Final Project: *Yashita Sharma*

# Report on Analysis of Water Quality Dataset

**Data Source:** Kaggle

### **Introduction**

In order to preserve the health of aquatic ecosystems and guarantee the safety of drinking water, water quality evaluation is essential. We examine a water quality dataset that we downloaded from Kaggle in this study. The dataset includes data on several water quality parameters that were measured at various times and places.  
**Objective**  
Goals are to examine the dataset, spot trends, patterns, and abnormalities in the parameters that determine the quality of the water, and offer information that can help with decision-making on environmental preservation and water management.

Attaching package: 'dplyr'

The following objects are masked from 'package:stats':  
  
 filter, lag

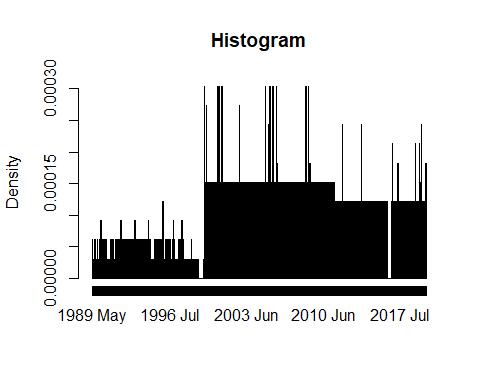
The following objects are masked from 'package:base':  
  
 intersect, setdiff, setequal, union

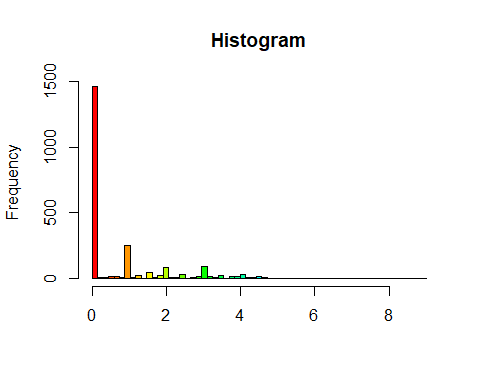
Rows: 2371 Columns: 8  
── Column specification ────────────────────────────────────────────────────────  
Delimiter: ","  
dbl (7): Salinity (ppt), DissolvedOxygen (mg/L), pH, SecchiDepth (m), Water...  
date (1): Date  
  
ℹ Use `spec()` to retrieve the full column specification for this data.  
ℹ Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

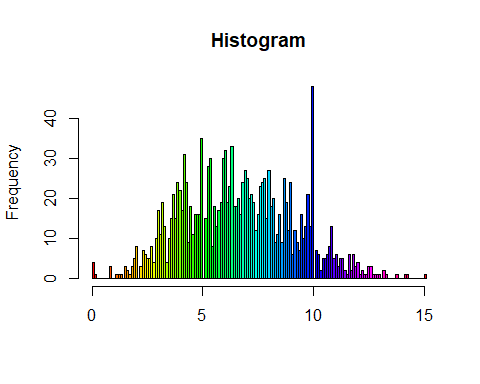
# A tibble: 6 × 8  
 Date `Salinity (ppt)` `DissolvedOxygen (mg/L)` pH `SecchiDepth (m)`  
 <date> <dbl> <dbl> <dbl> <dbl>  
1 1989-05-11 NA NA 7.5 0.3  
2 1989-05-18 NA 12 7.5 0.2  
3 1989-05-25 NA NA 8 0.4  
4 1989-06-01 NA 12 8 0.4  
5 1989-07-11 NA NA 8.5 0.3  
6 1989-07-20 NA 1.6 9 0.3  
# ℹ 3 more variables: `WaterDepth (m)` <dbl>, `WaterTemp (C)` <dbl>,  
# `AirTemp (C)` <dbl>

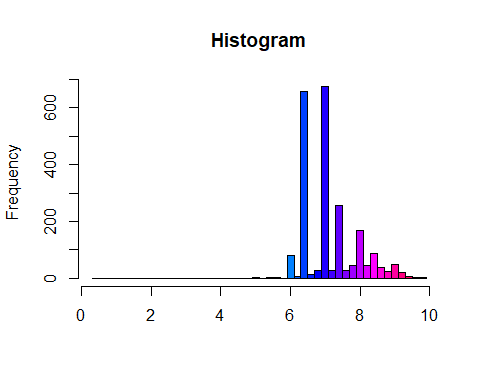
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 .. ..$ :'data.frame': 8 obs. of 6 variables:  
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 .. .. ..$ description: chr [1:8] "Indicates the date when the data entry was recorded." "Represents the salinity level of the water in parts per thousand (ppt)." "Indicates the concentration of dissolved oxygen in the water, measured in milligrams per liter (mg/L)." "Represents the acidity or alkalinity level of the water." ...  
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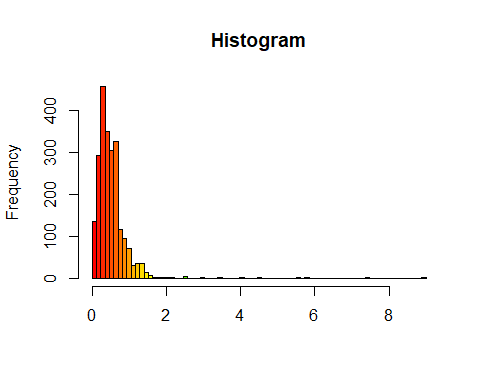
Date Salinity (ppt) DissolvedOxygen (mg/L) pH   
 Min. :1989-05-11 Min. :0.0000 Min. : 0.000 Min. :0.300   
 1st Qu.:2001-10-02 1st Qu.:0.0000 1st Qu.: 4.800 1st Qu.:6.500   
 Median :2007-03-01 Median :0.0000 Median : 6.500 Median :7.000   
 Mean :2006-10-09 Mean :0.7171 Mean : 6.646 Mean :7.168   
 3rd Qu.:2012-08-09 3rd Qu.:1.0000 3rd Qu.: 8.500 3rd Qu.:7.500   
 Max. :2019-11-05 Max. :9.0000 Max. :15.100 Max. :9.900   
 NA's :5 NA's :130 NA's :851 NA's :95   
 SecchiDepth (m) WaterDepth (m) WaterTemp (C) AirTemp (C)   
 Min. :0.0000 Min. : 0.0100 Min. : 0.00 Min. :-17.778   
 1st Qu.:0.3000 1st Qu.: 0.4000 1st Qu.:11.00 1st Qu.: 8.889   
 Median :0.4000 Median : 0.6500 Median :19.00 Median : 16.667   
 Mean :0.5249 Mean : 0.7626 Mean :18.06 Mean : 15.663   
 3rd Qu.:0.6500 3rd Qu.: 0.9500 3rd Qu.:25.00 3rd Qu.: 23.889   
 Max. :9.0000 Max. :12.0000 Max. :74.00 Max. : 33.500   
 NA's :73 NA's :71 NA's :121

