Feuille de Travaux Dirigés n^o 4
Les graphiques et R

Les exemples de cette feuille de travaux dirigées sont tirés de l'aide du logiciel R

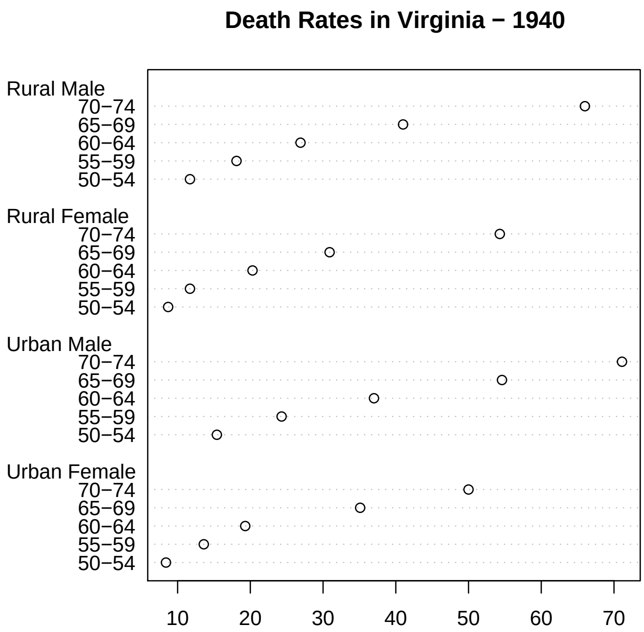
1 Contenu

Nous allons nous intéresser à différents types de représentations graphiques adaptées à la nature des variables que nous souhaitons représenter.

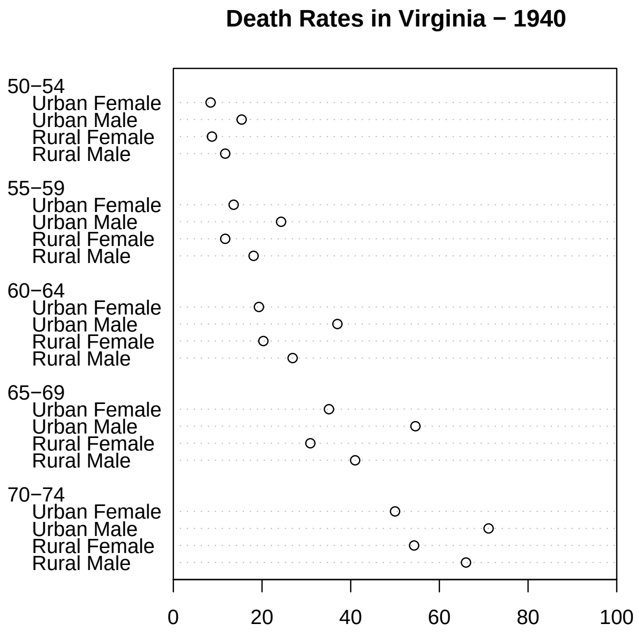
```
> library(graphics)
```

2 dotchart

```
> dotchart(VADeaths, main = "Death Rates in Virginia - 1940")
```

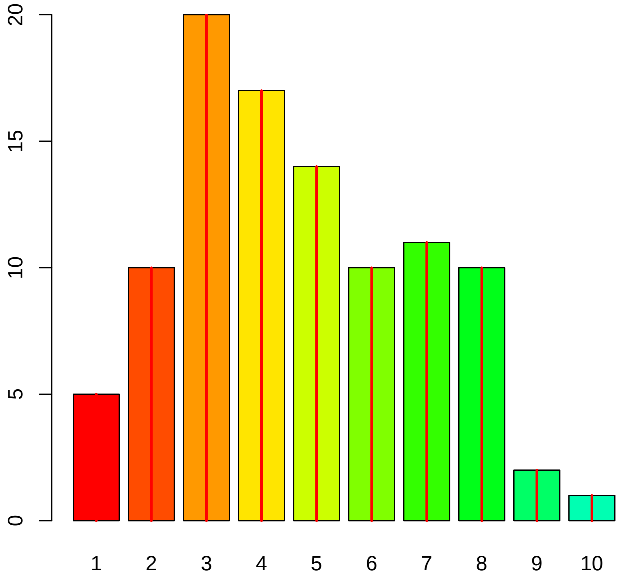



```
> op <- par(xaxs = "i")
> dotchart(t(VADeaths), main = "Death Rates in Virginia - 1940",
+     xlim = c(0, 100))
> par(op)
```

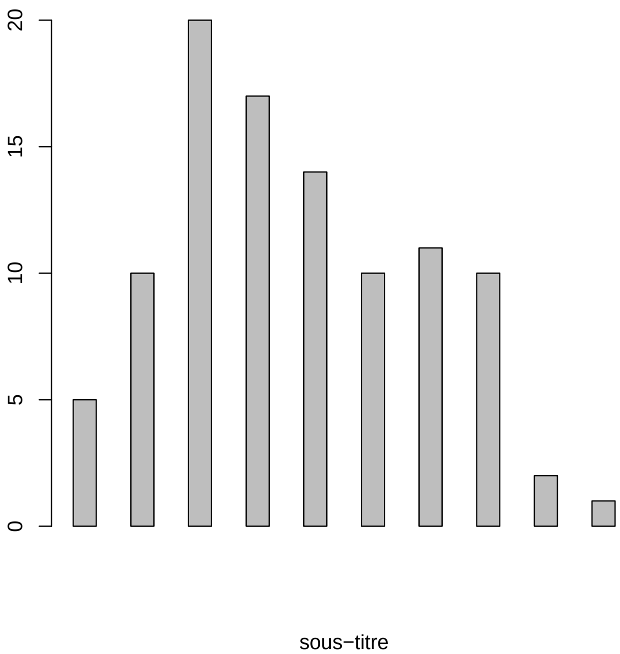


3 barplot

```
> require(grDevices)
> tN <- table(Ni <- stats::rpois(100, lambda = 5))

> r <- barplot(tN, col = rainbow(20))
> lines(r, tN, type = "h", col = "red", lwd = 2)
```



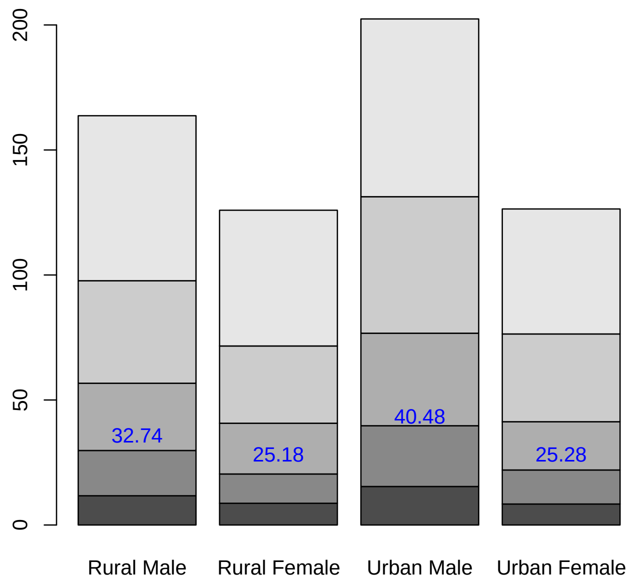

```
> barplot(tN, space = 1.5, axisnames = FALSE, sub = "sous-titre")
```



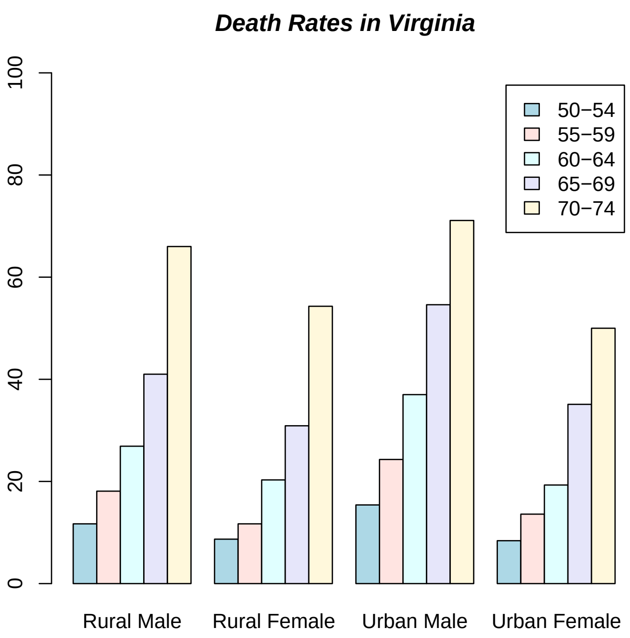

```
> barplot(VADeaths, plot = FALSE)
```

```
[1] 0.7 1.9 3.1 4.3
```

