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11096	3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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12946 12947 12948 12949 12949 12949 12949 12949 12949 12951 12951 12955 12955 12955 12955 12966 12966 12966 12966 12967 12979 12999 13000 13001 13
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13168 0.00379 13169 0.00380 13170 0.00387 13171 0.00387 13172 0.00381 13173 0.00381 13174 0.00384 13175 0.00381 13176 0.00381 13177 0.00382 13180 0.00384 13181 0.00384 13182 0.00381 13183 0.00382 13184 0.00381 13185 0.00382 13187 0.00382 13188 0.00381 13189 0.00382 13189 0.00383 13190 0.00386 13191 0.00386 13192 0.00386 13193 0.00386 13194 0.00387 13195 0.00387 13197 0.00387 13198 0.00387 13199 0.00384 13200 0.0384 13201 0.00384 13202 0.00384
7611

13316	
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13402	0.004264210	C
13404	0.004300171	C
13405	0.004278243	C
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13409	0.004239792	1
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13427	0.004288615	1
13428	0.004274231	1
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13503 13504	0.004650195 0.004637878	1 1
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13517	0.004618132 0.004598158	1
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13538

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13909 13910 13911 13912 13913 13914 13915 13916 13917 13918 13917 13918 13920 13921 13922 13923 13924 13923 13924 13924 13925 13927 13927 13929 13931 13932 13933 13933 13933 13933 13933 13933 13933 13933 13933 13933 13933 13933 13933 13934 13944 13945 13947 13948 13947 13948 13950 13951 13952 13953 13973 13
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14056 14057 14058 14057 14065 14065 14066 14066 14066 14066 14066 14067 14077 14077 14077 14077 14077 14077 14077 14077 14077 14077 14077 1408 1408 1408 1408 1409 1409 1409 1409 1409 1410 1410 1411 1411
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14248 0.004876040 14249 0.004860000 14250 0.004875481 14251 0.004876040 14252 0.004876040 14253 0.004876040 14254 0.004876040 14255 0.004889165 14257 0.004889165	14248 0.004876040 14249 0.004860000 14250 0.004875481 14251 0.004860000 14252 0.004876040 14253 0.004876040 14254 0.004876040 14255 0.004889165 14257 0.004889165 14258 0.004889165 14259 0.004889165 14260 0.004912499 14261 0.004919791 14262 0.004919791 14263 0.004919791 14264 0.004932917 14266 0.004932917 14267 0.004932917	14236 14237 14238 14239 14240 14241 14242 14243 14244 14245	0.004861019 0.004890424 0.004846877 0.004846877 0.004846877 0.004890424 0.004868609 0.004875481 0.004860000 0.004868020	
	14259	14247 14248 14249 14250 14251 14252 14253 14254 14255 14256 14257	0.004868020 0.004876040 0.004860000 0.004875481 0.004860000 0.004876040 0.004876040 0.004889165 0.004889165	

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14278
       0.004938734
14279
       0.004944046
       0.004951289
14280
14281
       0.004958532
14282
       0.004958532
14283
       0.004958532
14284
       0.004975601
       0.004976856
                            0
 [ reached 'max' / getOption("max.print") -- omitted 6275 rows ]
> dim(data) # Retourne le nombre de lignes et de colonnes
[1] 20560
> nrow(data) # Nombre de lignes
[1] 20560
> ncol(data)
            # Nombre de colonnes
[1] 7
> # Afficher les donn es dans une interface graphique
> View(data)
> # Visualisation des relations avec la variable 'Occupancy'
> library(ggplot2)
 # Temprature vs Occupancy
> library(ggplot2)
> # Creation du graphique avec regression logistique
> ggplot(data, aes(x = Temperature, y = Occupancy)) +
   geom point() + # Ajout des points de données
    geom smooth(method = "glm",
+
               method.args = list(family = binomial), # Passer `family` via method.args
+
                se = FALSE, color = "blue") + # Courbe de régression sans intervalle de confi
ance
+