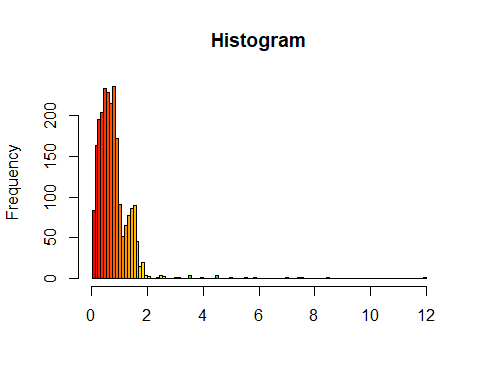


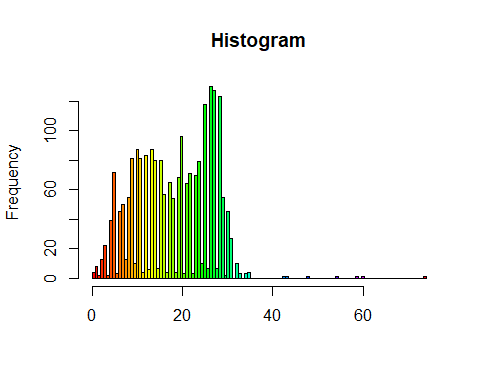


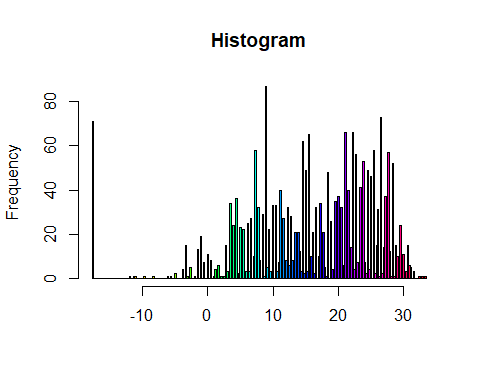












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[20] 4.1 4.3 4.5 4.7 4.9 5.1 5.3 5.5 5.7 5.9 6.1 6.3 6.5 6.7 6.9 7.1 7.3 7.5 7.7  
[39] 7.9 8.1 8.3 8.5 8.7 8.9 9.1 9.3 9.5 9.7 9.9  
  
$counts  
 [1] 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
[20] 0 0 0 1 3 0 3 2 0 81 5 658 13 27 676 28 258 28 46  
[39] 170 45 86 38 24 49 20 8 2 3  
  
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 [7] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
[13] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
[19] 0.000000000 0.000000000 0.000000000 0.000000000 0.002196837 0.006590510  
[25] 0.000000000 0.006590510 0.004393673 0.000000000 0.177943761 0.010984183  
[31] 1.445518453 0.028558875 0.059314587 1.485061511 0.061511424 0.566783831  
[37] 0.061511424 0.101054482 0.373462214 0.098857645 0.188927944 0.083479789  
[43] 0.052724077 0.107644991 0.043936731 0.017574692 0.004393673 0.006590510  
  
$mids  
 [1] 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0  
[20] 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6 7.8  
[39] 8.0 8.2 8.4 8.6 8.8 9.0 9.2 9.4 9.6 9.8  
  
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[1] "x"  
  
$equidist  
[1] TRUE  
  
attr(,"class")  
[1] "histogram"  
  
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 [1] 0.0000000 0.1168831 0.2337662 0.3506494 0.4675325 0.5844156 0.7012987  
 [8] 0.8181818 0.9350649 1.0519481 1.1688312 1.2857143 1.4025974 1.5194805  
[15] 1.6363636 1.7532468 1.8701299 1.9870130 2.1038961 2.2207792 2.3376623  
[22] 2.4545455 2.5714286 2.6883117 2.8051948 2.9220779 3.0389610 3.1558442  
[29] 3.2727273 3.3896104 3.5064935 3.6233766 3.7402597 3.8571429 3.9740260  
[36] 4.0909091 4.2077922 4.3246753 4.4415584 4.5584416 4.6753247 4.7922078  
[43] 4.9090909 5.0259740 5.1428571 5.2597403 5.3766234 5.4935065 5.6103896  
[50] 5.7272727 5.8441558 5.9610390 6.0779221 6.1948052 6.3116883 6.4285714  
[57] 6.5454545 6.6623377 6.7792208 6.8961039 7.0129870 7.1298701 7.2467532  
[64] 7.3636364 7.4805195 7.5974026 7.7142857 7.8311688 7.9480519 8.0649351  
[71] 8.1818182 8.2987013 8.4155844 8.5324675 8.6493506 8.7662338 8.8831169  
[78] 9.0000000  
  
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[20] 0 0 4 0 0 0 1 0 0 0 1 0 0 0 0 3 0 0 0  
[39] 2 0 0 0 0 0 0 0 0 2 0 1 0 0 0 0 0 0 0  
[58] 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0  
[77] 1  
  