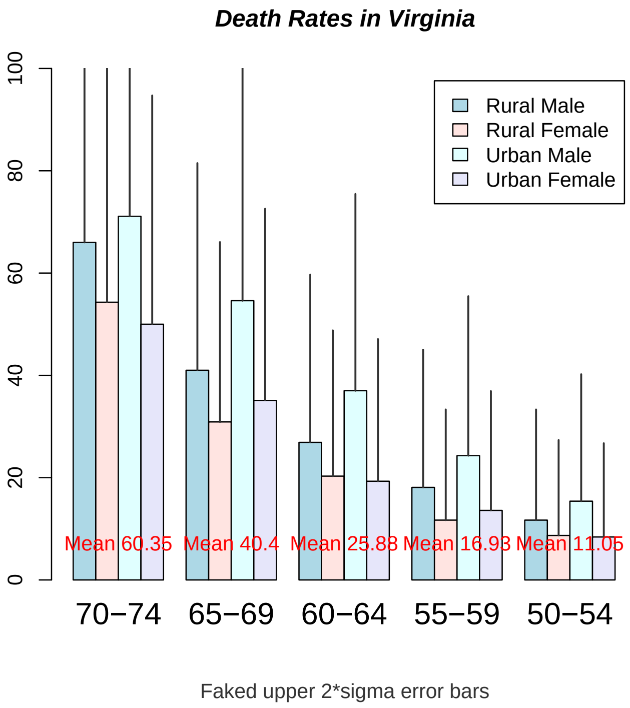
```
> barplot(VADeaths, plot = FALSE, beside = TRUE)

     [,1] [,2] [,3] [,4]
[1,]  1.5  7.5 13.5 19.5
[2,]  2.5  8.5 14.5 20.5
[3,]  3.5  9.5 15.5 21.5
[4,]  4.5 10.5 16.5 22.5
[5,]  5.5 11.5 17.5 23.5

> mp <- barplot(VADeaths)
> tot <- colMeans(VADeaths)
> text(mp, tot + 3, format(tot), xpd = TRUE, col = "blue")
```



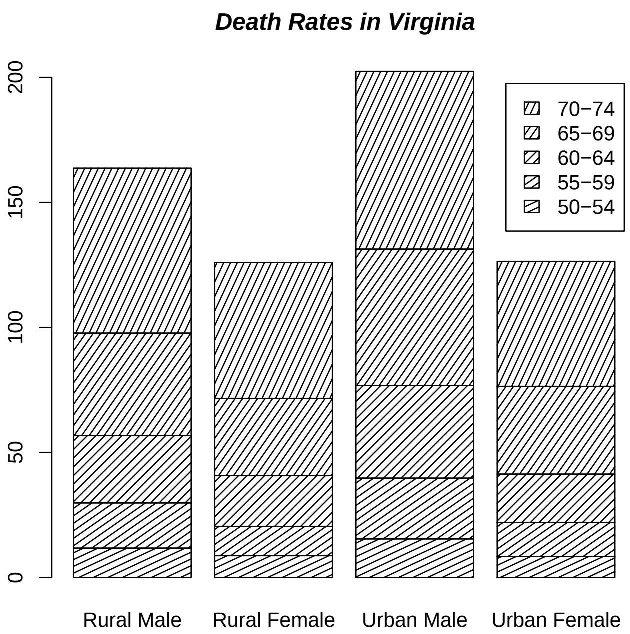

```
> barplot(VADeaths, beside = TRUE, col = c("lightblue",
+     "mistyrose", "lightcyan", "lavender", "cornsilk"),
+     legend = rownames(VADeaths), ylim = c(0, 100))
> title(main = "Death Rates in Virginia", font.main = 4)
```



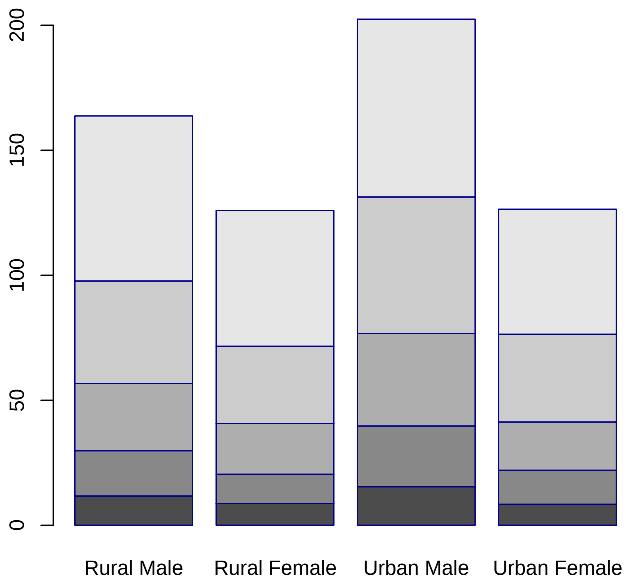

```
> hh <- t(VADeaths)[, 5:1]
> mybarcol <- "gray20"

> mp <- barplot(hh, beside = TRUE, col = c("lightblue",
+     "mistyrose", "lightcyan", "lavender"), legend = colnames(VADeaths),
+     ylim = c(0, 100), main = "Death Rates in Virginia",
+     font.main = 4, sub = "Faked upper 2*sigma error bars",
+     col.sub = mybarcol, cex.names = 1.5)
> segments(mp, hh, mp, hh + 2 * sqrt(1000 * hh/100), col = mybarcol,
+     lwd = 1.5)
> stopifnot(dim(mp) == dim(hh))
> mtext(side = 1, at = colMeans(mp), line = -2, text = paste("Mean",
+     formatC(colMeans(hh))), col = "red")
```




```
> barplot(VADeaths, angle = 15 + 10 * 1:5, density = 20,
+      col = "black", legend = rownames(VADeaths))
> title(main = list("Death Rates in Virginia", font = 4))
```

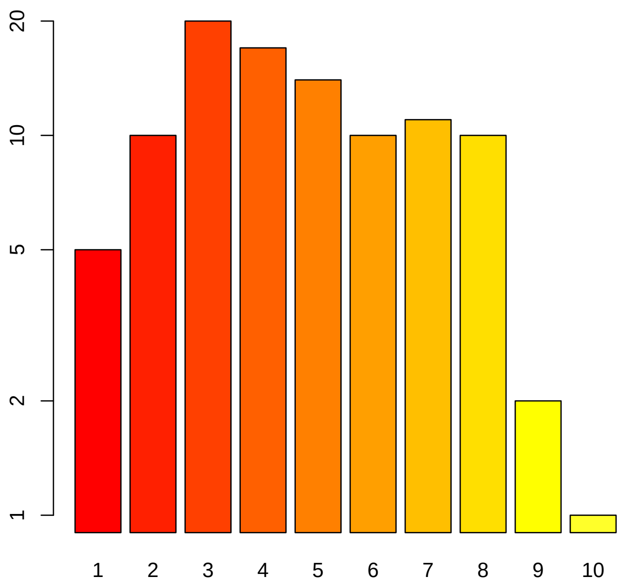



```
> barplot(VADeaths, border = "dark blue")
```

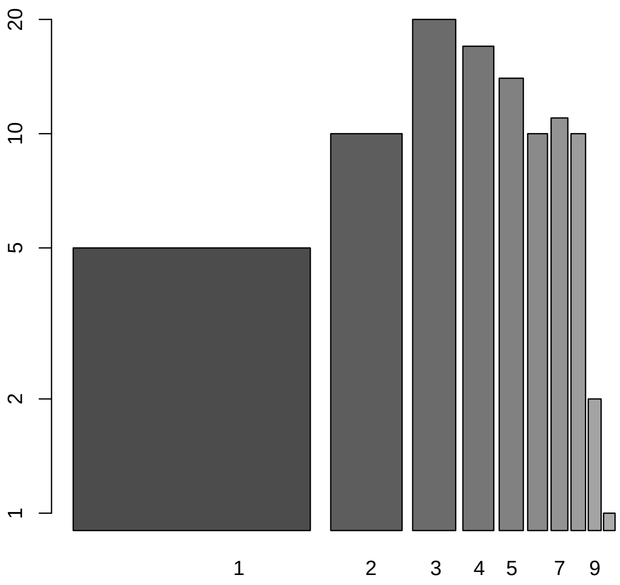


Échelles logarithmiques

```
> barplot(tN, col = heat.colors(12), log = "y")
```

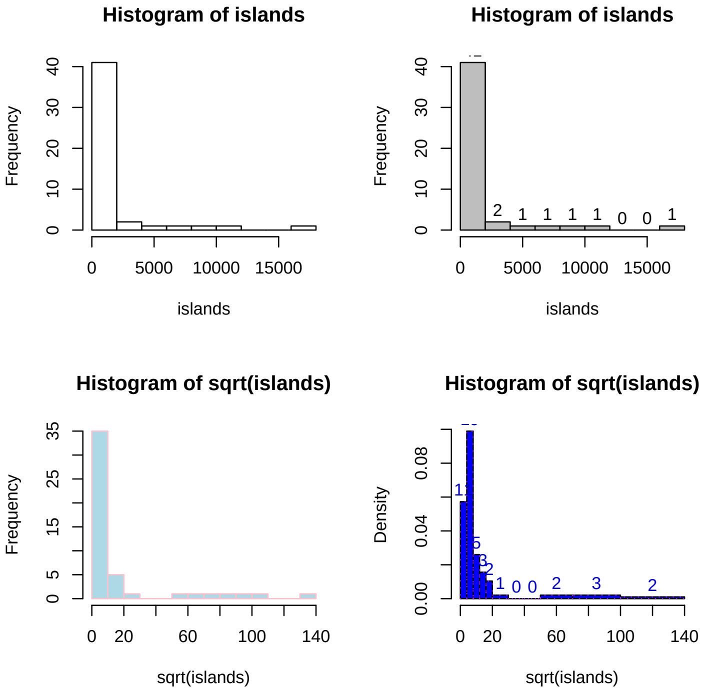



```
> barplot(tN, col = gray.colors(20), log = "xy")
```



