Australia Next Day Rain Prediction

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Table 1: Results of Kolmogorov-Smirnov test on Conditional Distributions (RainTomorrow = 0 vs. RainTomorrow = 0)

NumericVariable	D
MinTemp	0.09
MaxTemp	0.14
Rainfall	0.34
Evaporation	0.14
Sunshine	0.47
WindGustSpeed	0.23
WindSpeed9am	0.08
WindSpeed3pm	0.08
Humidity9am	0.29
Humidity3pm	0.46
Pressure9am	0.26
Pressure3pm	0.23
Cloud9am	0.34
Cloud3pm	0.41
Temp9am	0.04
Temp3pm	0.17

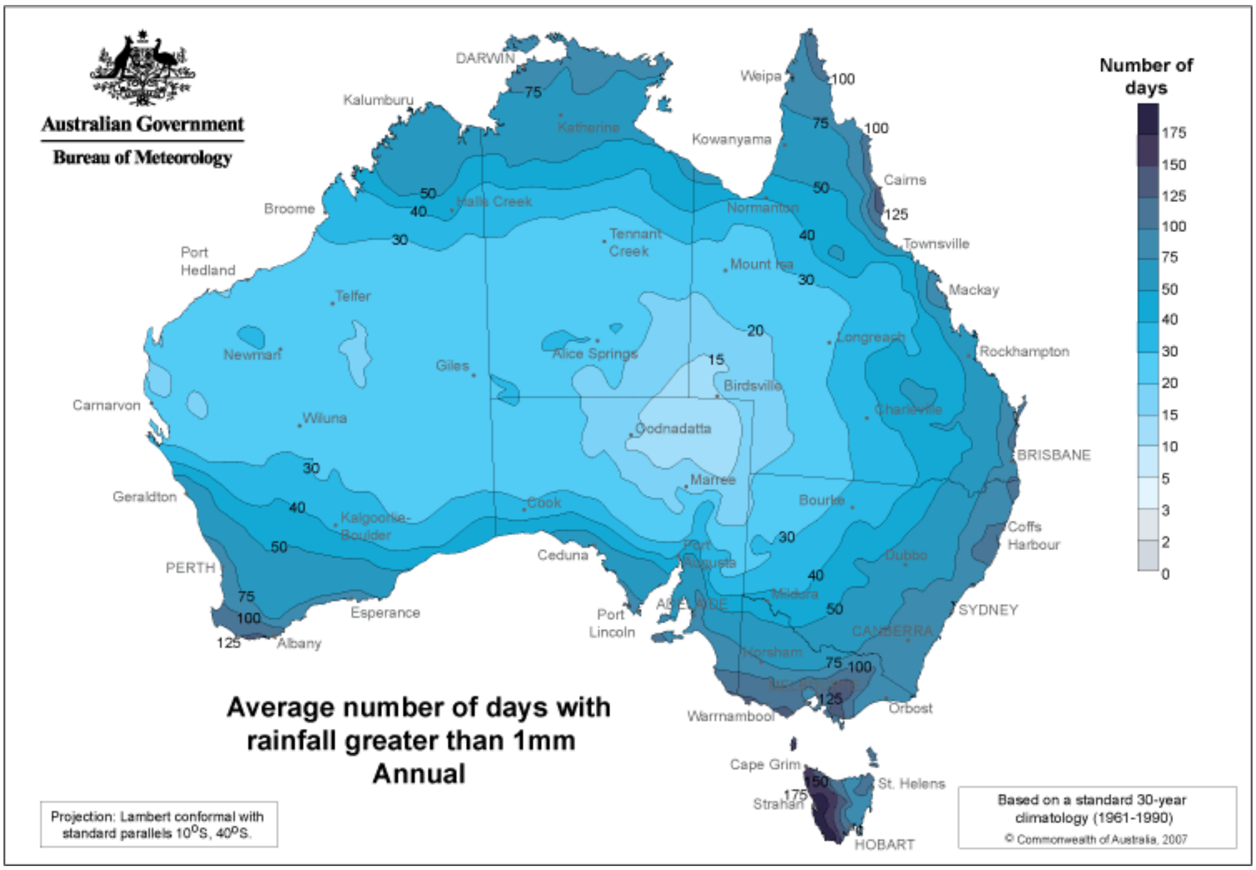


Figure 1: Rain Days across Australia Source: http://www.bom.gov.au/jsp/ncc/climate_averages/raindays/index.jsp