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 [7] 0.435596171 0.353689198 0.264336138 0.111691326 0.134029591 0.134029591  
[13] 0.055845663 0.026061309 0.007446088 0.003723044 0.011169133 0.007446088  
[19] 0.003723044 0.000000000 0.000000000 0.014892177 0.000000000 0.000000000  
[25] 0.000000000 0.003723044 0.000000000 0.000000000 0.000000000 0.003723044  
[31] 0.000000000 0.000000000 0.000000000 0.000000000 0.011169133 0.000000000  
[37] 0.000000000 0.000000000 0.007446088 0.000000000 0.000000000 0.000000000  
[43] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.007446088  
[49] 0.000000000 0.003723044 0.000000000 0.000000000 0.000000000 0.000000000  
[55] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
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[67] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
[73] 0.000000000 0.000000000 0.000000000 0.000000000 0.003723044  
  
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 [7] 0.75974026 0.87662338 0.99350649 1.11038961 1.22727273 1.34415584  
[13] 1.46103896 1.57792208 1.69480519 1.81168831 1.92857143 2.04545455  
[19] 2.16233766 2.27922078 2.39610390 2.51298701 2.62987013 2.74675325  
[25] 2.86363636 2.98051948 3.09740260 3.21428571 3.33116883 3.44805195  
[31] 3.56493506 3.68181818 3.79870130 3.91558442 4.03246753 4.14935065  
[37] 4.26623377 4.38311688 4.50000000 4.61688312 4.73376623 4.85064935  
[43] 4.96753247 5.08441558 5.20129870 5.31818182 5.43506494 5.55194805  
[49] 5.66883117 5.78571429 5.90259740 6.01948052 6.13636364 6.25324675  
[55] 6.37012987 6.48701299 6.60389610 6.72077922 6.83766234 6.95454545  
[61] 7.07142857 7.18831169 7.30519481 7.42207792 7.53896104 7.65584416  
[67] 7.77272727 7.88961039 8.00649351 8.12337662 8.24025974 8.35714286  
[73] 8.47402597 8.59090909 8.70779221 8.82467532 8.94155844  
  
$xname  
[1] "x"  
  
$equidist  
[1] TRUE  
  
attr(,"class")  
[1] "histogram"  
  
$`WaterDepth (m)`  
$breaks  
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 [7] 0.6410526 0.7462281 0.8514035 0.9565789 1.0617544 1.1669298  
 [13] 1.2721053 1.3772807 1.4824561 1.5876316 1.6928070 1.7979825  
 [19] 1.9031579 2.0083333 2.1135088 2.2186842 2.3238596 2.4290351  
 [25] 2.5342105 2.6393860 2.7445614 2.8497368 2.9549123 3.0600877  
 [31] 3.1652632 3.2704386 3.3756140 3.4807895 3.5859649 3.6911404  
 [37] 3.7963158 3.9014912 4.0066667 4.1118421 4.2170175 4.3221930  
 [43] 4.4273684 4.5325439 4.6377193 4.7428947 4.8480702 4.9532456  
 [49] 5.0584211 5.1635965 5.2687719 5.3739474 5.4791228 5.5842982  
 [55] 5.6894737 5.7946491 5.8998246 6.0050000 6.1101754 6.2153509  
 [61] 6.3205263 6.4257018 6.5308772 6.6360526 6.7412281 6.8464035  
 [67] 6.9515789 7.0567544 7.1619298 7.2671053 7.3722807 7.4774561  
 [73] 7.5826316 7.6878070 7.7929825 7.8981579 8.0033333 8.1085088  
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 [91] 9.4757895 9.5809649 9.6861404 9.7913158 9.8964912 10.0016667  
 [97] 10.1068421 10.2120175 10.3171930 10.4223684 10.5275439 10.6327193  
[103] 10.7378947 10.8430702 10.9482456 11.0534211 11.1585965 11.2637719  
[109] 11.3689474 11.4741228 11.5792982 11.6844737 11.7896491 11.8948246  
[115] 12.0000000  
  
$counts  
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 [19] 3 2 0 0 1 4 2 0 0 0 1 1 0 0 0 3 0 0  
 [37] 0 1 0 0 0 0 3 0 0 0 0 1 0 0 0 0 1 0  
 [55] 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1  
 [73] 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0  
 [91] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
[109] 0 0 0 0 0 1  
  
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 [7] 0.888784132 0.975595605 0.711027305 0.376183051 0.210827864 0.268702179  
 [13] 0.318308736 0.355513653 0.367915292 0.186024586 0.062008195 0.082677594  
 [19] 0.012401639 0.008267759 0.000000000 0.000000000 0.004133880 0.016535519  
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 [31] 0.000000000 0.000000000 0.000000000 0.012401639 0.000000000 0.000000000  
 [37] 0.000000000 0.004133880 0.000000000 0.000000000 0.000000000 0.000000000  
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 [67] 0.004133880 0.000000000 0.000000000 0.000000000 0.004133880 0.004133880  
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[103] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
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 [7] 0.69364035 0.79881579 0.90399123 1.00916667 1.11434211 1.21951754  
 [13] 1.32469298 1.42986842 1.53504386 1.64021930 1.74539474 1.85057018  
 [19] 1.95574561 2.06092105 2.16609649 2.27127193 2.37644737 2.48162281  
 [25] 2.58679825 2.69197368 2.79714912 2.90232456 3.00750000 3.11267544  
 [31] 3.21785088 3.32302632 3.42820175 3.53337719 3.63855263 3.74372807  
 [37] 3.84890351 3.95407895 4.05925439 4.16442982 4.26960526 4.37478070  
 [43] 4.47995614 4.58513158 4.69030702 4.79548246 4.90065789 5.00583333  
 [49] 5.11100877 5.21618421 5.32135965 5.42653509 5.53171053 5.63688596  
 [55] 5.74206140 5.84723684 5.95241228 6.05758772 6.16276316 6.26793860  
 [61] 6.37311404 6.47828947 6.58346491 6.68864035 6.79381579 6.89899123  
 [67] 7.00416667 7.10934211 7.21451754 7.31969298 7.42486842 7.53004386  
 [73] 7.63521930 7.74039474 7.84557018 7.95074561 8.05592105 8.16109649  
 [79] 8.26627193 8.37144737 8.47662281 8.58179825 8.68697368 8.79214912  
 [85] 8.89732456 9.00250000 9.10767544 9.21285088 9.31802632 9.42320175  
 [91] 9.52837719 9.63355263 9.73872807 9.84390351 9.94907895 10.05425439  
 [97] 10.15942982 10.26460526 10.36978070 10.47495614 10.58013158 10.68530702  
[103] 10.79048246 10.89565789 11.00083333 11.10600877 11.21118421 11.31635965  
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$xname  
[1] "x"  
  