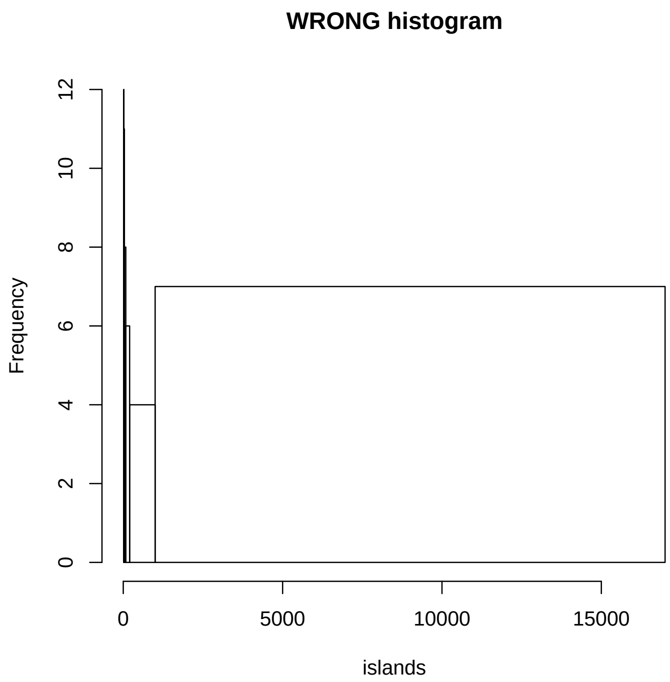
4 hist

```
> op <- par(mfrow = c(2, 2))
> hist(islands)
> utils::str(hist(islands, col = "gray", labels = TRUE))
> hist(sqrt(islands), breaks = 12, col = "lightblue",
+     border = "pink")
> r <- hist(sqrt(islands), breaks = c(4 * 0:5, 10 * 3:5,
+     70, 100, 140), col = "blue1")
> text(r$mids, r$density, r$counts, adj = c(0.5, -0.5),
+     col = "blue3")
> sapply(r[2:3], sum)
> sum(r$density * diff(r$breaks))
> lines(r, lty = 3, border = "purple")
> par(op)
```




```
> require(utils)
> str(hist(islands, breaks = 12, plot = FALSE))

List of 7
 $ breaks     : num [1:10] 0 2000 4000 6000 8000 10000 12000 14000 16000 18000
 $ counts     : int [1:9] 41 2 1 1 1 1 0 0 1
 $ intensities: num [1:9] 4.27e-04 2.08e-05 1.04e-05 1.04e-05 1.04e-05 ...
 $ density    : num [1:9] 4.27e-04 2.08e-05 1.04e-05 1.04e-05 1.04e-05 ...
 $ mids       : num [1:9] 1000 3000 5000 7000 9000 11000 13000 15000 17000
 $ xname      : chr "islands"
 $ equidist   : logi TRUE
 - attr(*, "class")= chr "histogram"

> str(hist(islands, breaks = c(12, 20, 36, 80, 200, 1000,
+      17000), plot = FALSE))

List of 7
 $ breaks     : num [1:7] 12 20 36 80 200 1000 17000
 $ counts     : int [1:6] 12 11 8 6 4 7
 $ intensities: num [1:6] 0.03125 0.014323 0.003788 0.001042 0.000104 ...
 $ density    : num [1:6] 0.03125 0.014323 0.003788 0.001042 0.000104 ...
 $ mids       : num [1:6] 16 28 58 140 600 9000
 $ xname      : chr "islands"
 $ equidist   : logi FALSE
 - attr(*, "class")= chr "histogram"
```

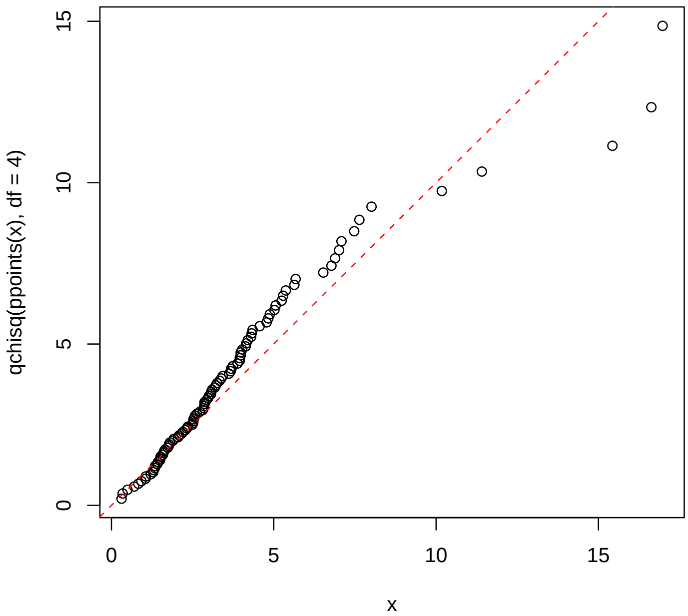
```
> hist(islands, breaks = c(12, 20, 36, 80, 200, 1000,
+     17000), freq = TRUE, main = "WRONG histogram")
```




```
> require(stats)
> set.seed(14)
> x <- rchisq(100, df = 4)
```

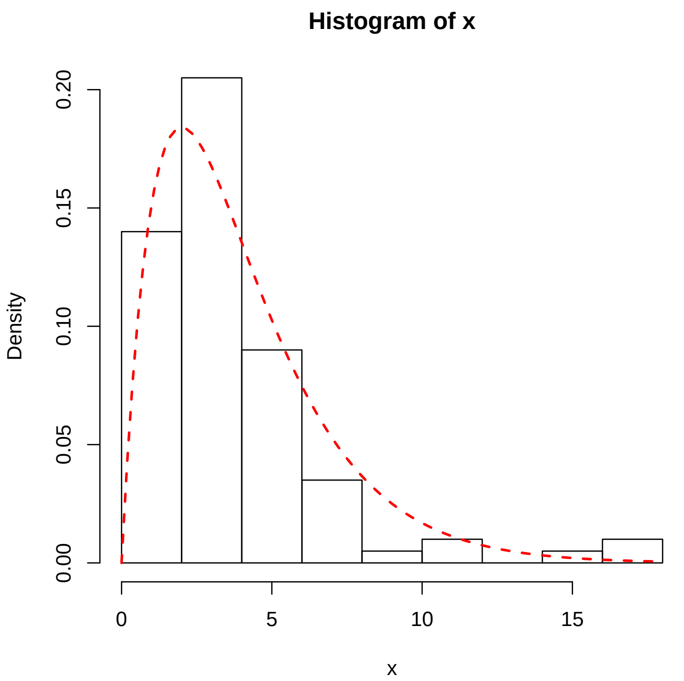
Comparing data with a model distribution should be done with qqplot() !

```
> qqplot(x, qchisq(ppoints(x), df = 4))
> abline(0, 1, col = 2, lty = 2)
```



if you really insist on using hist() ... :

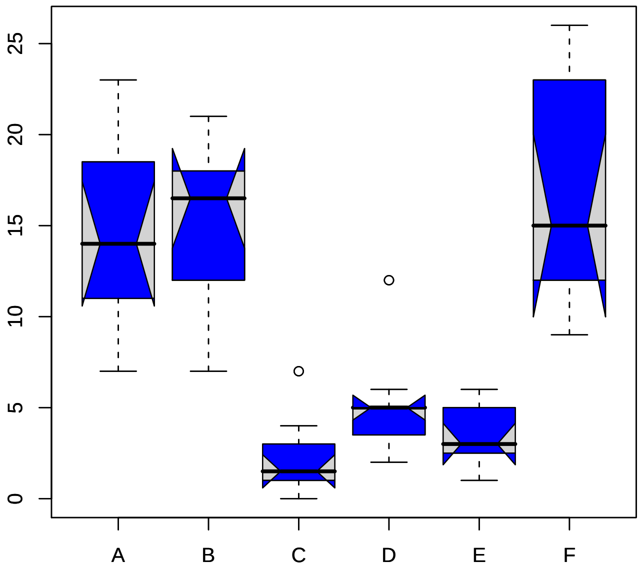
```
> hist(x, freq = FALSE, ylim = c(0, 0.2))
> curve(dchisq(x, df = 4), col = 2, lty = 2, lwd = 2,
+     add = TRUE)
```