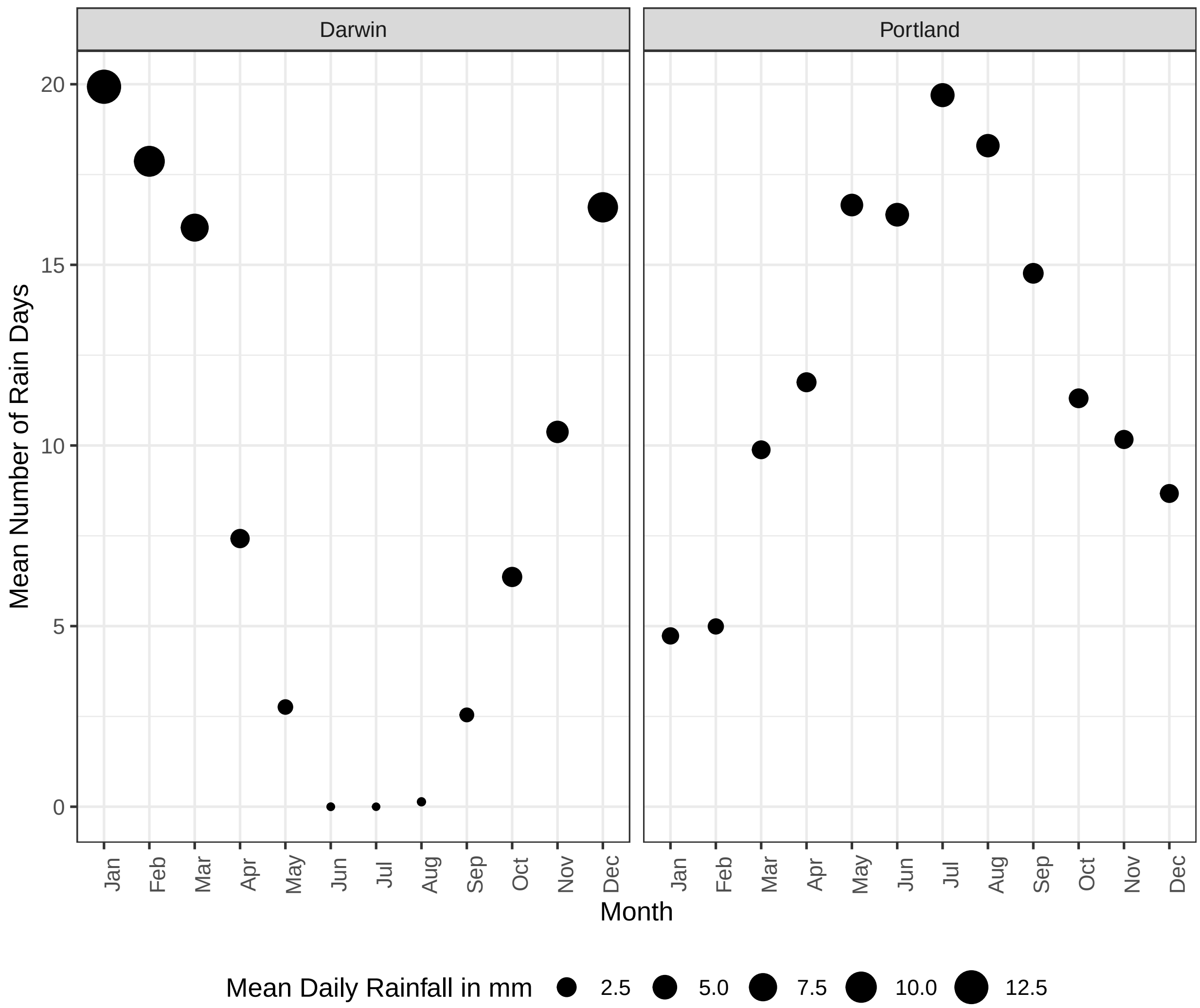


Figure 2: Monthly Rainfall Patterns by Location

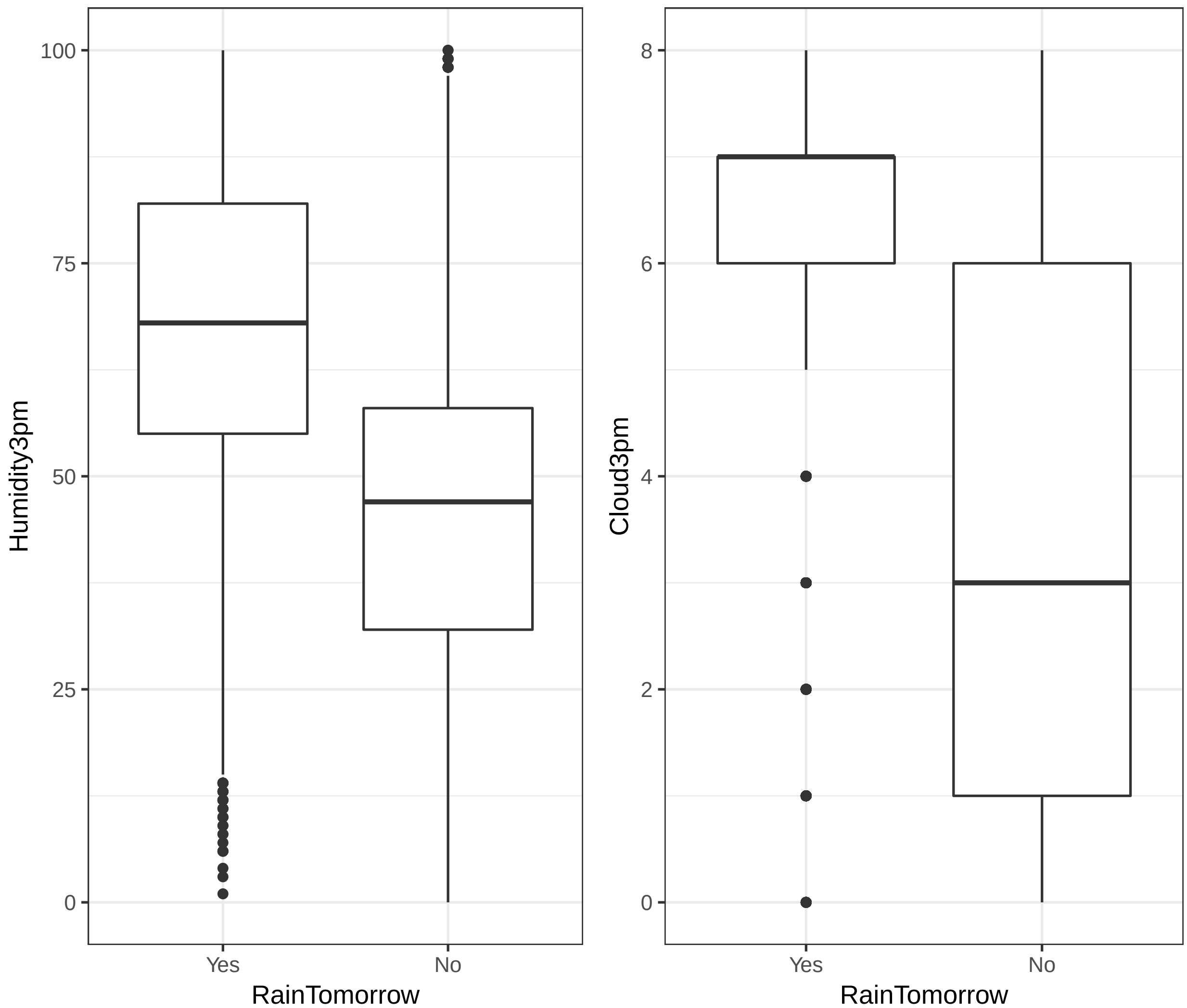


Figure 3: Examples of Some Well Separated Cases

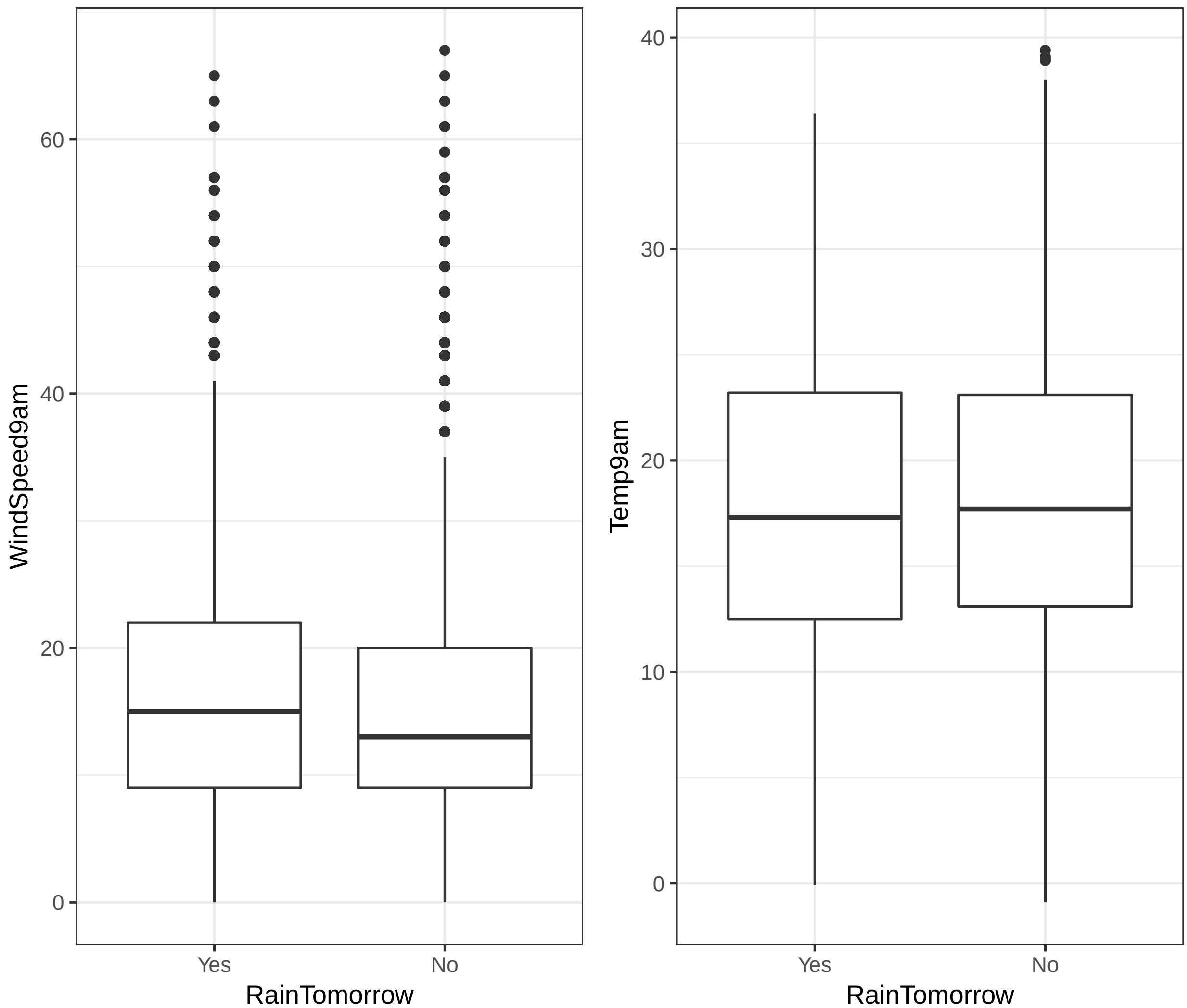


Figure 4: Examples of Some **NOT** Well Separated Cases

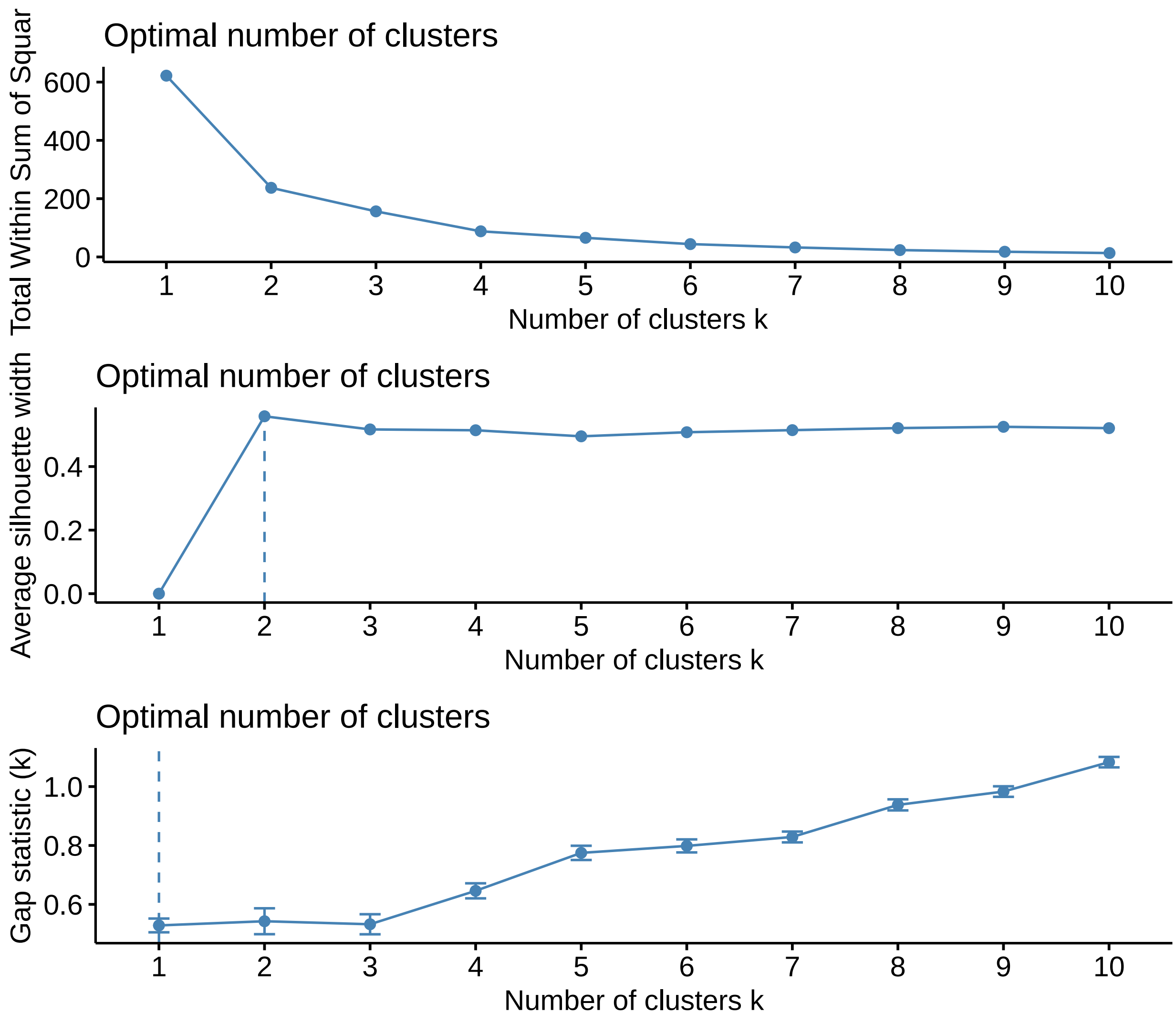


Figure 5: Finding Optimal Number for Location - Month Clustering

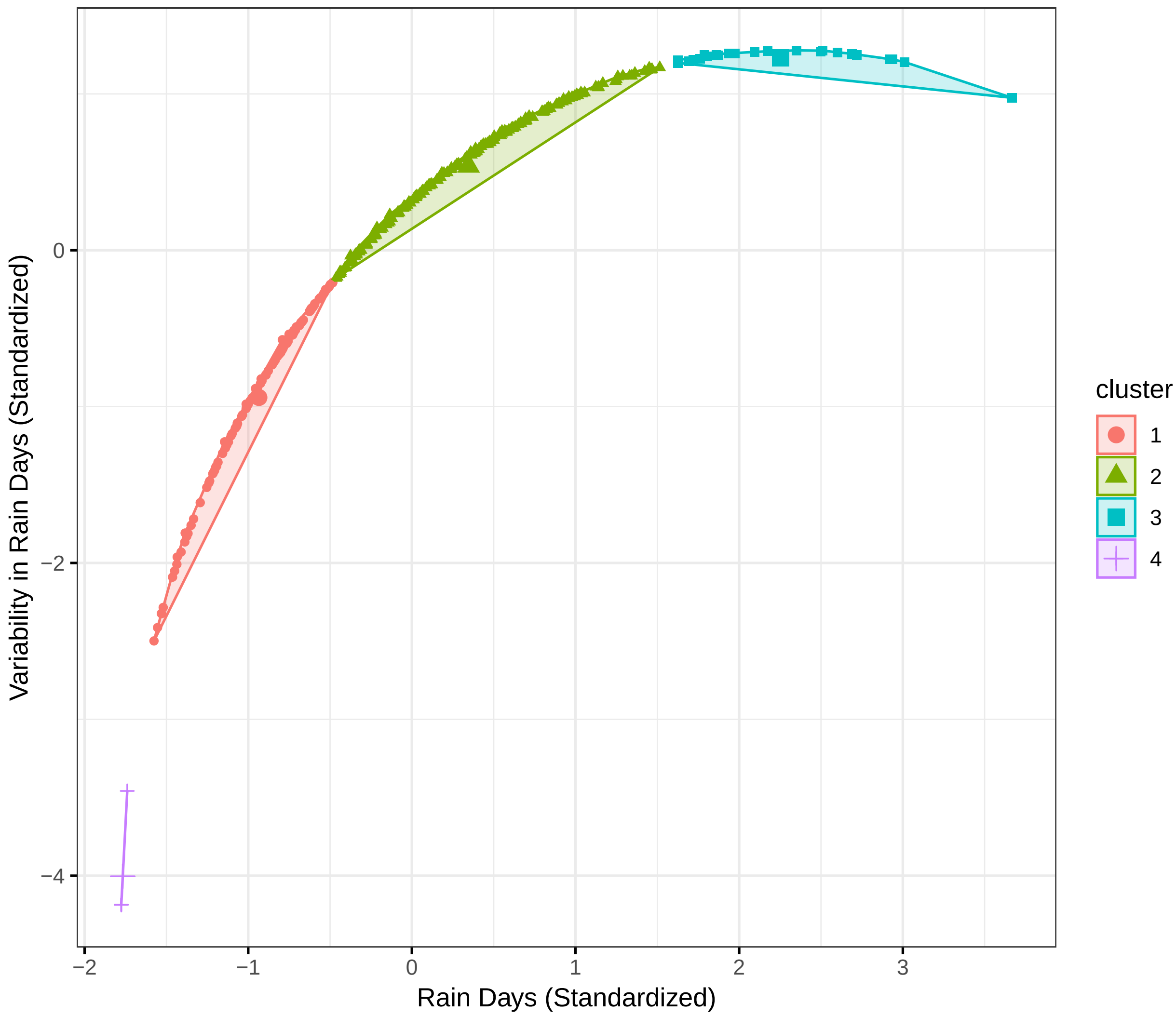