$equidist  
[1] TRUE  
  
attr(,"class")  
[1] "histogram"  
  
$`WaterTemp (C)`  
$breaks  
 [1] 0.0000000 0.6491228 1.2982456 1.9473684 2.5964912 3.2456140  
 [7] 3.8947368 4.5438596 5.1929825 5.8421053 6.4912281 7.1403509  
 [13] 7.7894737 8.4385965 9.0877193 9.7368421 10.3859649 11.0350877  
 [19] 11.6842105 12.3333333 12.9824561 13.6315789 14.2807018 14.9298246  
 [25] 15.5789474 16.2280702 16.8771930 17.5263158 18.1754386 18.8245614  
 [31] 19.4736842 20.1228070 20.7719298 21.4210526 22.0701754 22.7192982  
 [37] 23.3684211 24.0175439 24.6666667 25.3157895 25.9649123 26.6140351  
 [43] 27.2631579 27.9122807 28.5614035 29.2105263 29.8596491 30.5087719  
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[103] 66.2105263 66.8596491 67.5087719 68.1578947 68.8070175 69.4561404  
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[115] 74.0000000  
  
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 [19] 83 6 87 80 7 80 57 4 65 54 4 68 96 3 64 71 3 70  
 [37] 79 10 118 7 130 127 7 123 55 2 45 27 0 10 3 0 3 4  
 [55] 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0  
 [73] 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0  
 [91] 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
[109] 0 0 0 0 0 1  
  
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 [6] 0.0013693694 0.0267027027 0.0492972973 0.0020540541 0.0308108108  
 [11] 0.0342342342 0.0089009009 0.0376576577 0.0554594595 0.0068468468  
 [16] 0.0595675676 0.0554594595 0.0027387387 0.0568288288 0.0041081081  
 [21] 0.0595675676 0.0547747748 0.0047927928 0.0547747748 0.0390270270  
 [26] 0.0027387387 0.0445045045 0.0369729730 0.0027387387 0.0465585586  
 [31] 0.0657297297 0.0020540541 0.0438198198 0.0486126126 0.0020540541  
 [36] 0.0479279279 0.0540900901 0.0068468468 0.0807927928 0.0047927928  
 [41] 0.0890090090 0.0869549550 0.0047927928 0.0842162162 0.0376576577  
 [46] 0.0013693694 0.0308108108 0.0184864865 0.0000000000 0.0068468468  
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 [71] 0.0000000000 0.0000000000 0.0000000000 0.0006846847 0.0000000000  
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 [96] 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000  
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[106] 0.0000000000 0.0000000000 0.0000000000 0.0000000000 0.0000000000  
[111] 0.0000000000 0.0000000000 0.0000000000 0.0006846847  
  
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 [7] 4.2192982 4.8684211 5.5175439 6.1666667 6.8157895 7.4649123  
 [13] 8.1140351 8.7631579 9.4122807 10.0614035 10.7105263 11.3596491  
 [19] 12.0087719 12.6578947 13.3070175 13.9561404 14.6052632 15.2543860  
 [25] 15.9035088 16.5526316 17.2017544 17.8508772 18.5000000 19.1491228  
 [31] 19.7982456 20.4473684 21.0964912 21.7456140 22.3947368 23.0438596  
 [37] 23.6929825 24.3421053 24.9912281 25.6403509 26.2894737 26.9385965  
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 [49] 31.4824561 32.1315789 32.7807018 33.4298246 34.0789474 34.7280702  
 [55] 35.3771930 36.0263158 36.6754386 37.3245614 37.9736842 38.6228070  
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[1] "x"  
  
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[1] TRUE  
  
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[1] "histogram"  
  