5 Boîtes à moustaches

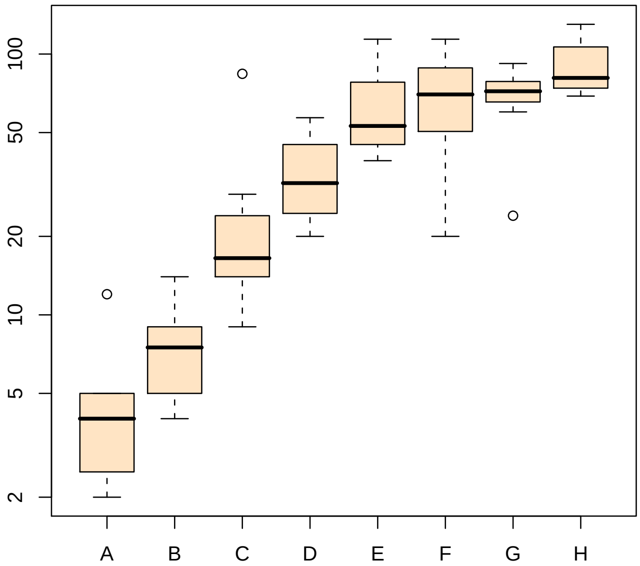
5.1 boxplot d'une formule

```
> boxplot(count ~ spray, data = InsectSprays, col = "lightgray")
> boxplot(count ~ spray, data = InsectSprays, notch = TRUE,
+      add = TRUE, col = "blue")
```

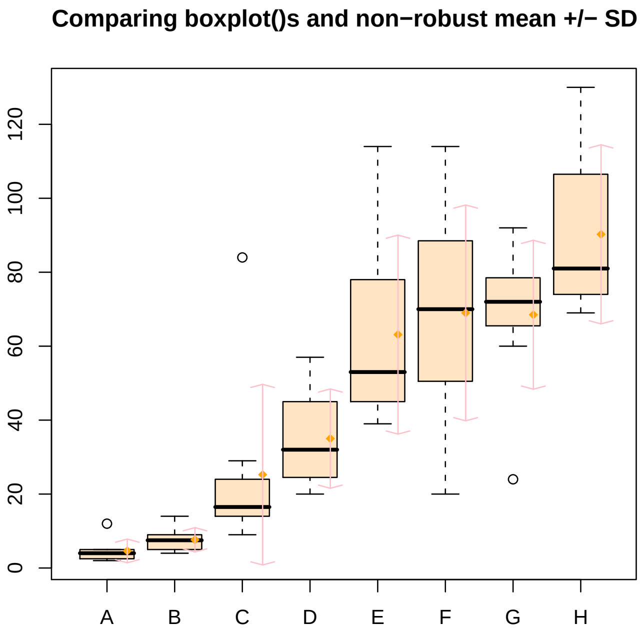


The last command add notches : If the notches of two plots do not overlap this is 'strong evidence' that the two medians differ.

```
> boxplot(decrease ~ treatment, data = OrchardSprays,
+      log = "y", col = "bisque")
```

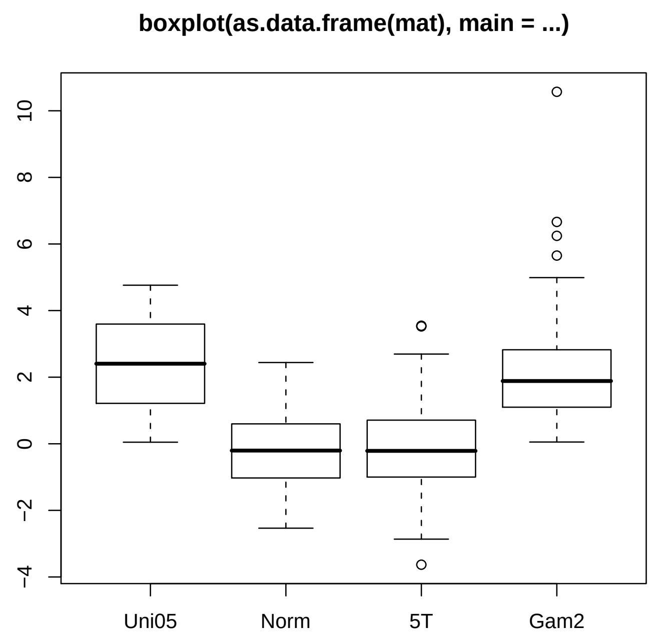



```
> rb <- boxplot(decrease ~ treatment, data = OrchardSprays,
+     col = "bisque")
> title("Comparing boxplot()s and non-robust mean +/- SD")
> mn.t <- tapply(OrchardSprays$decrease, OrchardSprays$treatment,
+     mean)
> sd.t <- tapply(OrchardSprays$decrease, OrchardSprays$treatment,
+     sd)
> xi <- 0.3 + seq(rb$n)
> points(xi, mn.t, col = "orange", pch = 18)
> arrows(xi, mn.t - sd.t, xi, mn.t + sd.t, code = 3, col = "pink",
+     angle = 75, length = 0.1)
```

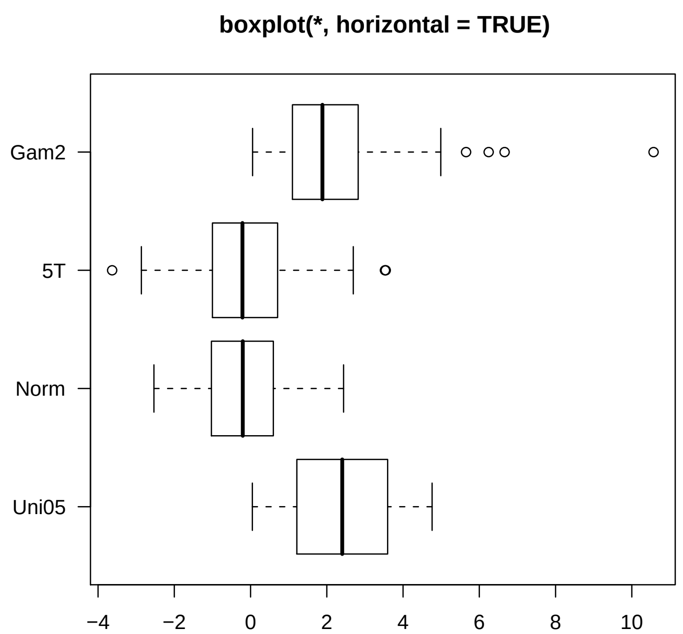


5.2 boxplot d'une matrice

```
> mat <- cbind(Uni05 = (1:100)/21, Norm = rnorm(100),
+     "5T" = rt(100, df = 5), Gam2 = rgamma(100, shape = 2))

> boxplot(as.data.frame(mat), main = "boxplot(as.data.frame(mat),
+     main = ...)")
```

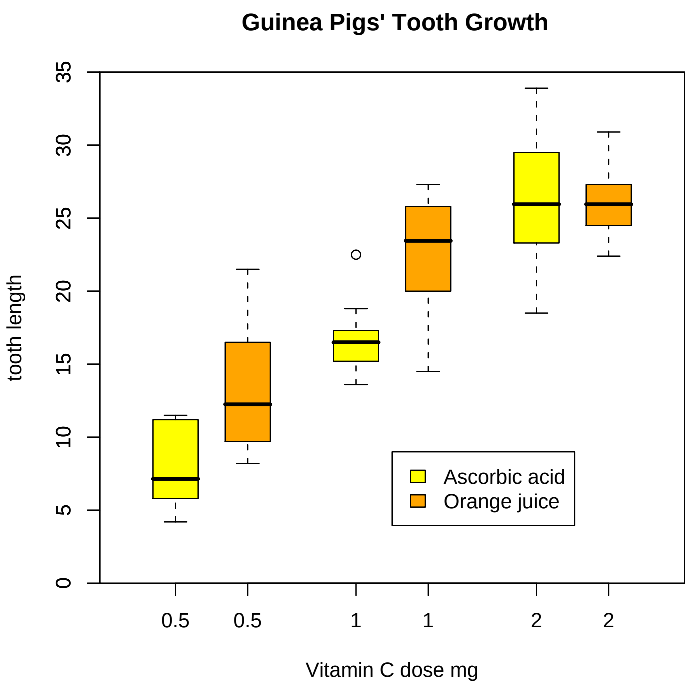



```
> par(las = 1)
> boxplot(as.data.frame(mat), main = "boxplot(*, horizontal = TRUE)",
+     horizontal = TRUE)
```



Using 'at = ' and adding boxplots – example idea by Roger Bivand :

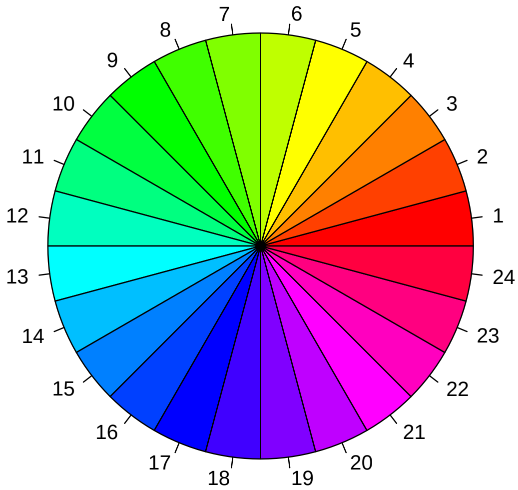
```
> boxplot(len ~ dose, data = ToothGrowth, boxwex = 0.25,
+     at = 1:3 - 0.2, subset = supp == "VC", col = "yellow",
+     main = "Guinea Pigs' Tooth Growth", xlab = "Vitamin C dose mg",
+     ylab = "tooth length", xlim = c(0.5, 3.5), ylim = c(0,
+         35), yaxs = "i")
> boxplot(len ~ dose, data = ToothGrowth, add = TRUE,
+     boxwex = 0.25, at = 1:3 + 0.2, subset = supp ==
+         "OJ", col = "orange")
> legend(2, 9, c("Ascorbic acid", "Orange juice"), fill = c("yellow",
+     "orange"))
```