Figure 6: Number of Rain Days and Variability in Rain Days accross Clusters

Table 2: Location-Month Clusters

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AliceSprings	1	1	1	1	1	1	1	1	1	1	1	2
Brisbane	2	2	2	2	2	2	1	1	1	1	2	2
Cairns	3	3	3	2	2	2	2	1	1	2	2	2
Canberra	1	2	1	2	1	2	1	2	2	2	2	2
Cobar	1	2	1	1	2	2	1	4	1	1	1	1
CoffsHarbour	2	2	3	2	2	2	2	1	2	2	2	3
Darwin	3	3	3	2	1	4	4	4	1	2	2	3
Hobart	2	1	2	2	2	2	2	2	2	2	2	2
Melbourne	1	1	2	2	2	2	2	2	2	2	2	2
MelbourneAirport	1	1	2	2	2	2	2	2	2	2	2	2
Mildura	1	1	1	1	1	1	1	1	1	1	1	1
Moree	2	1	1	1	1	1	1	1	1	1	1	2
MountGambier	1	1	2	2	3	3	3	3	2	2	2	2
NorfolkIsland	2	2	2	2	2	3	3	2	2	2	2	2
Nuriootpa	1	1	1	2	2	2	2	2	2	1	1	2
Perth	1	1	1	1	2	2	3	2	2	1	1	1
PerthAirport	1	1	1	1	2	2	2	2	2	1	1	1
Portland	1	2	2	2	3	3	3	3	3	2	2	2
Sale	1	2	2	2	2	2	2	2	2	2	2	2
Sydney	2	2	2	2	1	2	2	2	2	1	2	2
SydneyAirport	2	2	2	2	2	2	2	2	2	2	2	2
Townsville	2	3	2	1	1	1	1	1	1	1	2	2
WaggaWagga	1	2	1	1	2	2	2	2	1	1	1	2
Watsonia	1	1	2	2	2	2	2	2	2	2	2	2