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 [11] -15.50884956 -15.28195674 -15.05506392 -14.82817109 -14.60127827  
 [16] -14.37438545 -14.14749263 -13.92059981 -13.69370698 -13.46681416  
 [21] -13.23992134 -13.01302852 -12.78613570 -12.55924287 -12.33235005  
 [26] -12.10545723 -11.87856441 -11.65167159 -11.42477876 -11.19788594  
 [31] -10.97099312 -10.74410030 -10.51720747 -10.29031465 -10.06342183  
 [36] -9.83652901 -9.60963619 -9.38274336 -9.15585054 -8.92895772  
 [41] -8.70206490 -8.47517208 -8.24827925 -8.02138643 -7.79449361  
 [46] -7.56760079 -7.34070797 -7.11381514 -6.88692232 -6.66002950  
 [51] -6.43313668 -6.20624386 -5.97935103 -5.75245821 -5.52556539  
 [56] -5.29867257 -5.07177975 -4.84488692 -4.61799410 -4.39110128  
 [61] -4.16420846 -3.93731564 -3.71042281 -3.48352999 -3.25663717  
 [66] -3.02974435 -2.80285153 -2.57595870 -2.34906588 -2.12217306  
 [71] -1.89528024 -1.66838742 -1.44149459 -1.21460177 -0.98770895  
 [76] -0.76081613 -0.53392331 -0.30703048 -0.08013766 0.14675516  
 [81] 0.37364798 0.60054080 0.82743363 1.05432645 1.28121927  
 [86] 1.50811209 1.73500492 1.96189774 2.18879056 2.41568338  
 [91] 2.64257620 2.86946903 3.09636185 3.32325467 3.55014749  
 [96] 3.77704031 4.00393314 4.23082596 4.45771878 4.68461160  
[101] 4.91150442 5.13839725 5.36529007 5.59218289 5.81907571  
[106] 6.04596853 6.27286136 6.49975418 6.72664700 6.95353982  
[111] 7.18043264 7.40732547 7.63421829 7.86111111 8.08800393  
[116] 8.31489675 8.54178958 8.76868240 8.99557522 9.22246804  
[121] 9.44936086 9.67625369 9.90314651 10.13003933 10.35693215  
[126] 10.58382497 10.81071780 11.03761062 11.26450344 11.49139626  
[131] 11.71828908 11.94518191 12.17207473 12.39896755 12.62586037  
[136] 12.85275319 13.07964602 13.30653884 13.53343166 13.76032448  
[141] 13.98721730 14.21411013 14.44100295 14.66789577 14.89478859  
[146] 15.12168142 15.34857424 15.57546706 15.80235988 16.02925270  
[151] 16.25614553 16.48303835 16.70993117 16.93682399 17.16371681  
[156] 17.39060964 17.61750246 17.84439528 18.07128810 18.29818092  
[161] 18.52507375 18.75196657 18.97885939 19.20575221 19.43264503  
[166] 19.65953786 19.88643068 20.11332350 20.34021632 20.56710914  
[171] 20.79400197 21.02089479 21.24778761 21.47468043 21.70157325  
[176] 21.92846608 22.15535890 22.38225172 22.60914454 22.83603736  
[181] 23.06293019 23.28982301 23.51671583 23.74360865 23.97050147  
[186] 24.19739430 24.42428712 24.65117994 24.87807276 25.10496558  
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[196] 26.46632252 26.69321534 26.92010816 27.14700098 27.37389381  
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[221] 32.13864307 32.36553589 32.59242871 32.81932153 33.04621436  
[226] 33.27310718 33.50000000  
  
$counts  
 [1] 71 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 [26] 1 0 0 1 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0  
 [51] 0 1 0 1 0 0 2 0 0 0 0 4 0 15 1 0 5 0 0 1 0 13 0 19 0  
 [76] 7 0 0 11 0 8 0 1 4 1 6 0 1 0 1 15 3 0 34 0 24 0 36 2 0  
[101] 23 1 22 0 3 25 3 27 0 10 58 3 32 8 0 29 1 87 5 22 3 0 33 0 33  
[126] 3 7 40 2 27 0 8 32 6 28 8 0 21 2 21 12 3 62 2 49 3 65 3 10 21  
[151] 2 32 0 10 34 5 21 5 1 48 0 26 4 0 35 0 37 1 32 1 6 66 0 40 0  
[176] 14 66 4 56 7 1 41 0 53 7 2 49 4 46 0 58 2 15 31 1 73 2 14 37 7  
[201] 57 12 1 52 1 15 10 0 24 1 11 1 3 15 6 5 0 3 0 0 0 1 0 1 0  
[226] 1  
  
$density  
 [1] 0.131979366 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
 [7] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
 [13] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
 [19] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
 [25] 0.000000000 0.001858864 0.000000000 0.000000000 0.001858864 0.001858864  
 [31] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.001858864  
 [37] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.001858864  
 [43] 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000  
 [49] 0.000000000 0.000000000 0.000000000 0.001858864 0.000000000 0.001858864  
 [55] 0.000000000 0.000000000 0.003717729 0.000000000 0.000000000 0.000000000  
 [61] 0.000000000 0.007435457 0.000000000 0.027882965 0.001858864 0.000000000  
 [67] 0.009294322 0.000000000 0.000000000 0.001858864 0.000000000 0.024165236  
 [73] 0.000000000 0.035318422 0.000000000 0.013012050 0.000000000 0.000000000  
 [79] 0.020447507 0.000000000 0.014870914 0.000000000 0.001858864 0.007435457  
 [85] 0.001858864 0.011153186 0.000000000 0.001858864 0.000000000 0.001858864  
 [91] 0.027882965 0.005576593 0.000000000 0.063201387 0.000000000 0.044612743  
 [97] 0.000000000 0.066919115 0.003717729 0.000000000 0.042753879 0.001858864  
[103] 0.040895015 0.000000000 0.005576593 0.046471608 0.005576593 0.050189336  
[109] 0.000000000 0.018588643 0.107814130 0.005576593 0.059483658 0.014870914  
[115] 0.000000000 0.053907065 0.001858864 0.161721195 0.009294322 0.040895015  
[121] 0.005576593 0.000000000 0.061342522 0.000000000 0.061342522 0.005576593  
[127] 0.013012050 0.074354572 0.003717729 0.050189336 0.000000000 0.014870914  
[133] 0.059483658 0.011153186 0.052048201 0.014870914 0.000000000 0.039036151  
[139] 0.003717729 0.039036151 0.022306372 0.005576593 0.115249587 0.003717729  
[145] 0.091084351 0.005576593 0.120826180 0.005576593 0.018588643 0.039036151  
[151] 0.003717729 0.059483658 0.000000000 0.018588643 0.063201387 0.009294322  
[157] 0.039036151 0.009294322 0.001858864 0.089225487 0.000000000 0.048330472  
[163] 0.007435457 0.000000000 0.065060251 0.000000000 0.068777979 0.001858864  
[169] 0.059483658 0.001858864 0.011153186 0.122685044 0.000000000 0.074354572  
[175] 0.000000000 0.026024100 0.122685044 0.007435457 0.104096401 0.013012050  
[181] 0.001858864 0.076213437 0.000000000 0.098519808 0.013012050 0.003717729  
[187] 0.091084351 0.007435457 0.085507758 0.000000000 0.107814130 0.003717729  
[193] 0.027882965 0.057624794 0.001858864 0.135697095 0.003717729 0.026024100  
[199] 0.068777979 0.013012050 0.105955266 0.022306372 0.001858864 0.096660944  
[205] 0.001858864 0.027882965 0.018588643 0.000000000 0.044612743 0.001858864  
[211] 0.020447507 0.001858864 0.005576593 0.027882965 0.011153186 0.009294322  
[217] 0.000000000 0.005576593 0.000000000 0.000000000 0.000000000 0.001858864  
[223] 0.000000000 0.001858864 0.000000000 0.001858864  
  