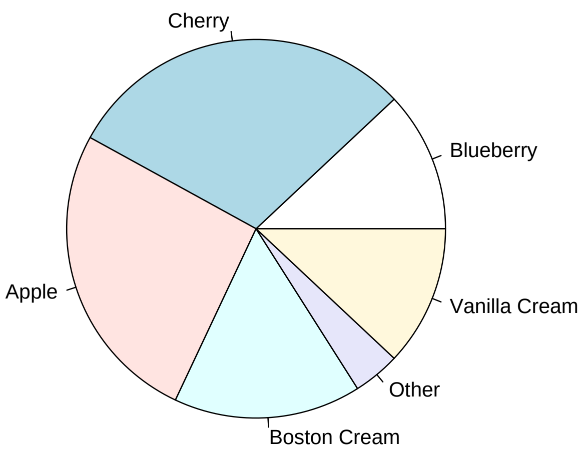
6 pie

```
> require(grDevices)
```

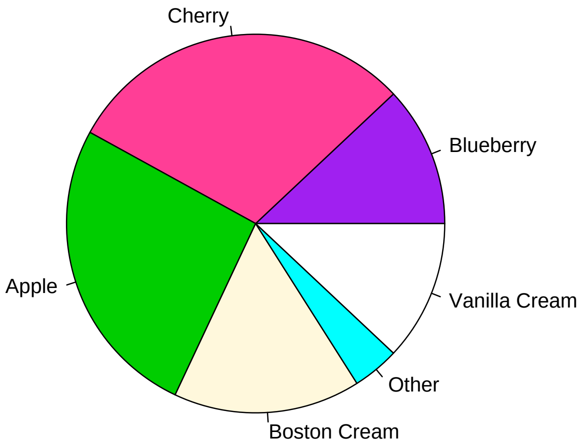
```
> pie(rep(1, 24), col = rainbow(24), radius = 0.9)
```



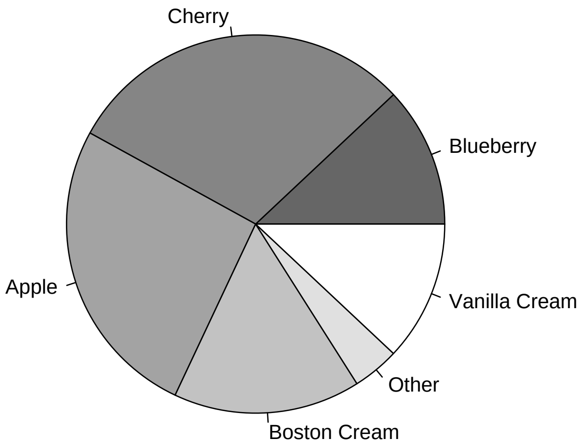

```
> pie.sales <- c(0.12, 0.3, 0.26, 0.16, 0.04, 0.12)
> names(pie.sales) <- c("Blueberry", "Cherry", "Apple",
+     "Boston Cream", "Other", "Vanilla Cream")

> pie(pie.sales)
```



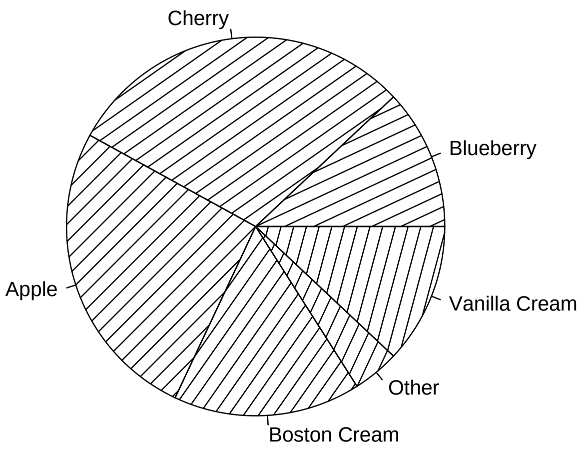
```
> pie(pie.sales, col = c("purple", "violetred1", "green3",
+     "cornsilk", "cyan", "white"))
```



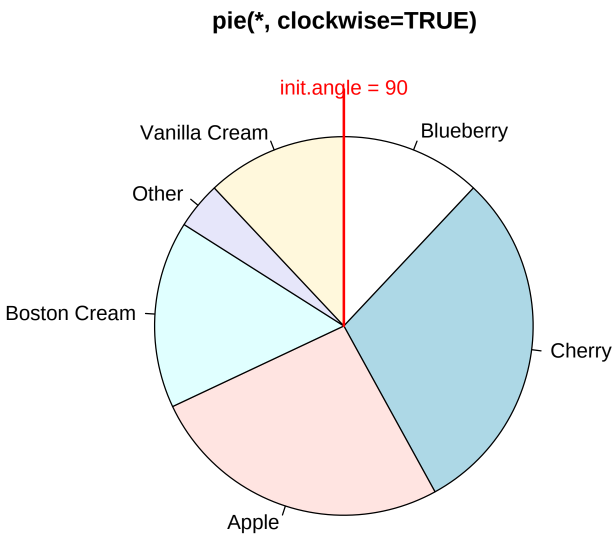

```
> pie(pie.sales, col = gray(seq(0.4, 1, length = 6)))
```




```
> pie(pie.sales, density = 10, angle = 15 + 10 * 1:6)
```

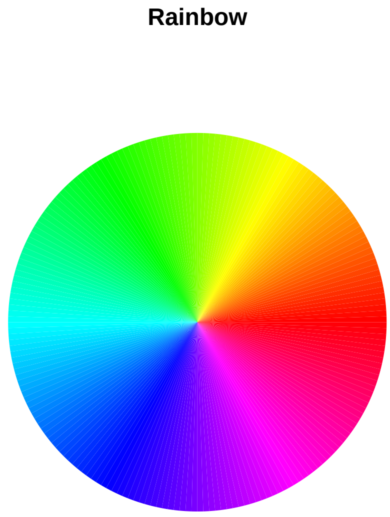



```
> pie(pie.sales, clockwise = TRUE, main = "pie(*, clockwise=TRUE)")
> segments(0, 0, 0, 1, col = "red", lwd = 2)
> text(0, 1, "init.angle = 90", col = "red")
```




```
> n <- 200
> pie(rep(1, n), labels = "", col = rainbow(n), border = NA,
```

```
+      main = "Rainbow")
```

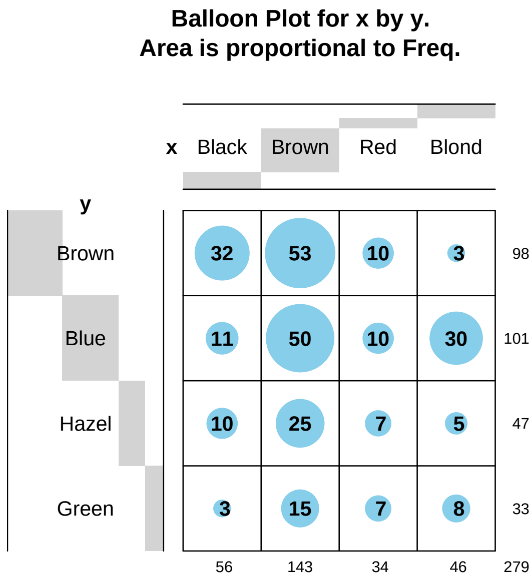


7 Tableaux de contingence

7.1 balloonplot

```
> library(gdata)
> library(gtools)
> library(gplots)
```

```
> balloonplot(as.table(HairEyeColor[, , Sex = "Male"]),
+      dotsize = 10)
> balloonplot(as.table(HairEyeColor[, , Sex = "Female"]),
+      dotsize = 10)
```

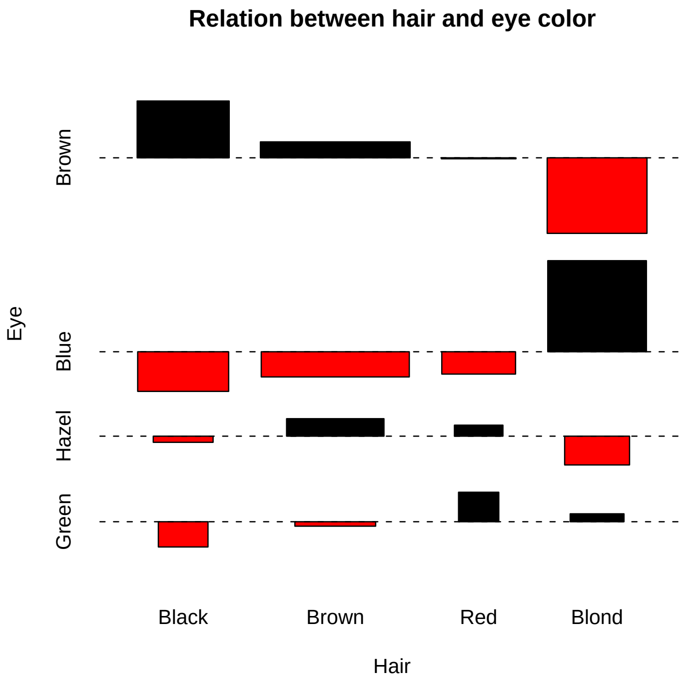


7.2 assocplot

Aggregate over sex :

