Section 3: Visual Representation

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```r
ozone <- read.table("ozone.txt", header = T)

summary(ozone)
```

```
##      maxO3              T9             T12             T15
##  Min.   : 42.00   Min.   :11.30   Min.   :14.00   Min.   :14.90
##  1st Qu.: 70.75   1st Qu.:16.20   1st Qu.:18.60   1st Qu.:19.27
##  Median : 81.50   Median :17.80   Median :20.55   Median :22.05
##  Mean   : 90.30   Mean   :18.36   Mean   :21.53   Mean   :22.63
##  3rd Qu.:106.00   3rd Qu.:19.93   3rd Qu.:23.55   3rd Qu.:25.40
##  Max.   :166.00   Max.   :27.00   Max.   :33.50   Max.   :35.50
##      Ne9             Ne12            Ne15            Wx9
##  Min.   :0.000   Min.   :0.000   Min.   :0.00   Min.   :-7.8785
##  1st Qu.:3.000   1st Qu.:4.000   1st Qu.:3.00   1st Qu.:-3.2765
##  Median :6.000   Median :5.000   Median :5.00   Median :-0.8660
##  Mean   :4.929   Mean   :5.018   Mean   :4.83   Mean   :-1.2143
##  3rd Qu.:7.000   3rd Qu.:7.000   3rd Qu.:7.00   3rd Qu.: 0.6946
##  Max.   :8.000   Max.   :8.000   Max.   :8.00   Max.   : 5.1962
##      Wx12            Wx15            maxO3v            wind
##  Min.   :-7.878   Min.   :-9.000   Min.   : 42.00   Length:112
##  1st Qu.:-3.565   1st Qu.:-3.939   1st Qu.: 71.00   Class :character
##  Median :-1.879   Median :-1.550   Median : 82.50   Mode  :character
##  Mean   :-1.611   Mean   :-1.691   Mean   : 90.57
##  3rd Qu.: 0.000   3rd Qu.: 0.000   3rd Qu.:106.00
##  Max.   : 6.578   Max.   : 5.000   Max.   :166.00
##      rain
##  Length:112
##  Class :character
##  Mode  :character
##
##
##
```

```r
# Explaining variables:
# maxO3: Maximum daily ozone
# T12: Temperature at midday
# Wx12: Projection of wind speed vector on east-west axis at midday