    labs(title = "Régression Logistique : Température vs Occupation",
        x = "Température (°C)",
        y = "Occupation (0 = Non occupé, 1 = Occupé)")
\epsilon
> # Humidity vs Occupancy
> # Création du graphique avec régression logistique
> ggplot(data, aes(x = Humidity, y = Occupancy)) +
   geom point() +
   geom smooth (method = "glm",
                method.args = list(family = "binomial"),
                se = FALSE, color = "blue") +
    labs(title = "Régression Logistique : Humidité vs Occupation",
        x = "Humidity (%)",
         y = "Occupation (0 = Non occupé, 1 = Occupé)")
 geom_smooth()`using formula = 'y ~ x'
> # CO2 vs Occupancy
> # Creation du graphique avec regression logistique
> ggplot(data, aes(x = CO2, y = Occupancy)) +
    geom point() + # Ajouter les points de données
    geom smooth(method = "glm"
               method.args = list(family = "binomial"), # Spécifier `family` via method.args
+
                se = FALSE, color = "blue") + # Courbe de régression sans intervalle de confi
ance
    labs(title = "Régression Logistique : CO2 vs Occupation",
        x = "CO2 (ppm)",
         y = "Occupation (0 = Non occupé, 1 = Occupé)")
 geom smooth()` using formula = 'y \sim x'
> # Creation du modèle logistique pour prédire la probabilité d'occupation en fonction des aut
res variables
> # Creer le modèle de regression logistique
> model <- glm(Occupancy ~ Temperature + Humidity + Light + CO2 + HumidityRatio,
               data = data clean,
               family = \overline{binomial}
Message d'avis :
glm.fit: des probabilités ont été ajustées numériquement à 0 ou 1
> # Suppression des lignes contenant des valeurs manquantes s'il y en a.
> data clean <- na.omit(data)</pre>
> # Verifiez la structure de `data_clean`
> str(data clean)
'data.frame':
               20560 obs. of 7 variables:
                      "2015-02-02 14:19:00" "2015-02-02 14:19:59" "2015-02-02 14:21:00" "2015
 $ date
                : chr
-02-02 14:22:00" ...
 $ Temperature : num 23.7 23.7 23.7 23.8 ...
 $ Humidity
                : num
                      26.3 26.3 26.2 26.1 26.2 ...
 $ Light
                      585 578 573 494 489 ...
                : num
 $ CO2
                : num 749 760 770 775 779 ...
```

```
$ HumidityRatio: num 0.00476 0.00477 0.00477 0.00474 0.00477 ...
 $ Occupancy : int 1 1 1 1 1 1 1 1 1 ...
> # Suppression des lignes où certaines colonnes spécifiques qui ont des valeurs manquantes
> data clean <- data[complete.cases(data[, c("Temperature", "Humidity", "Light", "CO2", "Humid
ityRatio")]), ]
> # Mod le avec régression logistique
> model <- glm(Occupancy ~ Temperature + Humidity + Light + CO2 + HumidityRatio,
              data = data clean,
               family = binomial)
Message d'avis :
glm.fit: des probabilités ont été ajustées numériquement à 0 ou 1
> # Resume du modele
> summary(model)
Call:
glm(formula = Occupancy ~ Temperature + Humidity + Light + CO2 +
   HumidityRatio, family = binomial, data = data clean)
Coefficients:
               Estimate Std. Error z value Pr(>|z|)
                                    5.709 1.14e-08 ***
               6.702e+01 1.174e+01
(Intercept)
             -3.721e+00 5.472e-01 -6.799 1.05e-11 ***
Temperature
             -1.644e+00 3.263e-01 -5.037 4.72e-07 ***
Humidity
              2.337e-02 5.608e-04 41.677 < 2e-16 ***
Light
              3.547e-03 2.677e-04 13.251 < 2e-16 ***
CO2
HumidityRatio 1.094e+04 2.057e+03 5.319 1.05e-07 ***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Dispersion parameter for binomial family taken to be 1)
   Null deviance: 22226.2
                          on 20559
                                     degrees of freedom
Residual deviance: 2173.3 on 20554 degrees of freedom
AIC: 2185.3
Number of Fisher Scoring iterations: 10
> # Installer et charger glmnet pour mieux expliquer le modele de LASSO
> install.packages("glmnet")
Installation du package dans 'C:/Users/PC/AppData/Local/R/win-library/4.4'