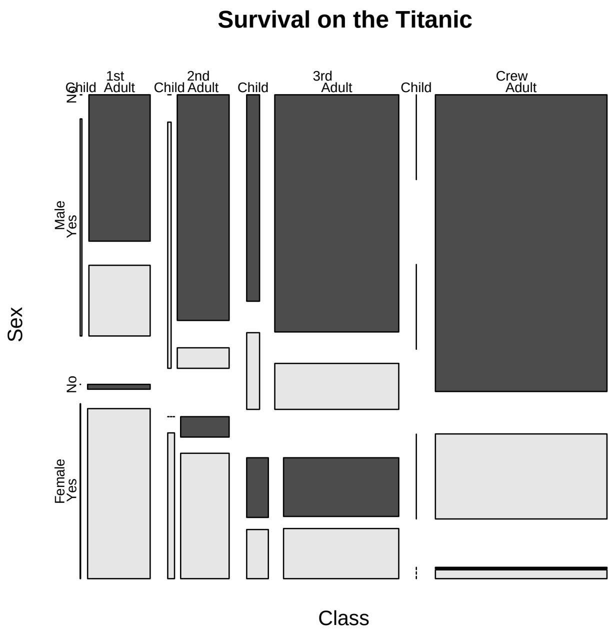
```
> x <- margin.table(HairEyeColor, c(1, 2))
> x
```

```
> assocplot(x, main = "Relation between hair and eye color")
```



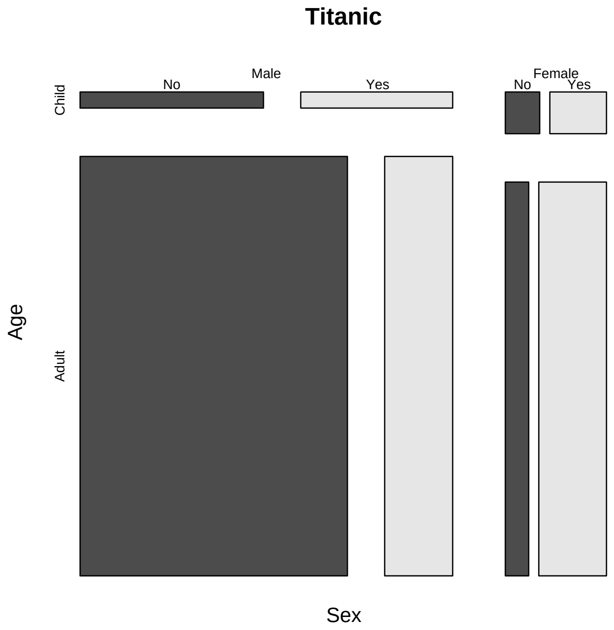
7.3 mosaicplot

```
> mosaicplot(Titanic, main = "Survival on the Titanic",
+     color = TRUE)
```

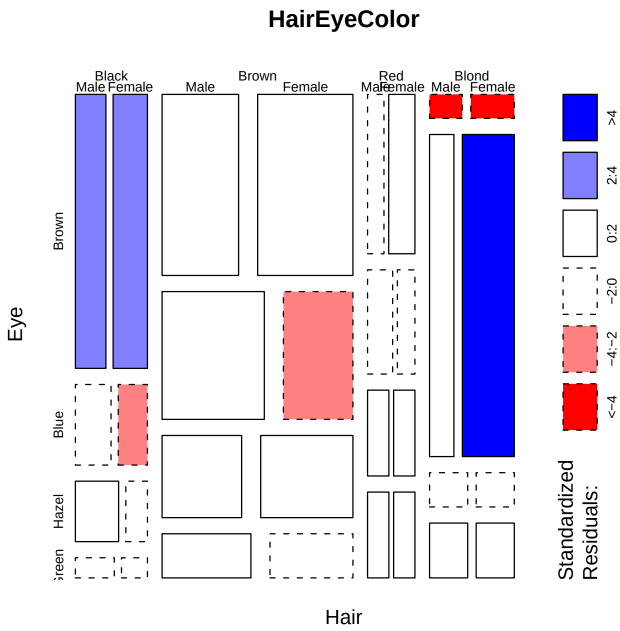


Formula interface for tabulated data :

```
> mosaicplot(~Sex + Age + Survived, data = Titanic, color = TRUE)
```

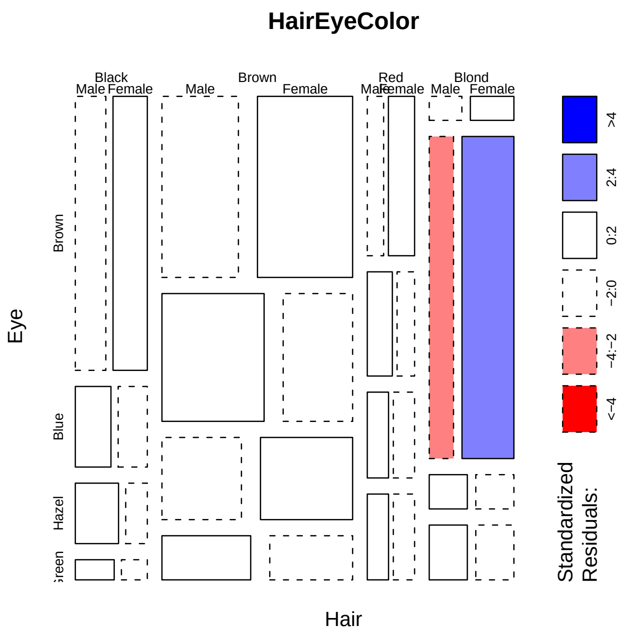



```
> mosaicplot(HairEyeColor, shade = TRUE)
```



Independence model of hair and eye color and sex. Indicates that ## there are more blue eyed blonde females than expected in the case ## of independence and too few brown eyed blonde females. ## The corresponding model is :

```
> fm <- loglin(HairEyeColor, list(1, 2, 3))
> pchisq(fm$pearson, fm$df, lower.tail = FALSE)

> mosaicplot(HairEyeColor, shade = TRUE, margin = list(1:2,
+     3))
```

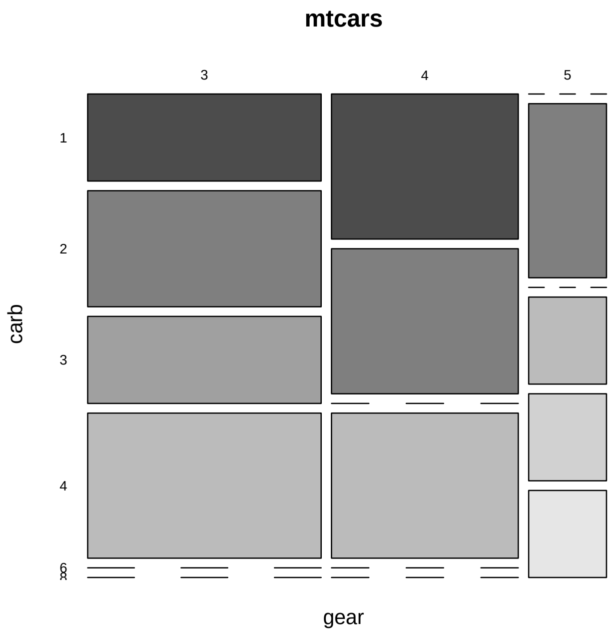


Model of joint independence of sex from hair and eye color. Males ## are underrepresented among people with brown hair and eyes, and are ## overrepresented among people with brown hair and blue eyes. ## The corresponding model is :

```
> fm <- loglin(HairEyeColor, list(1:2, 3))
> pchisq(fm$pearson, fm$df, lower.tail = FALSE)
```

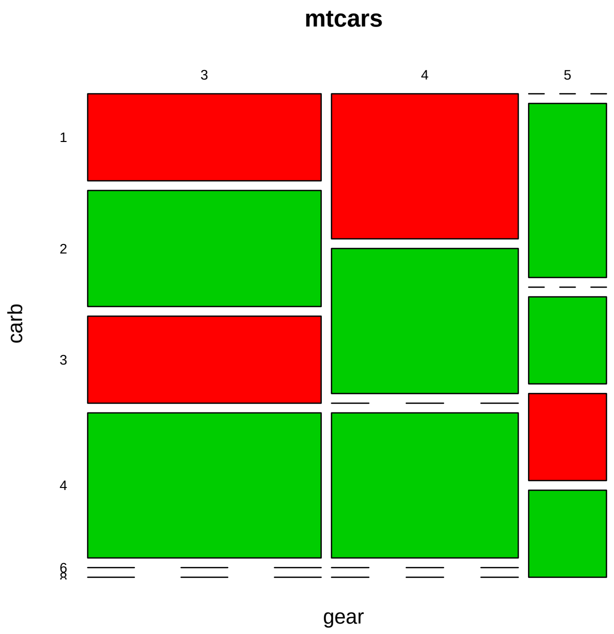
Formula interface for raw data : visualize cross-tabulation of numbers ## of gears and carburettors in Motor Trend car data.

```
> mosaicplot(~gear + carb, data = mtcars, color = TRUE,
+     las = 1)
```



color recycling

```
> mosaicplot(~gear + carb, data = mtcars, color = 2:3,
+     las = 1)
```