ozone$wind <- as.factor(ozone$wind)
ozone$rain <- as.factor(ozone$rain)
```
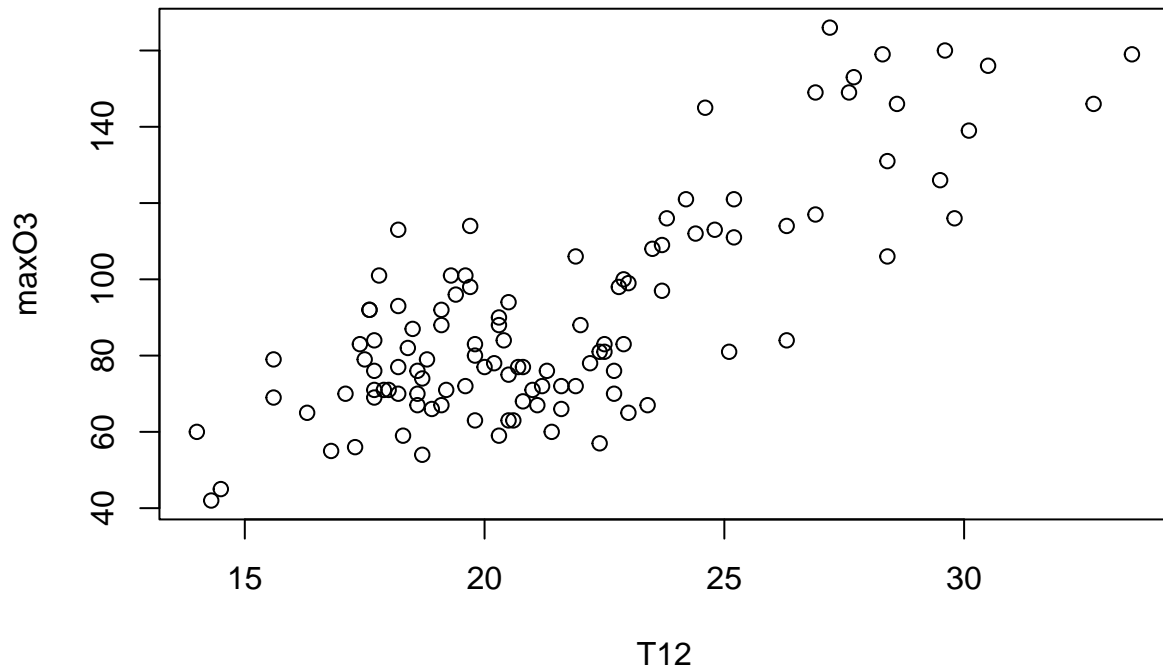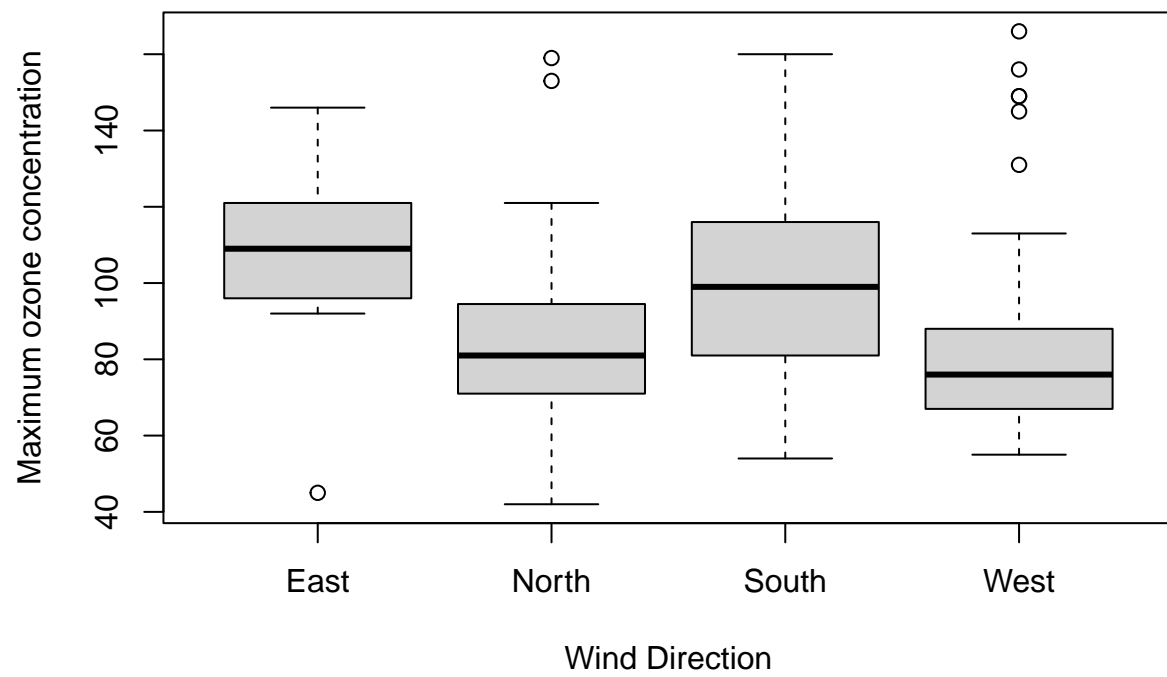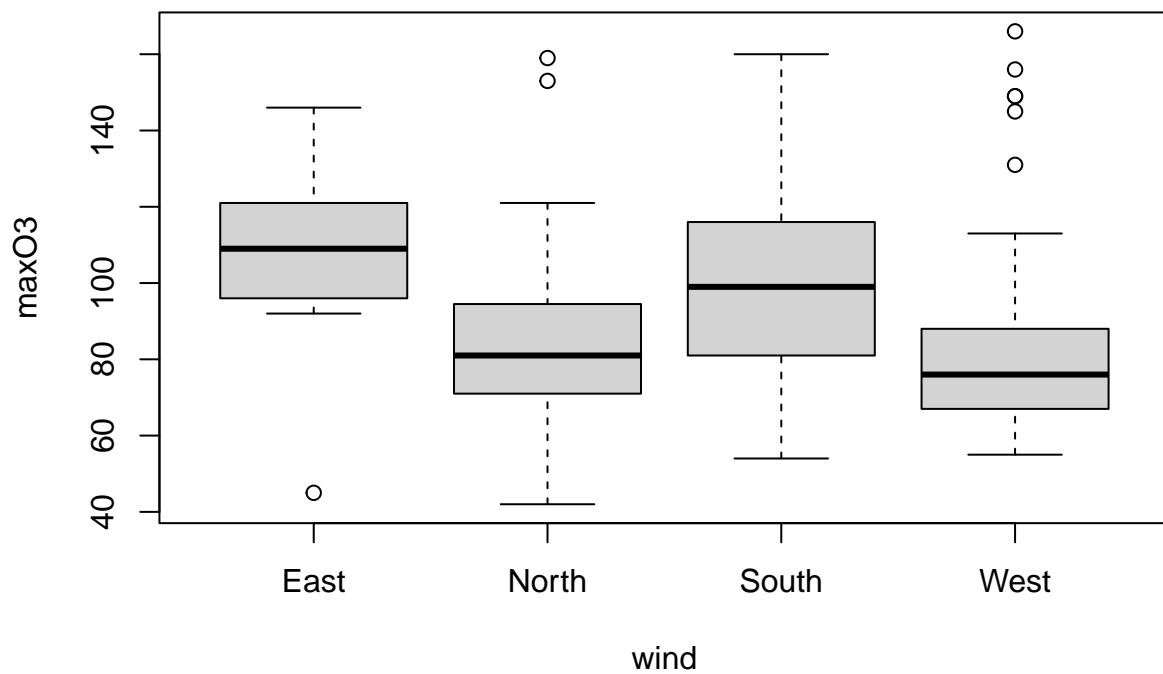
```
# Scatter plot of maxO3 and T12
plot(maxO3 ~ T12, data = ozone)
```
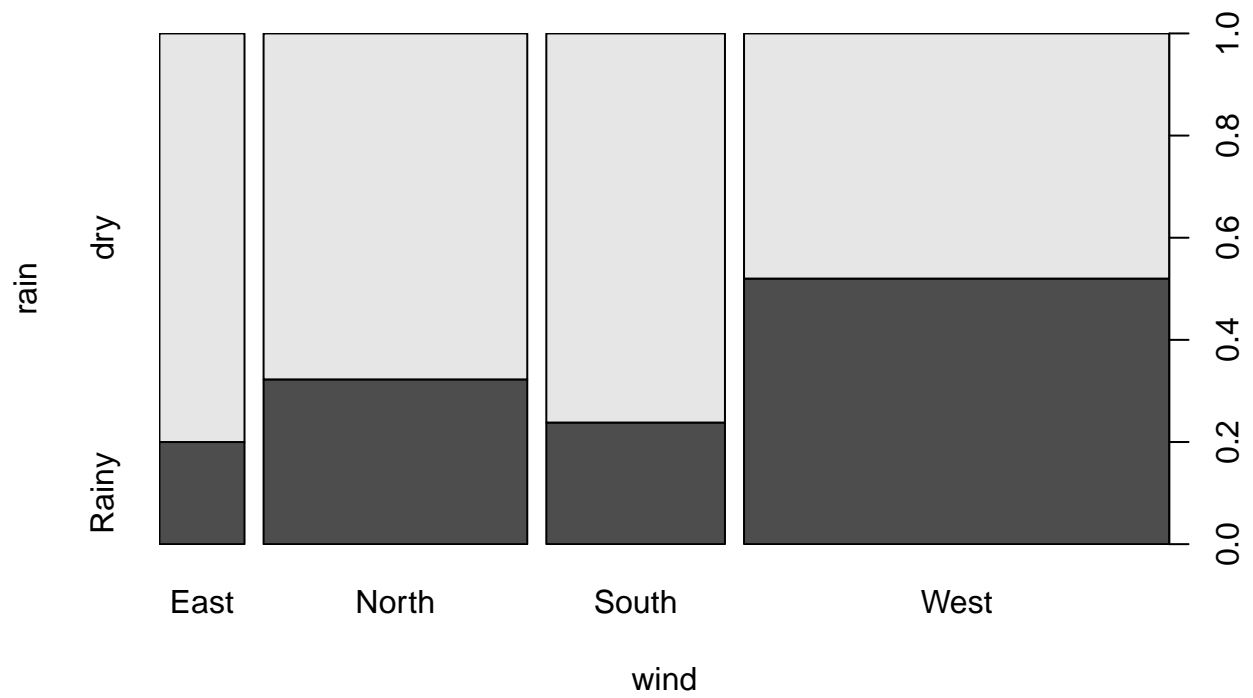