(car 'lib' n'est pas spécifié)
essai de l'URL 'https://cloud.r-project.org/bin/windows/contrib/4.4/glmnet 4.1-8.zip'
Content type 'application/zip' length 2448153 bytes (2.3 MB)
downloaded 2.3 MB
le package 'glmnet' a été décompressé et les sommes MD5 ont été vérifiées avec succés
Les packages binaires téléchargés sont dans
       C:\Users\PC\AppData\Local\Temp\RtmpE7WGC5\downloaded packages
> library(glmnet)
Le chargement a nécessité le package : Matrix
Loaded glmnet 4.1-8
> # Regression logistique avec regularisation L1 (lasso)
> model lasso <- glmnet(x = as.matrix(data clean[, c("Temperature", "Humidity", "Light", "CO2"
 "HumidityRatio")]),
                        y = data_clean$Occupancy,
                        family = "binomial", alpha = 1)
> # Resume du modele
> summary(model lasso)
          Length Class
                           Mode
a0
           87
                -none-
                           numeric
          435
beta
                 dqCMatrix S4
df
           87
                 -none-
                           numeric
           2
                 -none-
dim
                           numeric
          87
                 -none-
                          numeric
lambda
dev.ratio 87
                 -none-
                          numeric
nulldev
           1
                 -none-
                          numeric
           1
npasses
                 -none-
                          numeric
           1
jerr
                          numeric
                 -none-
           1
offset
                 -none-
                           logical
classnames
            2
                 -none-
                           character
                           call
call
            5
                 -none-
nobs
            1
                -none-
                          numeric
> # Supposons que vos donnees nettoyges sont dans 'data clean'
```

```
> # Si vous avez des valeurs manquantes, vous pouvez les supprimer comme suit
> data clean <- na.omit(data)</pre>
> # Ajuster le modele de regression logistique avec Lasso
> model lasso <- glmnet(</pre>
   x = as.matrix(data clean[, c("Temperature", "Humidity", "Light", "CO2", "HumidityRatio")])
   y = data clean $0ccupancy,
   family = "binomial", # Régression logistique (binomiale)
    alpha = 1 # alpha = 1 pour Lasso (régularisation L1)
+ # Resume du modele
+ print(model_lasso)
Erreur : symbole inattendu dans :
"# Resume du modele
print"
> # Obtenir les coefficients du modèle
> coef(model lasso)
6 x 87 sparse Matrix of class "dgCMatrix"
  [[ suppressing 87 column names 's0', 's1', 's2' ... ]]
              -1.202498 -1.3246886080 -1.442096967 -1.556535011 -1.668933846
(Intercept)
Temperature
Humidity
                         0.0008671949 0.001607272 0.002271178 0.002884263
Light
CO2
HumidityRatio
              -1.779852063 -1.889691216 -1.998752162 -2.107260741 -2.215388406
(Intercept)
Temperature
Humidity
               0.003460892 0.004010053
                                         0.004537644
                                                      0.005047645
                                                                   0.005542824
Light
CO<sub>2</sub>
HumidityRatio
(Intercept)
              -2.323269120 -2.431012026 -2.538710277 -2.646446863 -2.754298289
Temperature
Humidity
               0.006025166
                            0.006496152
                                         0.006956926
                                                       0.007408407
                                                                    0.007851354
Light
CO2
HumidityRatio
(Intercept)
              -2.862336898 -2.97063194 -3.079250657 -3.18825847 -3.297719202
Temperature
Humidity
               0.008286414
                           0.00871415
                                        0.009135064
                                                     0.00954961
                                                                 0.009958207
Light.