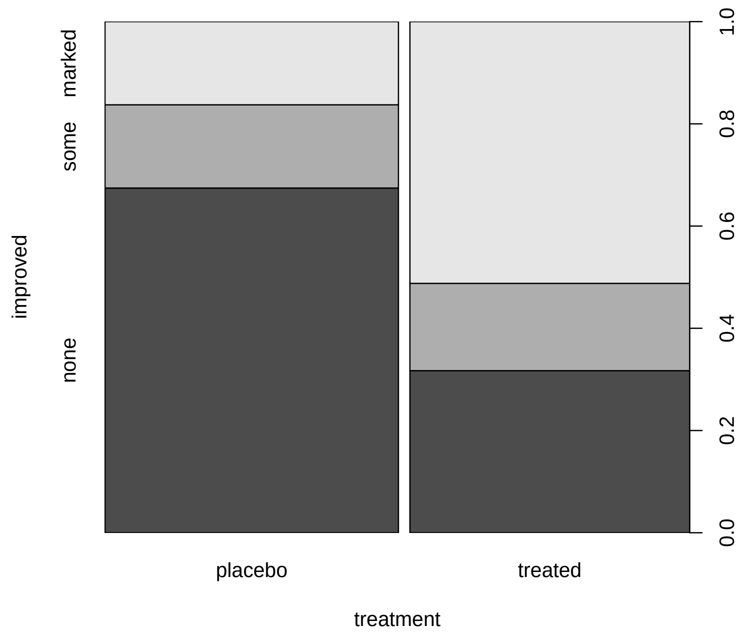
7.4 splineplot

treatment and improvement of patients with rheumatoid arthritis

```
> treatment <- factor(rep(c(1, 2), c(43, 41)), levels = c(1,
+     2), labels = c("placebo", "treated"))
> improved <- factor(rep(c(1, 2, 3, 1, 2, 3), c(29, 7,
+     7, 13, 7, 21)), levels = c(1, 2, 3), labels = c("none",
+     "some", "marked"))
```

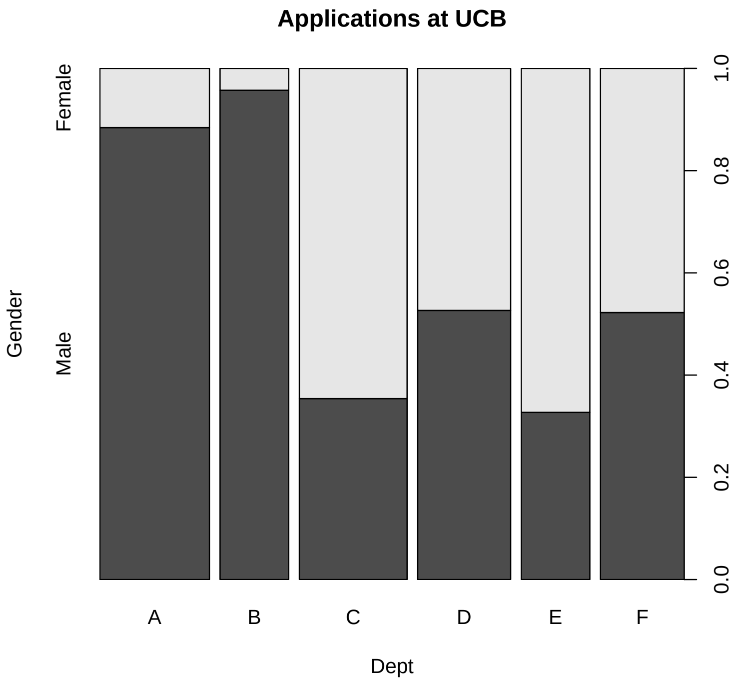
(dependence on a categorical variable)

```
> (spineplot(improved ~ treatment))
```

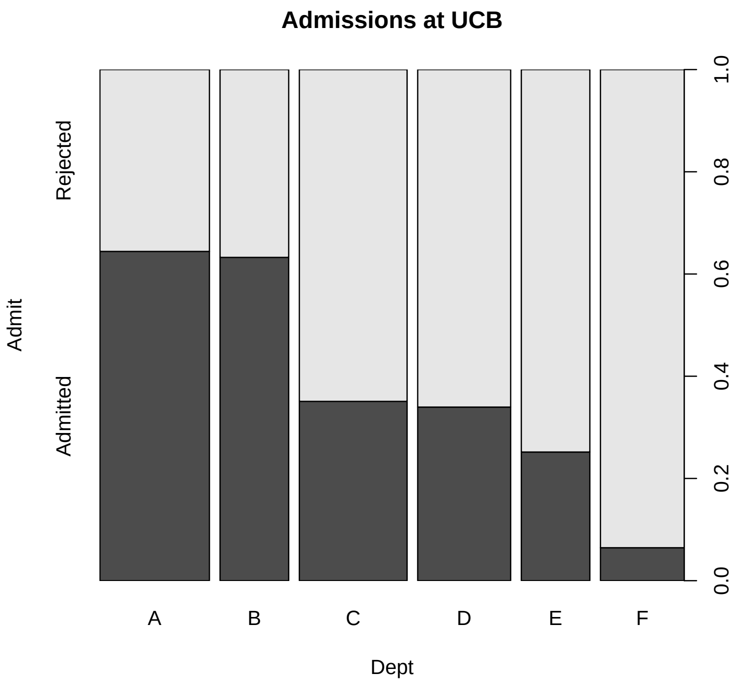


applications and admissions by department at UC Berkeley ## (two-way tables)

```
> (spineplot(margin.table(UCBAdmissions, c(3, 2)),
+     main = "Applications at UCB"))
```




```
> (spineplot(margin.table(UCBAdmissions, c(3, 1)),
+     main = "Admissions at UCB"))
```

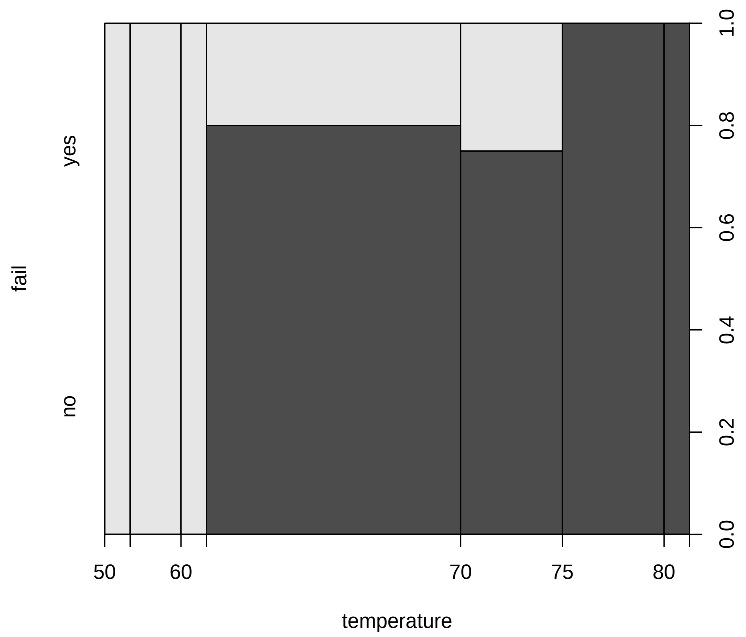


NASA space shuttle o-ring failures

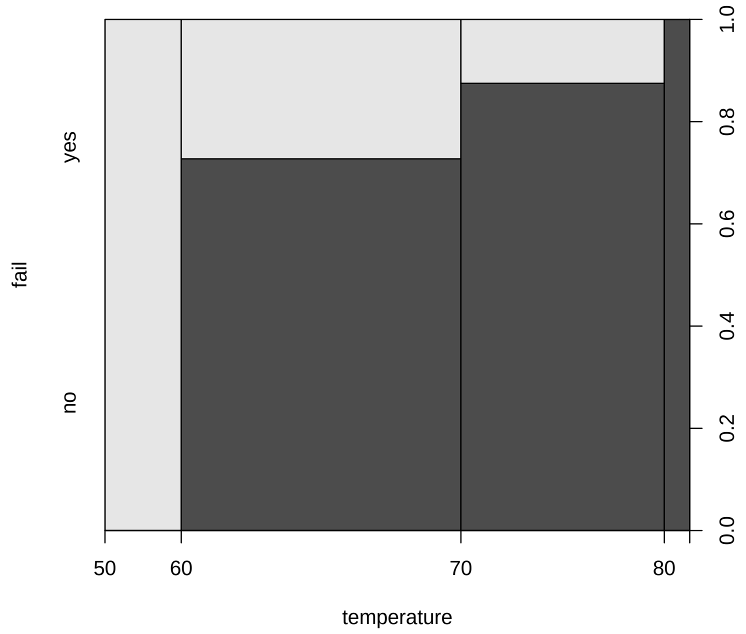
```
> fail <- factor(c(2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 2, 1,
+     2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1), levels = c(1,
+     2), labels = c("no", "yes"))
> temperature <- c(53, 57, 58, 63, 66, 67, 67, 67, 68,
+     69, 70, 70, 70, 70, 72, 73, 75, 75, 76, 76, 78,
+     79, 81)
```