```
# Plot of quantitative variable with respect to qualitative variable
plot(maxO3 ~ wind, data = ozone, xlab = "Wind Direction", ylab = "Maximum ozone concentration")
```
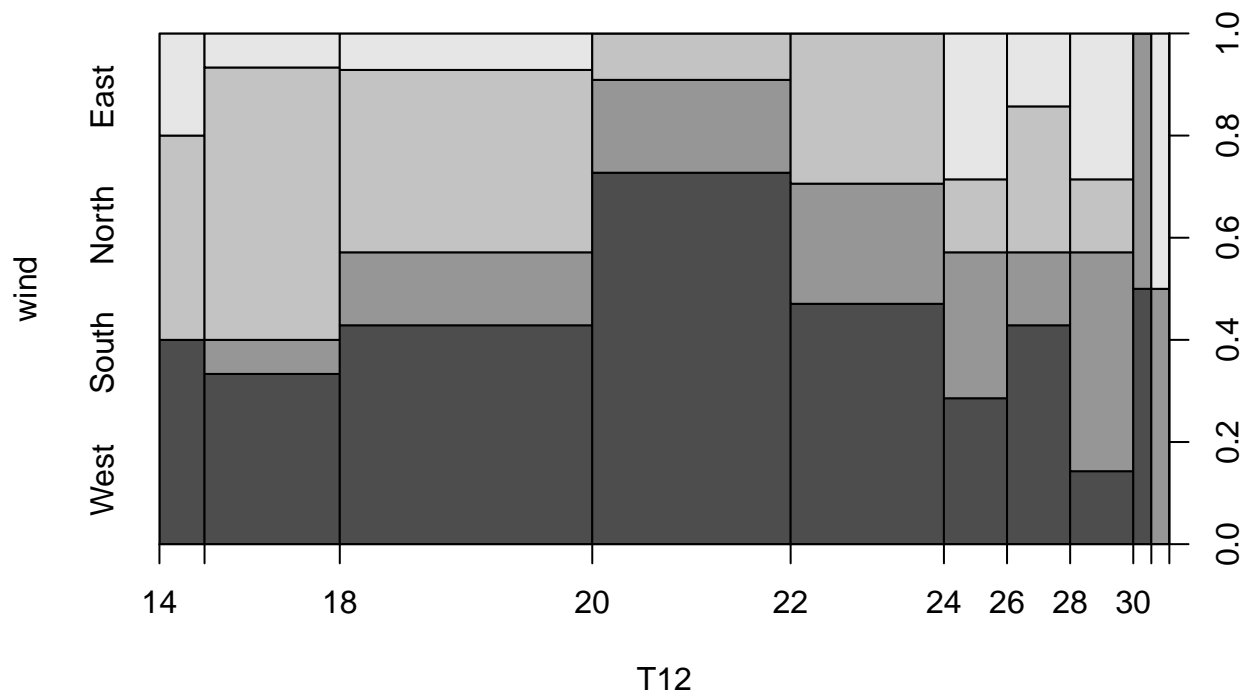
```r
boxplot(maxO3 ~ wind, data = ozone) # Same graph
```

```
# Plot of qualitative variable with respect to qualitative variable
plot(rain ~ wind, data = ozone)
```

```r
# Qualitative variable according to quantitative
plot(wind ~ T12, data = ozone)
spineplot(wind ~ T12, data = ozone) # Same plot
```

```
# Plotting various graphs...

# Saving a graph as a PDF file
pdf("graphik.pdf")
rangey <- range(ozone[1:7, "maxO3"], ozone[8:14, "maxO3"])
plot(ozone[1:7, "maxO3"], type = "l", ylim = rangey, lty = 1)
lines(ozone[8:14, "maxO3"], col = "grey50", lty = 1)
dev.off()
```

```
## pdf
##    2
```

```
# Creating multiple graphs using 'par()' function
par(mfrow = c(1, 2))
plot(1:10, 10:1, pch = 0)
plot(rep(1, 4), type = "l")   # 1 row and 2 columns

par(mfrow = c(1, 1)) # Reset to 1 graph per window

mat <- matrix(c(1, 1, 2, 3), nrow = 2, ncol = 2, byrow = TRUE)
layout(mat)   # Creating 3 graphs in 2 rows
plot(1:10, 10:1, pch = 0)
plot(rep(1, 4), type = "l")
plot(c(2, 3, -1, 0), type = "b")
```
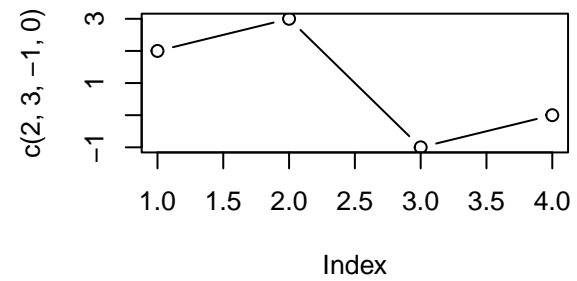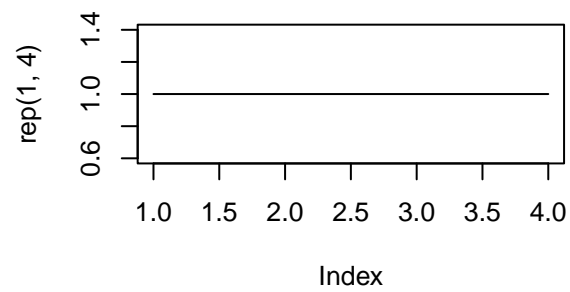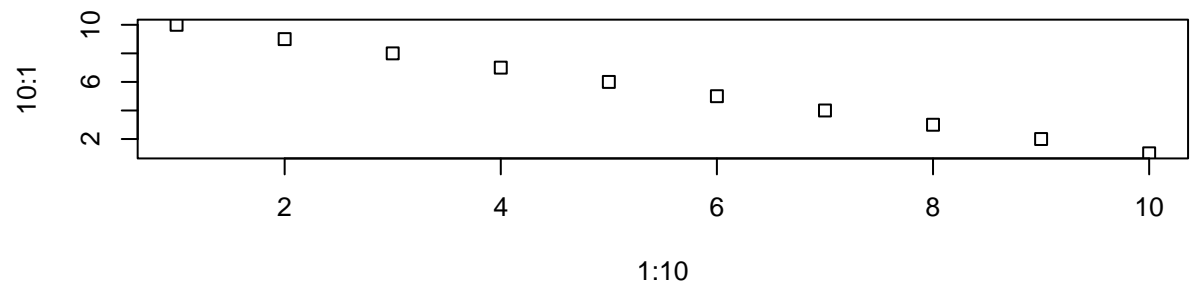
Certainly! Below is the provided R code written in R Markdown format with explanations and comments:

Multiple Windows