Williamtown	2	2	2	2	2	3	2	1	2	2	2	2
Woomera	1	1	1	1	1	1	1	1	1	1	1	1

Table 3: Conditional Probabilities No Rain Tomorrow vs. Rain Tomorrow Given WindGust Direction (Location = Cobar)

	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	Total
Yes	0.14	0.1	0.15	0.05	0.41	0.33	0.14	0.12	0.06	0.07	0.08	0.02	0.07	0	0.11	0.08	0.12
No	0.86	0.9	0.85	0.95	0.59	0.67	0.86	0.88	0.94	0.93	0.92	0.98	0.93	1	0.89	0.92	0.88
Total	1.00	1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	1.00	1.00	1.00

Table 4: Probabilites of Rain Tomorrow Conditioned on rainDir9am

	RainTomorrow=0	RainTomorrow=1	Total
rainDirGust=0	0.13	0.87	1
rainDirGust=1	0.32	0.68	1
Total	0.22	0.78	1

3 Results

result from Logistic hyper parameter tuning

Table 5: Probabilites of Rain Tomorrow Conditioned on rainDir3pm

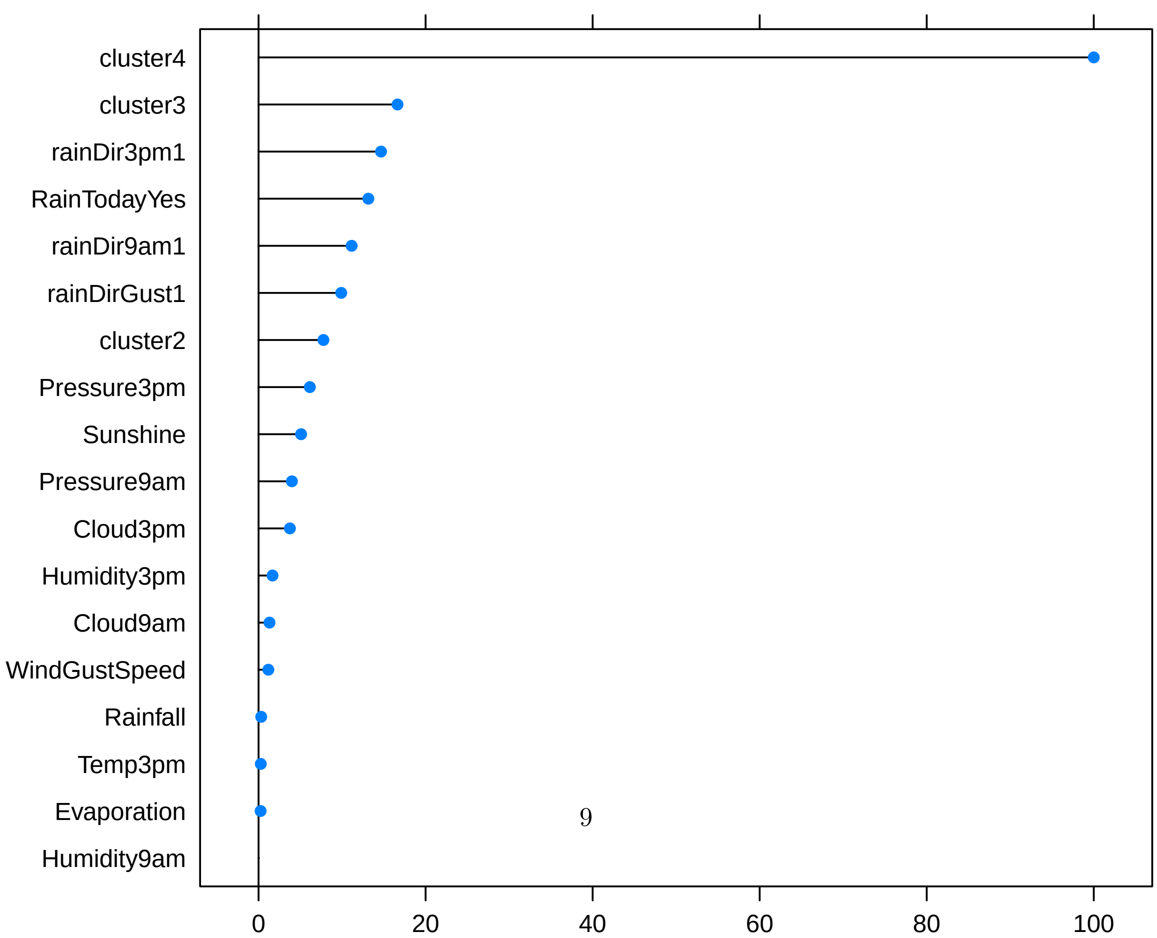
	RainTomorrow=0	RainTomorrow=1	Total
rainDir9am=0	0.14	0.86	1
rainDir9am=1	0.31	0.69	1
Total	0.22	0.78	1