CO<sub>2</sub>
HumidityRatio
              -3.40769511 -3.51824682 -3.62943425 -3.749433e+00 -3.9196430048
(Intercept)
Temperature
Humidity
               0.01036124 0.01075909
                                       0.01115209
Light
                                                   1.152805e-02 0.0118249546
                                                   1.452932e-05 0.0001173459
CO2
HumidityRatio
              -4.0902646515 -4.2614698486 -4.4333439681 -4.605928314
(Intercept)
Temperature
Humidity
               0.0121196420 0.0124125721
                                           0.0127039404 0.012993933
Light
              0.0002197407 0.0003218583 0.0004238245 0.000525707
CO2
HumidityRatio
              -4.7792500629 -4.9532410046 -5.1278455691 -5.3030086023
(Intercept)
Temperature
Humidity
               0.0132828151 0.0135706258 0.0138575448 0.0141438179
Light
CO<sub>2</sub>
               HumidityRatio
              -5.478519163 -5.654240402 -5.829972886 -6.005601559 -6.180707266
(Intercept)
Temperature
Humidity
               0.014429249 0.014713935
                                         0.014997814
Light
                                                      0.015281096
                                                                   0.015563115
               0.001033073 \quad 0.001133523 \quad 0.001233317 \quad 0.001332287 \quad 0.001430258
CO2
HumidityRatio
```

(Intercept) Temperature Humidity Light CO2 HumidityRatio	-6.458669007 -6.761968515 -7.059173141 -6.647233250 -6.035184512 . -0.031157638 -0.070989427 0.004843893 0.010926171 0.016778711 0.020137291 0.022738803 0.015861267 0.016161449 0.016458931 0.016779287 0.017101950 0.001486363 0.001531195 0.001576871 0.001655719 0.001743948
(Intercept) Temperature Humidity Light CO2 HumidityRatio	-5.443115045 -4.870709919 -4.317316783 -3.782482363 -3.271624278 -0.109738385 -0.147415323 -0.184041596 -0.219627929 -0.253777133 0.025316024 0.027873971 0.030414032 0.032936499 0.035463402 0.017417741 0.017726605 0.018028366 0.018322824 0.018601817 0.001831065 0.001916833 0.002001064 0.002083582 0.002163368
(Intercept) Temperature Humidity Light CO2 HumidityRatio	-2.773180669 -2.29250196 -1.829792662 -1.384160334 -0.957182857 -0.287261991 -0.31971634 -0.351109238 -0.381537268 -0.410784309 0.037942492 0.04039850 0.042828828 0.045235119 0.047602648 0.018880301 0.01915135 0.019414286 0.019672106 0.019918498 0.002241954 0.00231842 0.002392613 0.002464642 0.002534044
(Intercept) Temperature Humidity Light CO2 HumidityRatio	-0.54830698 -0.15743344 0.215500780 0.57060100 0.906380213 -0.43891918 -0.46593782 -0.491832015 -0.51659644 -0.540065505 0.04993108 0.05221532 0.054450176 0.05663051 0.058740485 0.02015596 0.02038454 0.020604110 0.02081460 0.021012293 0.00260090 0.00266517 0.002726816 0.00278581 0.002841813
(Intercept) Temperature Humidity Light CO2 HumidityRatio	1.22605859 1.528751136 1.814641443 2.084107824 2.337595338 -0.56254595 -0.583922526 -0.604193200 -0.623372931 -0.641482266 0.06079554 0.062783290 0.064699428 0.066540859 0.068305181 0.02120409 0.021387091 0.021561069 0.021726088 0.021882275 0.00289543 0.002946433 0.002994819 0.003040624 0.003083894
(Intercept) Temperature Humidity Light CO2 HumidityRatio	2.575597104 2.798646630 3.007310937 3.199717745 3.381072333 -0.658545860 -0.674591979 -0.689652068 -0.703537703 -0.716700188 0.069990647 0.071596160 0.073121255 0.074547818 0.075910223 0.022029797 0.022168851 0.022299661 0.022418486 0.022533091 0.003124687 0.003163068 0.003199111 0.003232437 0.003263982
(Intercept) Temperature Humidity Light CO2 HumidityRatio	3.550228711 3.706831420 3.910061409 5.988635323 -0.729017212 -0.740578395 -0.754062576 -0.853900132 0.077196817 0.078313921 0.077334285 0.023079702 0.022640836 0.022741386 0.022830183 0.022902174 0.003293509 0.003320965 0.003345482 0.003363117 1.163410544 15.807592594 364.434309689
(Intercept) Temperature Humidity Light CO2	6.979790098 7.112453928 7.256889819 7.382792384 -0.903280519 -0.912186433 -0.922182901 -0.930914603
(Intercept)	517.706248200 524.390329952 531.436923104 537.745325470 7.502230447 7.613200666 7.710804389 7.804461431
Temperature Humidity Light CO2 HumidityRatio	-0.939214565 -0.946938089 -0.953729691 -0.960248717
(Intercept) Temperature Humidity	7.885429823 7.956418606 8.036850991 8.098865098 -0.965908432 -0.970907733 -0.976455306 -0.980840292