```
plot(1:10, 10:1, pch = 0)
```
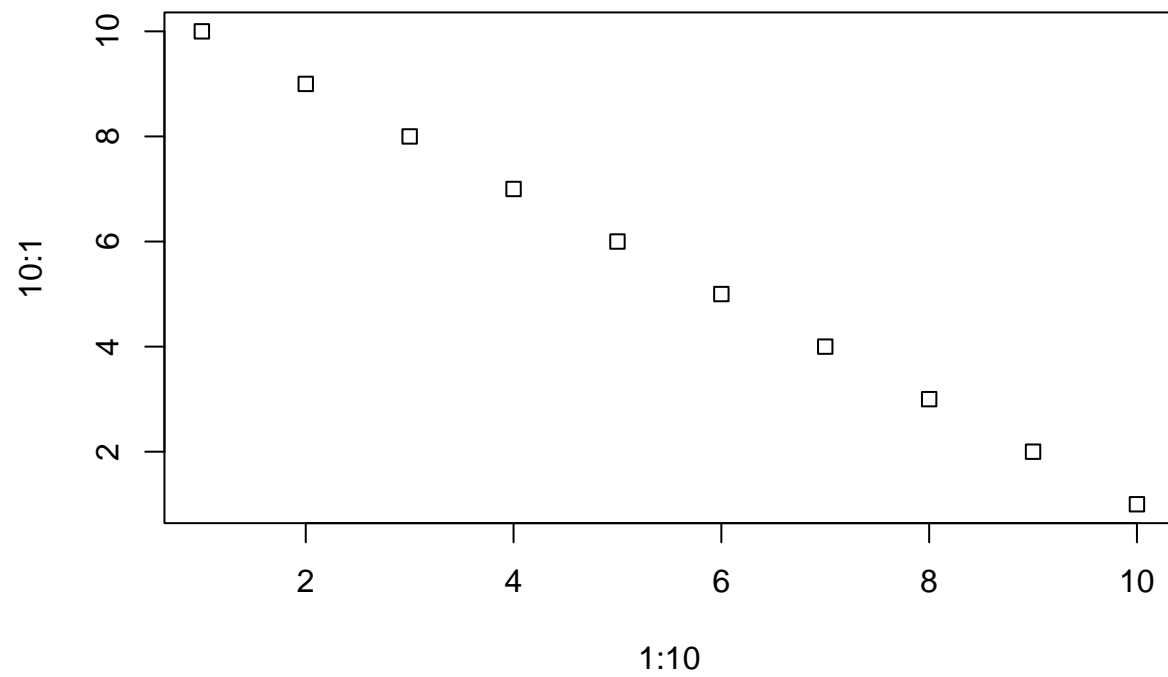
```
X11() # For Mac OS: Use 'quartz()' for separate window
plot(rep(1, 4), type = 'l')
```
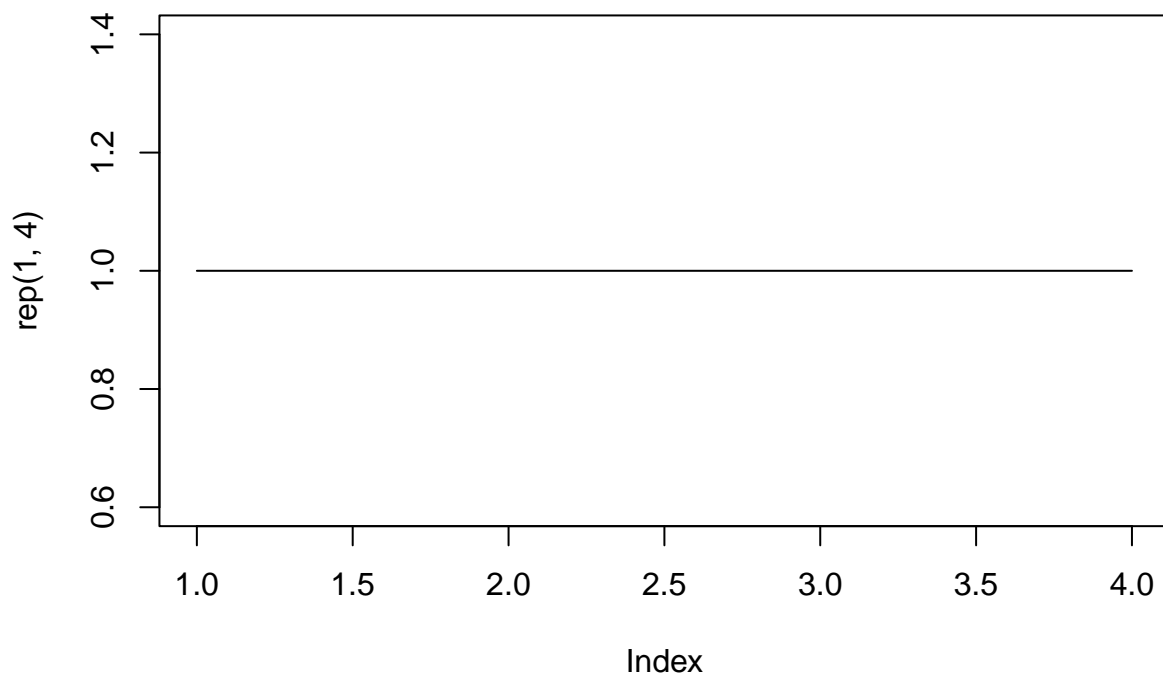
Improving and Personalizing Graphs