Table 6: Probabilites of Rain Tomorrow Conditioned on rainDirGust

	RainTomorrow=0	RainTomorrow=1	Total
rainDir3pm=0	0.14	0.86	1
rainDir3pm=1	0.33	0.67	1
Total	0.22	0.78	1

Table 7: Optimal Hyperparameter Selection Using Logistic Model 10-fold nested Cross Validation

alpha	lambda	ROC
0.10	0.0003750	0.8915252
0.10	0.0037499	0.8903169
0.10	0.0374991	0.8864241
0.55	0.0003750	0.8915066
0.55	0.0037499	0.8892782
0.55	0.0374991	0.8856168
1.00	0.0003750	0.8914790
1.00	0.0037499	0.8879022
1.00	0.0374991	0.8806607



we drop . . . the optimal hyperparameters values were the same with no significant change in ROC

Table 8: Expected Performance of the Logistic Model

ROC	Sens	Spec	alpha	lambda	Resample
0.891	0.565	0.946	0.1	0.00037499130337396	Fold01
0.895	0.560	0.937	0.1	0.00037499130337396	Fold02
0.895	0.556	0.939	0.1	0.00037499130337396	Fold03
0.886	0.535	0.942	0.1	0.00037499130337396	Fold04
0.879	0.523	0.940	0.1	0.00037499130337396	Fold05
0.902	0.556	0.938	0.1	0.00037499130337396	Fold06
0.884	0.523	0.936	0.1	0.00037499130337396	Fold07
0.885	0.542	0.937	0.1	0.00037499130337396	Fold08
0.898	0.527	0.944	0.1	0.00037499130337396	Fold09
0.897	0.556	0.944	0.1	0.00037499130337396	Fold10
0.891	0.544	0.940	0.1	0.00037499130337396	Mean
0.007	0.016	0.003	0.1	0.00037499130337396	STD

3.1 Adaptive Boosting Model

Tuning parameter 'shrinkage' was held constant at a value of 0.1 Tuning parameter 'n.minobsinnode' was held constant at a value of 10 ROC was used to select the optimal model using the largest value. The final values used for the model were n.trees = 150, interaction.depth = 3, shrinkage = 0.1 and n.minobsinnode = 10.

Table 9: Optimal Hyperparameter Selection for AdaBoost Model Using 5-fold nested Cross Validation

	shrinkage	interaction.depth	n.minobsinnode	n.trees	ROC	Sens	Spec
1	0.1	1	10	50	0.8755141	0.7953763	0.7862473
4	0.1	2	10	50	0.8845487	0.7986227	0.7978730
7	0.1	3	10	50	0.8878713	0.8044270	0.8010411
2	0.1	1	10	100	0.8843780	0.8034432	0.7973496
5	0.1	2	10	100	0.8899918	0.8051156	0.8040164
8	0.1	3	10	100	0.8926029	0.8102312	0.8070744
3	0.1	1	10	150	0.8875259	0.8046237	0.8015921
6	0.1	2	10	150	0.8923524	0.8068864	0.8076804
9	0.1	3	10	150	0.8946120	0.8109198	0.8096365

Table 10: Optimal Hyperparameter Selection for AdaBoost (Reduced) Model Using 5-fold nested Cross Validation

	shrinkage	interaction.depth	n.minobsinnode	n.trees	ROC	Sens	Spec
1	0.1	1	10	50	0.8755141	0.7953763	0.7862473
4	0.1	2	10	50	0.8844778	0.7988195	0.7983964
7	0.1	3	10	50	0.8874715	0.8036399	0.8006830
2	0.1	1	10	100	0.8843780	0.8034432	0.7973496
5	0.1	2	10	100	0.8891172	0.8051156	0.8044021
8	0.1	3	10	100	0.8909592	0.8097393	0.8061928
3	0.1	1	10	150	0.8871446	0.8049188	0.8018951
6	0.1	2	10	150	0.8909410	0.8087555	0.8065509
9	0.1	3	10	150	0.8928238	0.8090507	0.8083968