$mids  
 [1] -17.66433137 -17.43743855 -17.21054572 -16.98365290 -16.75676008  
 [6] -16.52986726 -16.30297444 -16.07608161 -15.84918879 -15.62229597  
 [11] -15.39540315 -15.16851033 -14.94161750 -14.71472468 -14.48783186  
 [16] -14.26093904 -14.03404622 -13.80715339 -13.58026057 -13.35336775  
 [21] -13.12647493 -12.89958211 -12.67268928 -12.44579646 -12.21890364  
 [26] -11.99201082 -11.76511800 -11.53822517 -11.31133235 -11.08443953  
 [31] -10.85754671 -10.63065389 -10.40376106 -10.17686824 -9.94997542  
 [36] -9.72308260 -9.49618978 -9.26929695 -9.04240413 -8.81551131  
 [41] -8.58861849 -8.36172567 -8.13483284 -7.90794002 -7.68104720  
 [46] -7.45415438 -7.22726156 -7.00036873 -6.77347591 -6.54658309  
 [51] -6.31969027 -6.09279745 -5.86590462 -5.63901180 -5.41211898  
 [56] -5.18522616 -4.95833334 -4.73144051 -4.50454769 -4.27765487  
 [61] -4.05076205 -3.82386922 -3.59697640 -3.37008358 -3.14319076  
 [66] -2.91629794 -2.68940511 -2.46251229 -2.23561947 -2.00872665  
 [71] -1.78183383 -1.55494100 -1.32804818 -1.10115536 -0.87426254  
 [76] -0.64736972 -0.42047689 -0.19358407 0.03330875 0.26020157  
 [81] 0.48709439 0.71398722 0.94088004 1.16777286 1.39466568  
 [86] 1.62155850 1.84845133 2.07534415 2.30223697 2.52912979  
 [91] 2.75602261 2.98291544 3.20980826 3.43670108 3.66359390  
 [96] 3.89048672 4.11737955 4.34427237 4.57116519 4.79805801  
[101] 5.02495083 5.25184366 5.47873648 5.70562930 5.93252212  
[106] 6.15941494 6.38630777 6.61320059 6.84009341 7.06698623  
[111] 7.29387905 7.52077188 7.74766470 7.97455752 8.20145034  
[116] 8.42834317 8.65523599 8.88212881 9.10902163 9.33591445  
[121] 9.56280728 9.78970010 10.01659292 10.24348574 10.47037856  
[126] 10.69727139 10.92416421 11.15105703 11.37794985 11.60484267  
[131] 11.83173550 12.05862832 12.28552114 12.51241396 12.73930678  
[136] 12.96619961 13.19309243 13.41998525 13.64687807 13.87377089  
[141] 14.10066372 14.32755654 14.55444936 14.78134218 15.00823500  
[146] 15.23512783 15.46202065 15.68891347 15.91580629 16.14269911  
[151] 16.36959194 16.59648476 16.82337758 17.05027040 17.27716322  
[156] 17.50405605 17.73094887 17.95784169 18.18473451 18.41162733  
[161] 18.63852016 18.86541298 19.09230580 19.31919862 19.54609144  
[166] 19.77298427 19.99987709 20.22676991 20.45366273 20.68055555  
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[181] 23.17637660 23.40326942 23.63016224 23.85705506 24.08394789  
[186] 24.31084071 24.53773353 24.76462635 24.99151917 25.21841200  
[191] 25.44530482 25.67219764 25.89909046 26.12598328 26.35287611  
[196] 26.57976893 26.80666175 27.03355457 27.26044739 27.48734022  
[201] 27.71423304 27.94112586 28.16801868 28.39491150 28.62180433  
[206] 28.84869715 29.07558997 29.30248279 29.52937561 29.75626844  
[211] 29.98316126 30.21005408 30.43694690 30.66383972 30.89073255  
[216] 31.11762537 31.34451819 31.57141101 31.79830383 32.02519666  
[221] 32.25208948 32.47898230 32.70587512 32.93276794 33.15966077  
[226] 33.38655359  
  
$xname  
[1] "x"  
  
$equidist  
[1] TRUE  
  
attr(,"class")  
[1] "histogram"

In order to preserve the health of aquatic ecosystems and guarantee the safety of drinking water, water quality evaluation is essential.  
We examine a water quality dataset that we downloaded from Kaggle in this study. The dataset includes data on several water quality parameters that were measured at various times and places. The object histograms hold the ‘histograms’. Herein we can see density was at its peak from june 1997 to april 2005 and respectively frequency fluctuating per year.

**Dataset Description**

The dataset consists of a CSV file named “waterquality.csv” containing 14 columns and several thousand rows. Each row represents a measurement of water quality parameters at a specific location and time. The columns include:

1. **ph:** pH value of the water
2. **Hardness:** Hardness of the water
3. **Solids:** Total dissolved solids in the water
4. **Chloramines:** Concentration of chloramines in the water
5. **Sulfate:** Concentration of sulfate in the water
6. **Conductivity:** Electrical conductivity of the water
7. **Organic\_carbon:** Concentration of organic carbon in the water
8. **Trihalomethanes:** Concentration of trihalomethanes in the water
9. **Turbidity:** Turbidity of the water
10. **Potability:** Target variable indicating whether the water is potable (1) or not (0)
11. **ph\_gp:** pH group (e.g., acidic, neutral, alkaline)
12. **Hardness\_gp:** Hardness group
13. **Solids\_gp:** Total dissolved solids group
14. **Potability\_gp:** Potability group

* **Summary and Missing Values:** The dataframe df’s dimensions, structure, and missing values in each column are all disclosed in this output.  
  Dataframe Dimensions: The dim function is used to output the dataframe’s dimensions.  
  The dataframe comprises 8 columns and 2371 rows, according to the output.
* Details on the Dataframe:  
  The str function is used to print structure information about the dataframe.  
  With 2371 rows and 8 columns, the dataframe is a special table dataframe (spc\_tbl\_df), according to the output, which shows the dataframe’s structure.  
  Names and data types (Date, Salinity (ppt), Dissolved Oxygen (mg/L), pH, SecchiDepth (m), WaterDepth (m), WaterTemp (C), and AirTemp (C)) are labeled for each column. Date, numeric, and double are the designated data types for each column.