```r
# To create a plot with a specific color (e.g., red)
plot(1:4, 4:1, type = "p", col = "red")
```

Using Color
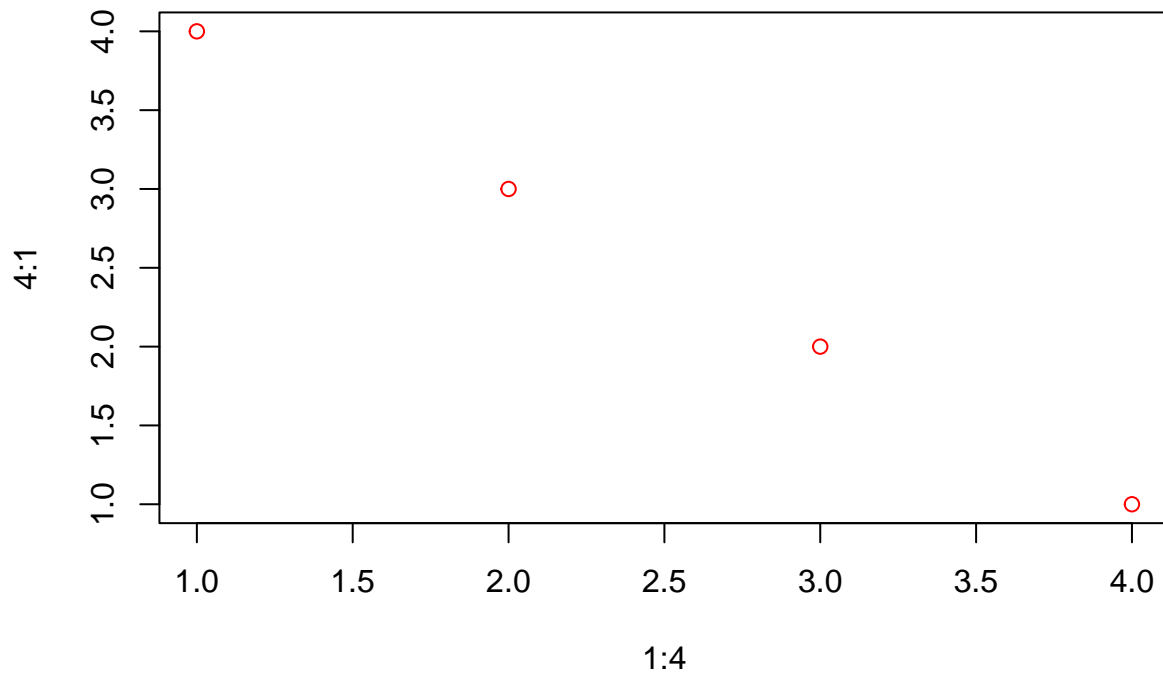
```
# Get a vector of available colors
colors()
```

```
##   [1] "white"            "aliceblue"
##   [3] "antiquewhite"     "antiquewhite1"
##   [5] "antiquewhite2"    "antiquewhite3"
##   [7] "antiquewhite4"    "aquamarine"
##   [9] "aquamarine1"      "aquamarine2"
##  [11] "aquamarine3"      "aquamarine4"
##  [13] "azure"            "azure1"
##  [15] "azure2"           "azure3"
##  [17] "azure4"           "beige"
##  [19] "bisque"           "bisque1"
##  [21] "bisque2"          "bisque3"
##  [23] "bisque4"          "black"
##  [25] "blanchedalmond"   "blue"
##  [27] "blue1"            "blue2"
##  [29] "blue3"            "blue4"
##  [31] "blueviolet"       "brown"
##  [33] "brown1"           "brown2"
##  [35] "brown3"           "brown4"
##  [37] "burlywood"        "burlywood1"
##  [39] "burlywood2"       "burlywood3"
##  [41] "burlywood4"       "cadetblue"
##  [43] "cadetblue1"       "cadetblue2"
##  [45] "cadetblue3"       "cadetblue4"
```

```
##  [47] "chartreuse"         "chartreuse1"
##  [49] "chartreuse2"        "chartreuse3"
##  [51] "chartreuse4"        "chocolate"
##  [53] "chocolate1"         "chocolate2"
##  [55] "chocolate3"         "chocolate4"
##  [57] "coral"              "coral1"
##  [59] "coral2"             "coral3"
##  [61] "coral4"             "cornflowerblue"
##  [63] "cornsilk"           "cornsilk1"
##  [65] "cornsilk2"          "cornsilk3"
##  [67] "cornsilk4"          "cyan"
##  [69] "cyan1"              "cyan2"
##  [71] "cyan3"              "cyan4"
##  [73] "darkblue"           "darkcyan"
##  [75] "darkgoldenrod"      "darkgoldenrod1"
##  [77] "darkgoldenrod2"     "darkgoldenrod3"
##  [79] "darkgoldenrod4"     "darkgray"
##  [81] "darkgreen"          "darkgrey"
##  [83] "darkkhaki"          "darkmagenta"
##  [85] "darkolivegreen"     "darkolivegreen1"
##  [87] "darkolivegreen2"    "darkolivegreen3"
##  [89] "darkolivegreen4"    "darkorange"
##  [91] "darkorange1"        "darkorange2"
##  [93] "darkorange3"        "darkorange4"
##  [95] "darkorchid"         "darkorchid1"
##  [97] "darkorchid2"        "darkorchid3"
##  [99] "darkorchid4"        "darkred"
## [101] "darksalmon"         "darkseagreen"
## [103] "darkseagreen1"      "darkseagreen2"
## [105] "darkseagreen3"      "darkseagreen4"
## [107] "darkslateblue"      "darkslategray"
## [109] "darkslategray1"     "darkslategray2"
## [111] "darkslategray3"     "darkslategray4"
## [113] "darkslategrey"      "darkturquoise"
## [115] "darkviolet"         "deeppink"
## [117] "deeppink1"          "deeppink2"
## [119] "deeppink3"          "deeppink4"
## [121] "deepskyblue"        "deepskyblue1"
## [123] "deepskyblue2"       "deepskyblue3"
## [125] "deepskyblue4"       "dimgray"
## [127] "dimgrey"            "dodgerblue"
## [129] "dodgerblue1"        "dodgerblue2"
## [131] "dodgerblue3"        "dodgerblue4"
## [133] "firebrick"          "firebrick1"
## [135] "firebrick2"         "firebrick3"
## [137] "firebrick4"         "floralwhite"
## [139] "forestgreen"        "gainsboro"
## [141] "ghostwhite"         "gold"
## [143] "gold1"              "gold2"
## [145] "gold3"              "gold4"
## [147] "goldenrod"          "goldenrod1"
## [149] "goldenrod2"         "goldenrod3"
## [151] "goldenrod4"         "gray"
## [153] "gray0"              "gray1"
```

```
## [155] "gray2"          "gray3"
## [157] "gray4"          "gray5"
## [159] "gray6"          "gray7"
## [161] "gray8"          "gray9"
## [163] "gray10"         "gray11"
## [165] "gray12"         "gray13"
## [167] "gray14"         "gray15"
## [169] "gray16"         "gray17"
## [171] "gray18"         "gray19"
## [173] "gray20"         "gray21"
## [175] "gray22"         "gray23"
## [177] "gray24"         "gray25"
## [179] "gray26"         "gray27"
## [181] "gray28"         "gray29"
## [183] "gray30"         "gray31"
## [185] "gray32"         "gray33"
## [187] "gray34"         "gray35"
## [189] "gray36"         "gray37"
## [191] "gray38"         "gray39"
## [193] "gray40"         "gray41"
## [195] "gray42"         "gray43"
## [197] "gray44"         "gray45"
## [199] "gray46"         "gray47"
## [201] "gray48"         "gray49"
## [203] "gray50"         "gray51"
## [205] "gray52"         "gray53"
## [207] "gray54"         "gray55"
## [209] "gray56"         "gray57"
## [211] "gray58"         "gray59"
## [213] "gray60"         "gray61"
## [215] "gray62"         "gray63"
## [217] "gray64"         "gray65"
## [219] "gray66"         "gray67"
## [221] "gray68"         "gray69"
## [223] "gray70"         "gray71"
## [225] "gray72"         "gray73"
## [227] "gray74"         "gray75"
## [229] "gray76"         "gray77"
## [231] "gray78"         "gray79"
## [233] "gray80"         "gray81"
## [235] "gray82"         "gray83"
## [237] "gray84"         "gray85"
## [239] "gray86"         "gray87"
## [241] "gray88"         "gray89"
## [243] "gray90"         "gray91"
## [245] "gray92"         "gray93"
## [247] "gray94"         "gray95"
## [249] "gray96"         "gray97"
## [251] "gray98"         "gray99"
## [253] "gray100"        "green"
## [255] "green1"         "green2"
## [257] "green3"         "green4"
## [259] "greenyellow"    "grey"
## [261] "grey0"          "grey1"
```