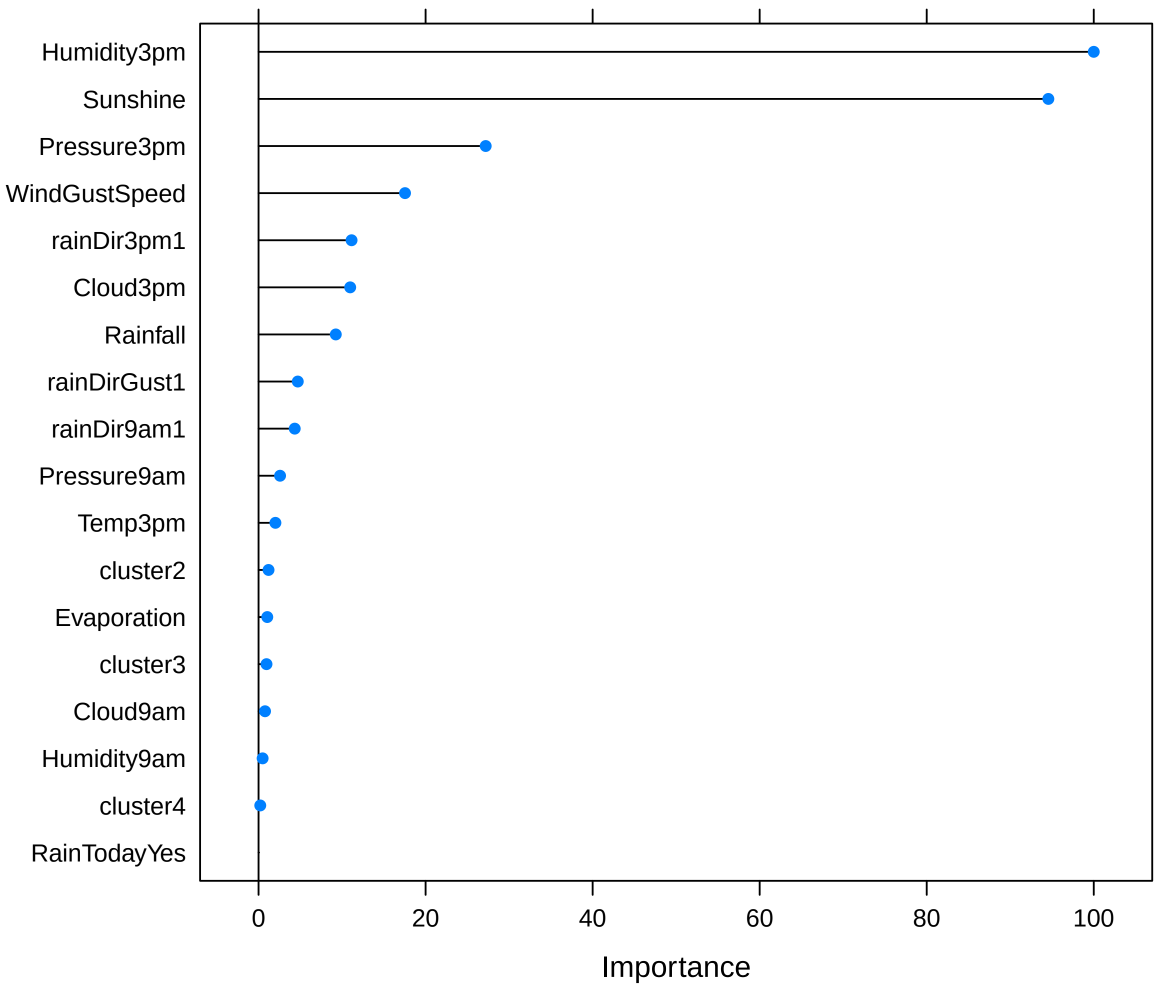


Figure 7: Variable Importance for AdaBoost Model

Table 11: Expected Performance of the AdaBoost Model

ROC	Sens	Spec	n.trees	interaction.depth	shrinkage	n.minobsinnode	Resample
0.895	0.822	0.797	150	3	0.1	10	Fold1
0.888	0.802	0.805	150	3	0.1	10	Fold2
0.896	0.821	0.802	150	3	0.1	10	Fold3
0.892	0.805	0.808	150	3	0.1	10	Fold4
0.893	0.807	0.819	150	3	0.1	10	Fold5
0.893	0.811	0.806	150	3	0.1	10	Mean
0.003	0.010	0.008	150	3	0.1	10	STD

4 Conclusion