Light CO2	0.0234154980.0234517500.0234923950.0235251980.0034947470.0035044320.0035143460.003522823563.099295423566.861978670570.759293189574.029270348
(Intercept) Temperature Humidity	8.160843502 8.218734294 8.272250180 -0.985166142 -0.989208638 -0.992948586

```
0.023557097 0.023587168
0.003530856 0.003538339
                                            0.023615142
Liaht
                                            0.003545257
CO2
HumidityRatio 577.167617001 580.087172427 582.784529636
> # Evaluation du modele
> # Predictions sur les donnees
> predictions <- predict(model, type = "response")</pre>
> # Ajouter les predictions au jeu de donnees
> data clean$predicted occupancy <- ifelse(predictions > 0.5, 1, 0)
> # Visualiser les predictions
> table(data_clean$Occupancy, data_clean$predicted_occupancy)
            206
  0 15604
       23 4727
> # Calcul de la precision, sensibilite et specificite
> # Predictions sur les donnees
> predictions <- predict(model, type = "response")</pre>
> # Ameliorer le modele
> # Installer et charger le package 'rpart' pour les arbres de décision
> install.packages("rpart")
Installation du package dans 'C:/Users/PC/AppData/Local/R/win-library/4.4'
(car 'lib' n'est pas spécifié)
essai de l'URL 'https://cloud.r-project.org/bin/windows/contrib/4.4/rpart_4.1.23.zip'
Content type 'application/zip' length 716367 bytes (699 KB)
downloaded 699 KB
le package 'rpart' a été décompressé et les sommes MD5 ont été vérifiées avec succés
Avis : impossible de supprimer l'installation précédente du package 'rpart'
Avis : 'rpart' restauré
Les packages binaires téléchargés sont dans
        C:\Users\PC\AppData\Local\Temp\RtmpE7WGC5\downloaded packages
Message d'avis :
Dans file.copy(savedcopy, lib, recursive = TRUE) :
  problème lors de la copie de C:\Users\PC\AppData\Local\R\win-library\4.4\00LOCK\rpart\libs\x
64\rpart.dll vers C:\Users\PC\AppData\Local\R\win-library\4.4\rpart\libs\x64\rpart.dll□: Permi
ssion denied
> library(rpart)
> # Creer un modele d'arbre de decision
> tree model <- rpart(Occupancy ~ Temperature + Humidity + Light + CO2 + HumidityRatio,
                      data = data clean, method = "class")
> # Resume de l'arbre de decision
> summary(tree model)
Call:
rpart(formula = Occupancy ~ Temperature + Humidity + Light +
    CO2 + HumidityRatio, data = data clean, method = "class")
  n = 20560
         CP nsplit rel error
                                   xerror
1 0.9538947
                 0 1.00000000 1.00000000 0.012723529
2 0.0100000
                 1 0.04610526 0.04631579 0.003105858
Variable importance
        Light
                Temperature
                                       CO2 HumidityRatio
           55
                         22
                                        19
Node number 1: 20560 observations,
                                      complexity param=0.9538947
  predicted class=0 expected loss=0.2310311 P(node) =1
    class counts: 15810 4750
   probabilities: 0.769 0.231
  left son=2 (15643 obs) right son=3 (4917 obs)
  Primary splits:
                                                 improve=6882.4420, (0 missing)
      Light
                    < 388.1667
                                   to the left,
                                                 improve=2962.9250, (0 missing)
                    < 21.2075
                                   to the left,
      Temperature
                    < 771.1667
                                   to the left,
                                                 improve=2383.4690, (0 missing)
      HumidityRatio < 0.005617807 to the left, improve= 423.0296, (0 missing)
      Humidity
                    < 19.40625
                                  to the left, improve= 137.1891, (0 missing)
  Surrogate splits:
                                 to the left, agree=0.857, adj=0.403, (0 split)
                    < 21.29833
      Temperature
                    < 829.125
                                  to the left, agree=0.843, adj=0.343, (0 split)
      CO2
      HumidityRatio < 0.005617807 to the left, agree=0.779, adj=0.075, (0 split) Humidity < 38.60375 to the left, agree=0.762, adj=0.004, (0 split)
```

predicted class=0 expected loss=0.001662085 P(node) =0.7608463

class counts: 15617 26 probabilities: 0.998 0.002

Node number 3: 4917 observations

predicted class=1 expected loss=0.03925158 P(node) =0.2391537
 class counts: 193 4724

probabilities: 0.039 0.961