```
## [263] "grey2"       "grey3"
## [265] "grey4"       "grey5"
## [267] "grey6"       "grey7"
## [269] "grey8"       "grey9"
## [271] "grey10"      "grey11"
## [273] "grey12"      "grey13"
## [275] "grey14"      "grey15"
## [277] "grey16"      "grey17"
## [279] "grey18"      "grey19"
## [281] "grey20"      "grey21"
## [283] "grey22"      "grey23"
## [285] "grey24"      "grey25"
## [287] "grey26"      "grey27"
## [289] "grey28"      "grey29"
## [291] "grey30"      "grey31"
## [293] "grey32"      "grey33"
## [295] "grey34"      "grey35"
## [297] "grey36"      "grey37"
## [299] "grey38"      "grey39"
## [301] "grey40"      "grey41"
## [303] "grey42"      "grey43"
## [305] "grey44"      "grey45"
## [307] "grey46"      "grey47"
## [309] "grey48"      "grey49"
## [311] "grey50"      "grey51"
## [313] "grey52"      "grey53"
## [315] "grey54"      "grey55"
## [317] "grey56"      "grey57"
## [319] "grey58"      "grey59"
## [321] "grey60"      "grey61"
## [323] "grey62"      "grey63"
## [325] "grey64"      "grey65"
## [327] "grey66"      "grey67"
## [329] "grey68"      "grey69"
## [331] "grey70"      "grey71"
## [333] "grey72"      "grey73"
## [335] "grey74"      "grey75"
## [337] "grey76"      "grey77"
## [339] "grey78"      "grey79"
## [341] "grey80"      "grey81"
## [343] "grey82"      "grey83"
## [345] "grey84"      "grey85"
## [347] "grey86"      "grey87"
## [349] "grey88"      "grey89"
## [351] "grey90"      "grey91"
## [353] "grey92"      "grey93"
## [355] "grey94"      "grey95"
## [357] "grey96"      "grey97"
## [359] "grey98"      "grey99"
## [361] "grey100"     "honeydew"
## [363] "honeydew1"   "honeydew2"
## [365] "honeydew3"   "honeydew4"
## [367] "hotpink"     "hotpink1"
## [369] "hotpink2"    "hotpink3"
```

```
## [371] "hotpink4"             "indianred"
## [373] "indianred1"           "indianred2"
## [375] "indianred3"           "indianred4"
## [377] "ivory"                "ivory1"
## [379] "ivory2"               "ivory3"
## [381] "ivory4"               "khaki"
## [383] "khaki1"               "khaki2"
## [385] "khaki3"               "khaki4"
## [387] "lavender"             "lavenderblush"
## [389] "lavenderblush1"       "lavenderblush2"
## [391] "lavenderblush3"       "lavenderblush4"
## [393] "lawngreen"            "lemonchiffon"
## [395] "lemonchiffon1"        "lemonchiffon2"
## [397] "lemonchiffon3"        "lemonchiffon4"
## [399] "lightblue"            "lightblue1"
## [401] "lightblue2"           "lightblue3"
## [403] "lightblue4"           "lightcoral"
## [405] "lightcyan"            "lightcyan1"
## [407] "lightcyan2"           "lightcyan3"
## [409] "lightcyan4"           "lightgoldenrod"
## [411] "lightgoldenrod1"      "lightgoldenrod2"
## [413] "lightgoldenrod3"      "lightgoldenrod4"
## [415] "lightgoldenrodyellow" "lightgray"
## [417] "lightgreen"           "lightgrey"
## [419] "lightpink"            "lightpink1"
## [421] "lightpink2"           "lightpink3"
## [423] "lightpink4"           "lightsalmon"
## [425] "lightsalmon1"         "lightsalmon2"
## [427] "lightsalmon3"         "lightsalmon4"
## [429] "lightseagreen"        "lightskyblue"
## [431] "lightskyblue1"        "lightskyblue2"
## [433] "lightskyblue3"        "lightskyblue4"
## [435] "lightslateblue"       "lightslategray"
## [437] "lightslategrey"       "lightsteelblue"
## [439] "lightsteelblue1"      "lightsteelblue2"
## [441] "lightsteelblue3"      "lightsteelblue4"
## [443] "lightyellow"          "lightyellow1"
## [445] "lightyellow2"         "lightyellow3"
## [447] "lightyellow4"         "limegreen"
## [449] "linen"                "magenta"
## [451] "magenta1"             "magenta2"
## [453] "magenta3"             "magenta4"
## [455] "maroon"               "maroon1"
## [457] "maroon2"              "maroon3"
## [459] "maroon4"              "mediumaquamarine"
## [461] "mediumblue"           "mediumorchid"
## [463] "mediumorchid1"        "mediumorchid2"
## [465] "mediumorchid3"        "mediumorchid4"
## [467] "mediumpurple"         "mediumpurple1"
## [469] "mediumpurple2"        "mediumpurple3"
## [471] "mediumpurple4"        "mediumseagreen"
## [473] "mediumslateblue"      "mediumspringgreen"
## [475] "mediumturquoise"      "mediumvioletred"
## [477] "midnightblue"         "mintcream"
```