Dimensions of the dataframe:

[1] 2371 8

Information about the dataframe:

spc\_tbl\_ [2,371 × 8] (S3: spec\_tbl\_df/tbl\_df/tbl/data.frame)  
 $ Date : Date[1:2371], format: "1989-05-11" "1989-05-18" ...  
 $ Salinity (ppt) : num [1:2371] NA NA NA NA NA NA NA NA NA NA ...  
 $ DissolvedOxygen (mg/L): num [1:2371] NA 12 NA 12 NA 1.6 6.2 5.8 3.2 7.3 ...  
 $ pH : num [1:2371] 7.5 7.5 8 8 8.5 9 9 9.5 9 9 ...  
 $ SecchiDepth (m) : num [1:2371] 0.3 0.2 0.4 0.4 0.3 0.3 0.3 0.2 0.2 0.2 ...  
 $ WaterDepth (m) : num [1:2371] 0.9 0.6 0.8 0.9 0.9 0.9 0.8 0.7 0.3 0.8 ...  
 $ WaterTemp (C) : num [1:2371] 17 17.5 23 25.5 28.5 30 27 25 21.5 28 ...  
 $ AirTemp (C) : num [1:2371] -17.8 20.5 25 29 28 ...  
 - attr(\*, "spec")=  
 .. cols(  
 .. Date = col\_date(format = ""),  
 .. `Salinity (ppt)` = col\_double(),  
 .. `DissolvedOxygen (mg/L)` = col\_double(),  
 .. pH = col\_double(),  
 .. `SecchiDepth (m)` = col\_double(),  
 .. `WaterDepth (m)` = col\_double(),  
 .. `WaterTemp (C)` = col\_double(),  
 .. `AirTemp (C)` = col\_double()  
 .. )  
 - attr(\*, "problems")=<externalptr>

Count of missing values for each column:

Date Salinity (ppt) DissolvedOxygen (mg/L)   
 5 130 851   
 pH SecchiDepth (m) WaterDepth (m)   
 95 73 71   
 WaterTemp (C) AirTemp (C)   
 121 0

The spec attribute also offers details about the column specifications, including the types of columns and the format of the Date column. If there were any issues with reading or processing the data, these are indicated via the difficulties property.

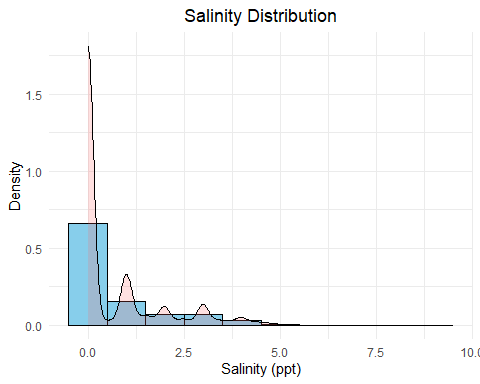
Count of Missing Values for Each Column: The colSums(is.na(df)) function is used to print the number of missing values for each column.  
The amount of missing values for each column in the dataframe is shown in the output.

**Salinity Distribution**

Warning: The dot-dot notation (`..density..`) was deprecated in ggplot2 3.4.0.  
ℹ Please use `after\_stat(density)` instead.

Warning: Removed 130 rows containing non-finite outside the scale range  
(`stat\_bin()`).

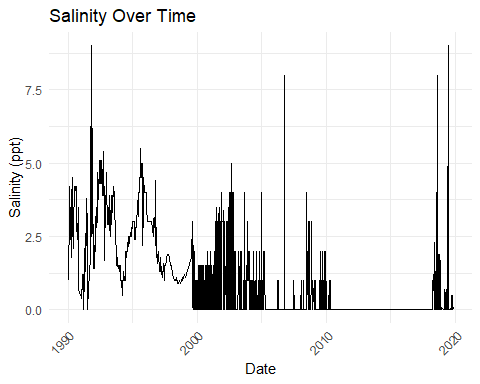
Warning: Removed 130 rows containing non-finite outside the scale range  
(`stat\_density()`).



Maximum Density at Zero Salinity:  
The greatest peak or maximum density is shown at or around the salinity value of 0 in the histogram for the “Salinity (ppt)” variable.  
This suggests that there are a sizable number of observations or cases in the dataset where the salinity level is close to zero points per cent.  
Stated otherwise, the dataset’s most prevalent salinity value is in or near 0 ppt.  
Interpretation  
A significant percentage of the water samples in the dataset may have extremely low salt levels or perhaps represent freshwater sources, as shown by the occurrence of a peak at a salinity value of 0.  
This finding may be important for comprehending how salinity levels vary among various settings or situations as depicted in the dataset.

It might also make people wonder or encourage more research into the variables that affect salinity levels, like proximity to freshwater sources, seasonal changes, or human activities.

**Salinity Over Time:**



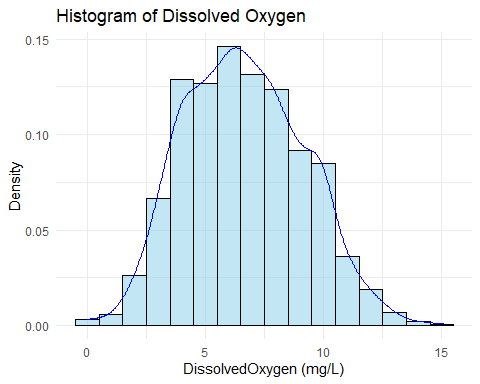
With dates on the x-axis and salinity values on the y-axis, the graphic shows the trend of salinity levels over time.  
The trend line shows the variations in salinity levels across various time intervals.  
It is evident from the description that the salinity levels peaked between 1990 and 2020, surpassing a value of 7.5 ppt. By looking at the maxima in the salinity levels on the plot throughout these years, this information is deduced.

