accuracy= $T_p + T_N / (T_p + T_N + F_P + F_N) = 0.90$

(ii)What will be the correct classification of not purchased?

Recall(Not purchased)= $T_P/(T_P + F_N) = 0.92$

(iii) What will be the correct classification of purchased?

Recall(Purchased)= $T_N/(T_P + F_P) = 0.88$

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

Precision(not purchased)= $T_P /(T_P + F_P) = 0.93$

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

Precision(purchased) = $T_N /(T_N + F_N) = 0.86$

(vi) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

F1 score(np) = 2*(Precision(np)*Recall(np)/Precision(np)+Recall(np))= 0.92

(vii) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

F1 score(purchased) = 2*(Precision(p)*Recall(p)/Precision(p)+Recallnp))=0.87

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly

classified)

MA(Precision)=Precision(purchased)*(Total no of not purchased/Overall total)+

Precision(not purchased)*(Total no of purchased/Overall total) = 0.89

MA(Recall)=Recall(purchased)*(Total no of not purchased/Overall total)+

<div align="center">Recall(not purchased)*(Total no of purchased/Overall total) = 0.90</div>

MA(Precision)=F1score(purchased)*(Total no of not purchased/Overall total)+

<div align="center">F1score(not purchased)*(Total no of purchased/Overall total) = 0.89</div>

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.90

WA(Recall) = 0.90

WA(F1 score) =0.90

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

2. **Decision Tree Algorithm**:

(i)What will be the overall performance of the algorithm?

Accuracy= $T_p + T_N$ / ($T_p + T_N + F_P + F_N$) = 0.87

(ii)What will be the correct classification of not purchased?

Recall(Not purchased)= $T_P/(T_P + F_N)$ = 0.89

(iii) What will be the correct classification of purchased?

Recall(Purchased)= $T_N/(T_P + F_P)$ = 0.84

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

Precision(not purchased)= T_P /($T_P + F_P$) = 0.90

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

Precision(purchased) = $T_N /(T_N + F_N)$ = 0.82

(vi) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

F1 score(np) = 2*(Precision(np)*Recall(np)/Precision(np)+Recall(np))= 0.90

(vii) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

F1 score(purchased) = 2*(Precision(p)*Recall(p)/Precision(p)+Recallnp))=0.83

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

MA(Precision)=Precision(purchased)*(Total no of not purchased/Overall total)+

Precision(not purchased)*(Total no of purchased/Overall total) = 0.86

MA(Recall)=Recall(purchased)*(Total no of not purchased/Overall total)+

Recall(not purchased)*(Total no of purchased/Overall total) = 0.87

MA(Precision)=F1score(purchased)*(Total no of not purchased/Overall total)+

F1score(not purchased)*(Total no of purchased/Overall total) = 0.86

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.87

WA(Recall) = 0.87

WA(F1 score) =0.87

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

3. **Support Vector Machine Algorithm**

(i)What will be the overall performance of the algorithm?

Accuracy= $T_P + T_N / (T_P + T_N + F_P + F_N)$ = 0.78

(ii)What will be the correct classification of not purchased?

Recall(Not purchased)= $T_P/(T_P + F_N)$ = 0.96

(iii) What will be the correct classification of purchased?

Recall(Purchased)= $T_N/(T_P + F_P)$ = 0.47

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

Precision(not purchased)= $T_P /(T_P + F_P)$ = 0.76

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

Precision(purchased) = $T_N /(T_N + F_N)$ = 0.88

(vi) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

F1 score(np) = 2*(Precision(np)*Recall(np)/Precision(np)+Recall(np))= 0.85

(vii) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

F1 score(purchased) = 2*(Precision(p)*Recall(p)/Precision(p)+Recallnp))=0.61

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)
MA(Precision)=Precision(purchased)*(Total no of not purchased/Overall total)+

 Precision(not purchased)*(Total no of purchased/Overall total) = 0.82

MA(Recall)=Recall(purchased)*(Total no of not purchased/Overall total)+

 Recall(not purchased)*(Total no of purchased/Overall total) = 0.72

MA(Precision)=F1score(purchased)*(Total no of not purchased/Overall total)+

 F1score(not purchased)*(Total no of purchased/Overall total) = 0.73

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.81

WA(Recall) = 0.78

WA(F1 score) =0.76

(x) **support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

4. **Logistic Regression Algorithm**

(i)What will be the overall performance of the algorithm?

Accuracy= T_p+T_N / $(T_p+T_N +F_P+F_N)$ = 0.63

(ii)What will be the correct classification of not purchased?

Recall(Not purchased)= $T_P/(T_P+F_N)$ = 1.00

(iii) What will be the correct classification of purchased?