```
## [479] "mistyrose"        "mistyrose1"
## [481] "mistyrose2"       "mistyrose3"
## [483] "mistyrose4"       "moccasin"
## [485] "navajowhite"      "navajowhite1"
## [487] "navajowhite2"     "navajowhite3"
## [489] "navajowhite4"     "navy"
## [491] "navyblue"         "oldlace"
## [493] "olivedrab"        "olivedrab1"
## [495] "olivedrab2"       "olivedrab3"
## [497] "olivedrab4"       "orange"
## [499] "orange1"          "orange2"
## [501] "orange3"          "orange4"
## [503] "orangered"        "orangered1"
## [505] "orangered2"       "orangered3"
## [507] "orangered4"       "orchid"
## [509] "orchid1"          "orchid2"
## [511] "orchid3"          "orchid4"
## [513] "palegoldenrod"    "palegreen"
## [515] "palegreen1"       "palegreen2"
## [517] "palegreen3"       "palegreen4"
## [519] "paleturquoise"    "paleturquoise1"
## [521] "paleturquoise2"   "paleturquoise3"
## [523] "paleturquoise4"   "palevioletred"
## [525] "palevioletred1"   "palevioletred2"
## [527] "palevioletred3"   "palevioletred4"
## [529] "papayawhip"       "peachpuff"
## [531] "peachpuff1"       "peachpuff2"
## [533] "peachpuff3"       "peachpuff4"
## [535] "peru"             "pink"
## [537] "pink1"            "pink2"
## [539] "pink3"            "pink4"
## [541] "plum"             "plum1"
## [543] "plum2"            "plum3"
## [545] "plum4"            "powderblue"
## [547] "purple"           "purple1"
## [549] "purple2"          "purple3"
## [551] "purple4"          "red"
## [553] "red1"             "red2"
## [555] "red3"             "red4"
## [557] "rosybrown"        "rosybrown1"
## [559] "rosybrown2"       "rosybrown3"
## [561] "rosybrown4"       "royalblue"
## [563] "royalblue1"       "royalblue2"
## [565] "royalblue3"       "royalblue4"
## [567] "saddlebrown"      "salmon"
## [569] "salmon1"          "salmon2"
## [571] "salmon3"          "salmon4"
## [573] "sandybrown"       "seagreen"
## [575] "seagreen1"        "seagreen2"
## [577] "seagreen3"        "seagreen4"
## [579] "seashell"         "seashell1"
## [581] "seashell2"        "seashell3"
## [583] "seashell4"        "sienna"
## [585] "sienna1"          "sienna2"
```

```
## [587] "sienna3"          "sienna4"
## [589] "skyblue"          "skyblue1"
## [591] "skyblue2"         "skyblue3"
## [593] "skyblue4"         "slateblue"
## [595] "slateblue1"       "slateblue2"
## [597] "slateblue3"       "slateblue4"
## [599] "slategray"        "slategray1"
## [601] "slategray2"       "slategray3"
## [603] "slategray4"       "slategrey"
## [605] "snow"             "snow1"
## [607] "snow2"            "snow3"
## [609] "snow4"            "springgreen"
## [611] "springgreen1"     "springgreen2"
## [613] "springgreen3"     "springgreen4"
## [615] "steelblue"        "steelblue1"
## [617] "steelblue2"       "steelblue3"
## [619] "steelblue4"       "tan"
## [621] "tan1"             "tan2"
## [623] "tan3"             "tan4"
## [625] "thistle"          "thistle1"
## [627] "thistle2"         "thistle3"
## [629] "thistle4"         "tomato"
## [631] "tomato1"          "tomato2"
## [633] "tomato3"          "tomato4"
## [635] "turquoise"        "turquoise1"
## [637] "turquoise2"       "turquoise3"
## [639] "turquoise4"       "violet"
## [641] "violetred"        "violetred1"
## [643] "violetred2"       "violetred3"
## [645] "violetred4"       "wheat"
## [647] "wheat1"           "wheat2"
## [649] "wheat3"           "wheat4"
## [651] "whitesmoke"       "yellow"
## [653] "yellow1"          "yellow2"
## [655] "yellow3"          "yellow4"
## [657] "yellowgreen"
```

```r
# 'par()' function manages graphical parameters
par(fg = "blue", bg = "#f2a1c2")
```

```r
# Modifying palette to ensure correspondence between number and color
palette(gray(seq(0, 0.9, len = 10))) # Gray palette
plot(1:10, rep(1, 10), type = "p", pch = 25, bg = 1:10)
```
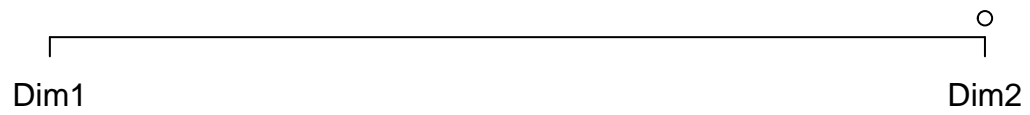
Modifying Palette
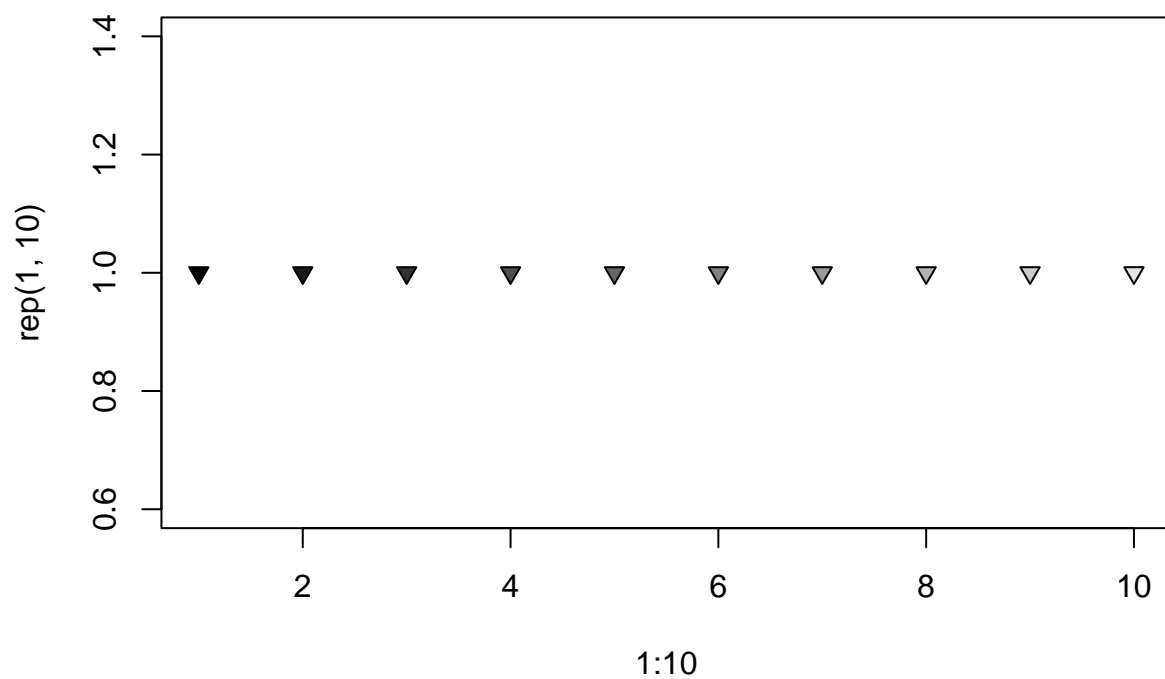
```r
palette("default") # Reset to default palette
```