**Dissolved Oxygen :**

Rows: 2371 Columns: 8  
── Column specification ────────────────────────────────────────────────────────  
Delimiter: ","  
dbl (7): Salinity (ppt), DissolvedOxygen (mg/L), pH, SecchiDepth (m), Water...  
date (1): Date  
  
ℹ Use `spec()` to retrieve the full column specification for this data.  
ℹ Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

Warning: Removed 851 rows containing non-finite outside the scale range  
(`stat\_bin()`).

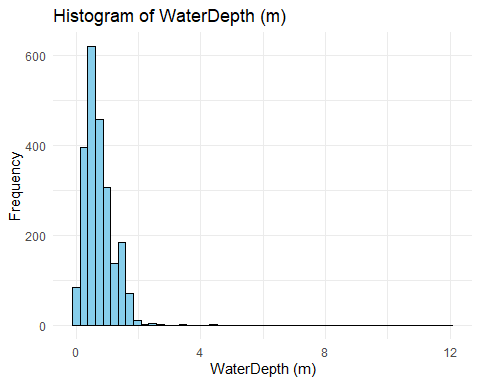
Warning: Removed 851 rows containing non-finite outside the scale range  
(`stat\_density()`).



The distribution of dissolved oxygen levels in the water samples is shown in the code’s output, which is a histogram with a density plot overlay. A prominent density peak is shown in the region of 0.10 to 0.15 mg/L.

**Water Depth :**

Warning: Removed 71 rows containing non-finite outside the scale range  
(`stat\_bin()`).

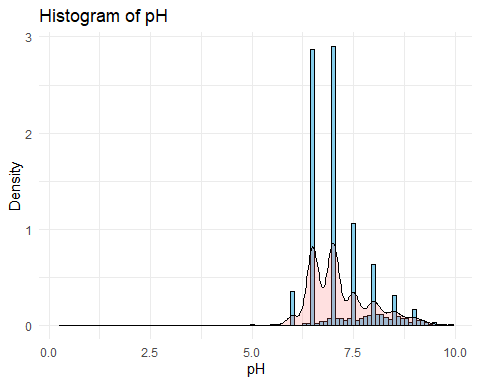


1. **geom\_histogram(bins = 50, fill = "skyblue", color = "black")**: This line adds a histogram layer to the plot. It creates a histogram of the **WaterDepth (m)** variable with 50 bins. The **fill** parameter sets the color of the bars to “skyblue”, and the **color** parameter sets the color of the border of the bars to “black”.
2. it was being observed that less water depth has highest frequency i.e around 600.

**pH:**

Warning: Removed 95 rows containing non-finite outside the scale range  
(`stat\_bin()`).

Warning: Removed 95 rows containing non-finite outside the scale range  
(`stat\_density()`).



The distribution of pH values in the dataset is displayed as a histogram with a density plot overlay as the code’s output. Notably, the largest density of observations is seen in the pH range of 6 to 7.5.

**Correlation Matrix:**

corrplot 0.92 loaded

null device   
 1

Warning in ind1:ind2: numerical expression has 2 elements: only the first used

It is being observed that SecchiDepth and WaterDepth has highest correlation of 0.82 which implies they have highest correlation. Also, waterTemp and Air Temp has second highest correlation of 0.68.

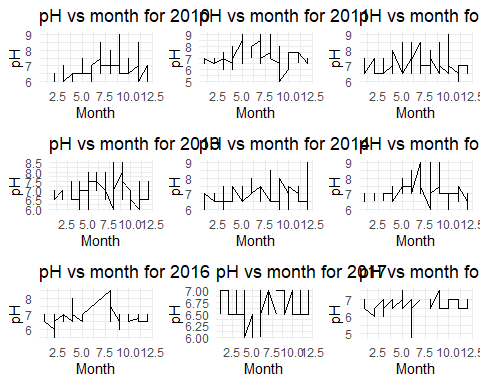
**Monthly variation for pH:**

Attaching package: 'lubridate'

The following objects are masked from 'package:base':  
  
 date, intersect, setdiff, union

Warning: Removed 7 rows containing missing values or values outside the scale range  
(`geom\_line()`).

Warning: Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).  
Removed 5 rows containing missing values or values outside the scale range  
(`geom\_line()`).



In this pictorial description we can see the pH level varying in water from 2010 to 2018 and we have observed that overtime the pH level has reduced to 7.0 even after various fluctuation its highest variance was 7.0 in 2018.

**Monthly Variation of dissolved Oxygen:**

we have observed that overtime with passing year dissolved oxygen reduced in 2018. wherein in contrary to other year where it dropped but then the dissolved oxygen used to increase.

**Linear Regresion:**

The scattered pattern of points around this line suggests that there might be no strong linear relationship between Salinity and the predictor variables or that the model assumptions might not be met.

**conclusion :**  
The examination of the water quality information yielded significant knowledge about the distribution, patterns, and connections between different water quality factors. Stakeholders can guarantee the availability of clean, drinkable water for communities while maintaining the integrity of aquatic ecosystems by using these findings to inform their decision-making.

**Recommendations:**

Constant Observation: Establish ongoing monitoring procedures to evaluate changes in the parameters governing water quality throughout time. Frequent monitoring enables prompt response in the event that standard water quality values are deviated from.  
Specific Interventions: Determine which regions or priority locations have continuously low water quality so that efforts can be focused there. Upgrades to the infrastructure, steps to reduce pollutants, and community education programs are a few examples of interventions.  
Engaging Stakeholders: Involve pertinent parties in water quality management initiatives, such as regional communities, governmental institutions, and environmental advocacy groups. Encourage cooperation and information exchange to successfully handle challenging issues with water quality.  
**Citations**:  
Water Quality Data in the Kaggle Dataset  
Additional references were reviewed in order to analyze and interpret.