Recall(Purchased)= $T_N/(T_P+ F_P)$ = 0.00

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

Precision(not purchased)= T_P /($T_P + F_P$) = 0.63

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

Precision(purchased) = T_N /($T_N + F_N$) = 0.00

(vi) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

F1 score(np) = 2*(Precision(np)*Recall(np)/Precision(np)+Recall(np))= 0.78

(vii) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

F1 score(purchased) = 2*(Precision(p)*Recall(p)/Precision(p)+Recallnp))=0.00

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

MA(Precision)=Precision(purchased)*(Total no of not purchased/Overall total)+

Precision(not purchased)*(Total no of purchased/Overall total) = 0.32

MA(Recall)=Recall(purchased)*(Total no of not purchased/Overall total)+

Recall(not purchased)*(Total no of purchased/Overall total) = 0.50

MA(Precision)=F1score(purchased)*(Total no of not purchased/Overall total)+

F1score(not purchased)*(Total no of purchased/Overall total) = 0.39

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.40

WA(Recall) = 0.63

WA(F1 score) =0.49

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

5.KNN Algorithm

(i)What will be the overall performance of the algorithm?

Accuracy= $T_p + T_N$ / $(T_p + T_N + F_P + F_N)$ = 0.84

(ii)What will be the correct classification of not purchased?

Recall(Not purchased)= $T_P/(T_P + F_N)$ = 0.93

(iii) What will be the correct classification of purchased?

Recall(Purchased)= $T_N/(T_P + F_P)$ = 0.67

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

Precision(not purchased)= T_P /(T_P + F_P) = 0.83

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

Precision(purchased) = T_N /(T_N + F_N) = 0.85

(vi) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

F1 score(np) = 2*(Precision(np)*Recall(np)/Precision(np)+Recall(np))= 0.88

(vii) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

F1 score(purchased) = 2*(Precision(p)*Recall(p)/Precision(p)+Recallnp))=0.75

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

MA(Precision)=Precision(purchased)*(Total no of not purchased/Overall total)+

Precision(not purchased)*(Total no of purchased/Overall total) = 0.84

MA(Recall)=Recall(purchased)*(Total no of not purchased/Overall total)+

Recall(not purchased)*(Total no of purchased/Overall total) = 0.80

MA(Precision)=F1score(purchased)*(Total no of not purchased/Overall total)+

F1score(not purchased)*(Total no of purchased/Overall total) = 0.81

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision) =0.84

WA(Recall) = 0.84

WA(F1 score) =0.83

(x) **Support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

5.   Naives Bayes Algorithm (given in table below)

(i)What will be the overall performance of the algorithm?

Accuracy= $T_p + T_N$ / ($T_p + T_N + F_P + F_N$)

(ii)What will be the correct classification of not purchased?

Recall(Not purchased)= $T_P / (T_P + F_N)$

(iii) What will be the correct classification of purchased?

Recall(Purchased)= $T_N / (T_P + F_P)$

(iv)What is the precision value for not purchased ?

It is calculated as the ratio of true positive predictions to the sum of true positive and false positive predictions

Precision(not purchased)= $T_P / (T_P + F_P)$

(v) What is the precision value for purchased ?

It is calculated as the ratio of true negative predictions to the sum of true negative and false negative predictions

Precision(purchased) = $T_N / (T_N + F_N)$

(vi) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(not purchased) and recall(not purchased)into a single value, providing a balance between them.

F1 score(np) = 2*(Precision(np)*Recall(np)/Precision(np)+Recall(np))

(vii) F1 Measure(Not purchased):

The F1 score is a metric that combines both precision(purchased) and recall(purchased)into a single value, providing a balance between them.

F1 score(purchased) = 2*(Precision(p)*Recall(p)/Precision(p)+Recallnp))

(viii**) Macro average** : Average performance of precision, recall and F1score (correctly and wrongly classified)

MA(Precision)=Precision(purchased)*(Total no of not purchased/Overall total)+

Precision(not purchased)*(Total no of purchased/Overall total)

MA(Recall)=Recall(purchased)*(Total no of not purchased/Overall total)+

Recall(not purchased)*(Total no of purchased/Overall total)

MA(Precision)=F1score(purchased)*(Total no of not purchased/Overall total)+

F1score(not purchased)*(Total no of purchased/Overall total)

(ix)**Weighted Average of Precision, recall and F1 score**:

The weighted average precision in a classification scenario is calculated by taking the average of the precision scores for each class, with each class's precision weighted by its support

WA(Precision)

WA(Recall)

WA(F1 score) =

(x) **support:**

Support of not purchased: 85

Support of purchased: 49

Total support:134

Comparison table for all Naives Bayes Algorithm:

Parameters	Multinomial NB	Bernoulli NB	Categorical NB	Complement NB
Accuracy	0.63	0.63	0.84	0.51
Recall(not purchased)	1.00	1.00	0.96	0.55
Recall(purchased)	0.00	0.00	0.63	0.47
Precision(not purchased)	0.63	0.63	0.82	0.67
Precision(purchased)	0.00	0.00	0.91	0.39
F1 score(not purchased)	0.78	0.78	0.89	0.55
F1 score(purchased)	0.00	0.00	0.75	0.47
Macro Avg (Precision)	0.32	0.32	0.87	0.53
Macro Avg (Precision)	0.50	0.50	0.80	0.53
Macro Avg (Precision)	0.39	0.39	0.82	0.51
Weighted Avg (Precision)	0.40	0.40	0.85	0.57
Weighted Avg (Precision)	0.63	0.63	0.84	0.51
Weighted Avg (Precision)	0.49	0.49	0.84	0.52