```r
# Adding a title and controlling the appearance of axes
plot(c(10, 11), c(12, 11), type = "p", axes = "FALSE", xlab = "", ylab = "")
axis(1, at = c(10, 11), label = c("Dim1", "Dim2")) # Redefine axes
```
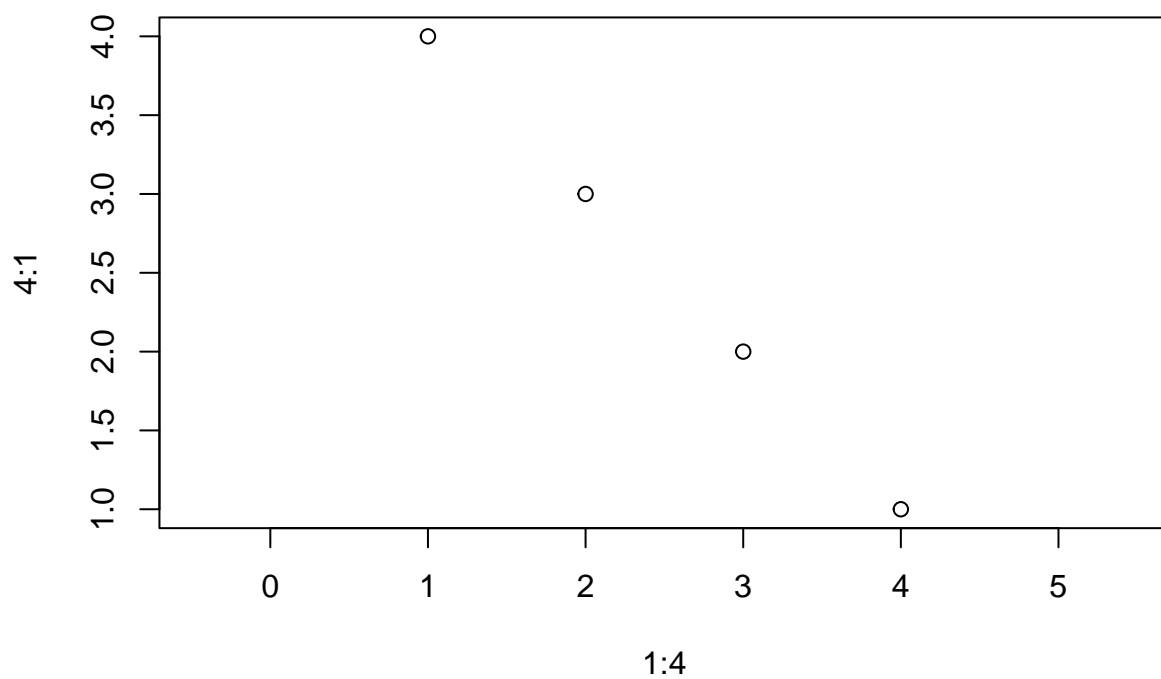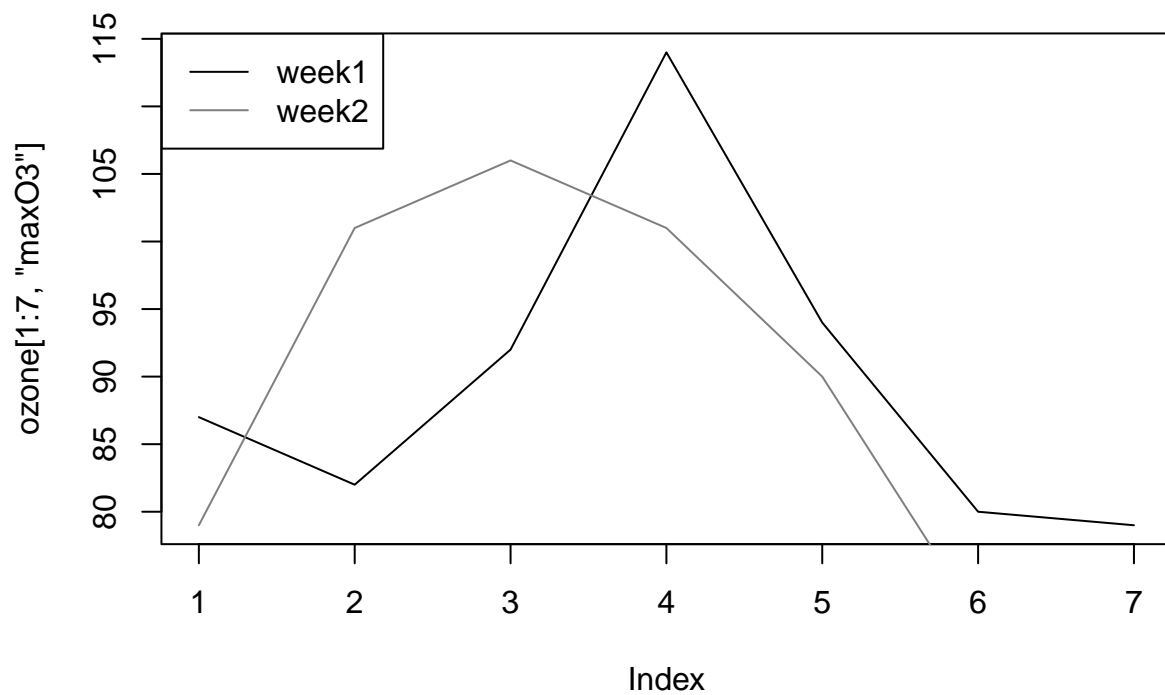
Adding Title and Adjusting Axes

Dim1   Dim2

```r
# Constructing orthonormal axes
plot(1:4, 4:1, type = "p", asp = 1)
```

Constructing Orthonormal Axes

```r
# Adding a legend to the plot
rangey <- range(ozone[1:7, "maxO3"])
plot(ozone[1:7, "maxO3"], type = "l")
lines(ozone[8:14, "maxO3"], ylim = rangey, col = "grey50")
legend("topleft", legend = c("week1", "week2"),
       col = c("black", "grey50"), lty = 1)
```

Adding a Legend and Mathematical Formulas

```
# Inserting symbols or mathematical formulae
help("plotmath")

plot(1, 1, xlab = expression(bar(x) == sum(frac(x[i], n), i == 1, n)))
```

$$\overline{x} = \sum_{i=1}^{n} \frac{x_i}{n}$$