(dependence on a numerical variable)

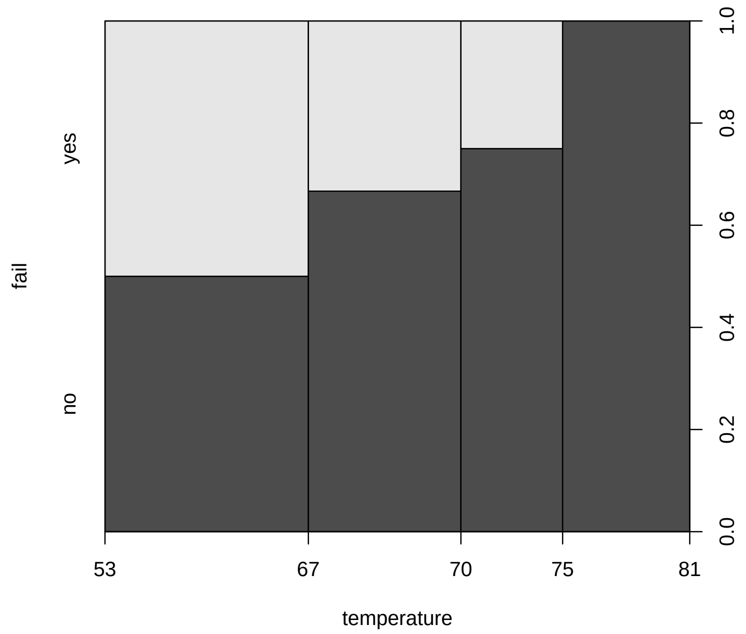
```
> (spineplot(fail ~ temperature))
```




```
> (spineplot(fail ~ temperature, breaks = 3))
```

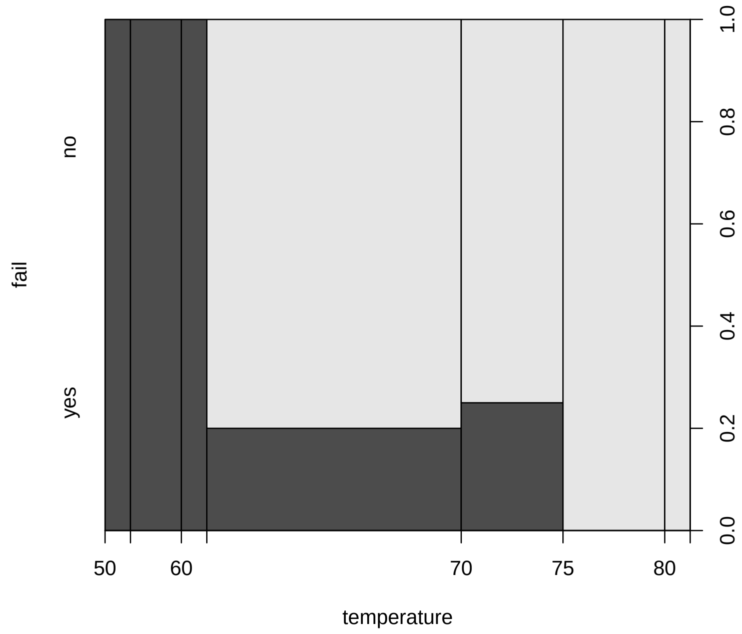



```
> (spineplot(fail ~ temperature, breaks = quantile(temperature)))
```



highlighting for failures

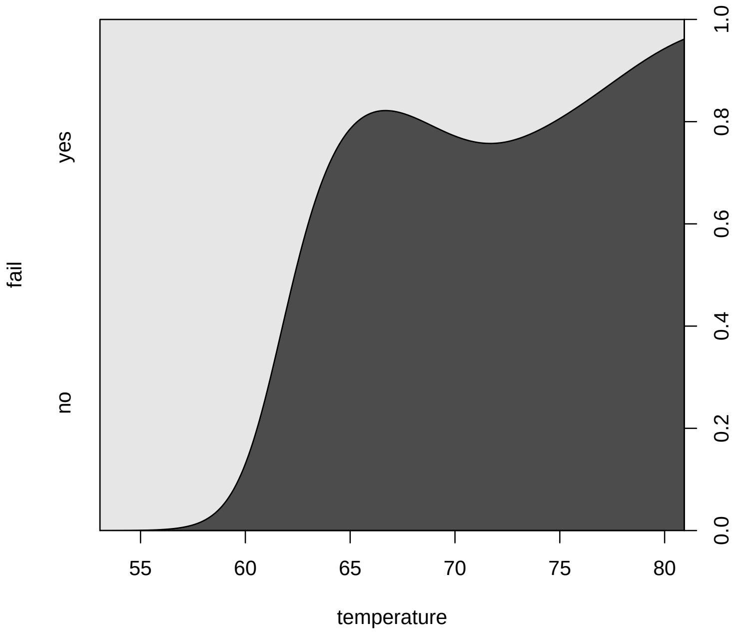
```
> spineplot(fail ~ temperature, ylevels = 2:1)
```



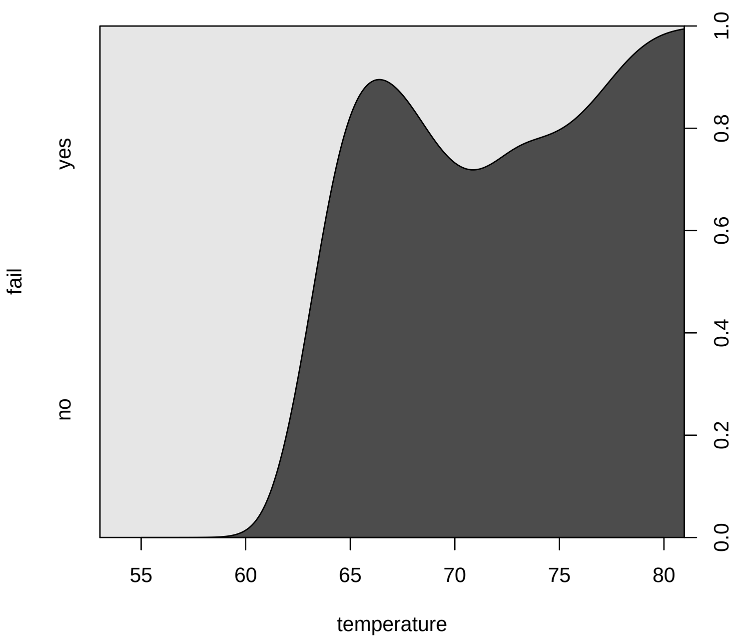
7.5 cdplot (Conditional Density Plots)

NASA space shuttle o-ring failures

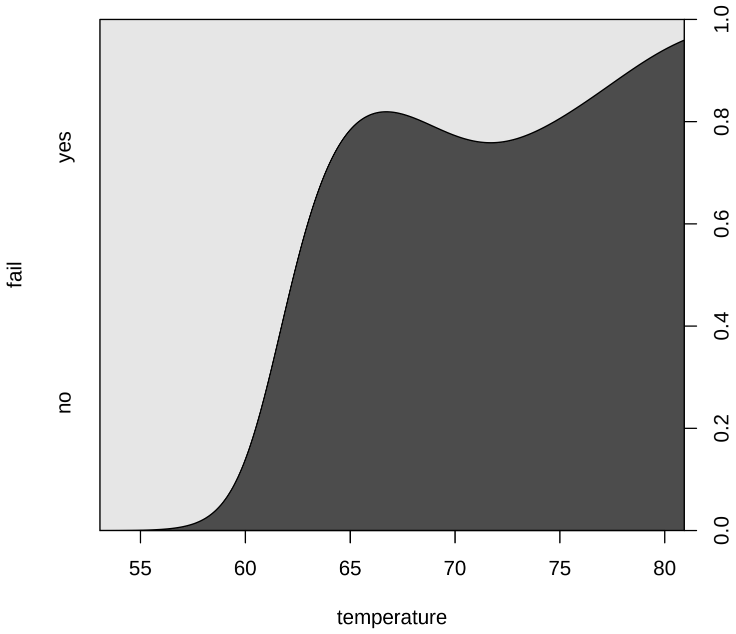
```
> fail <- factor(c(2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 2, 1,
+     2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1), levels = 1:2,
+     labels = c("no", "yes"))
> temperature <- c(53, 57, 58, 63, 66, 67, 67, 67, 68,
+     69, 70, 70, 70, 70, 72, 73, 75, 75, 76, 76, 78,
+     79, 81)

> cdplot(fail ~ temperature)
```




```
> cdplot(fail ~ temperature, bw = 2)
```

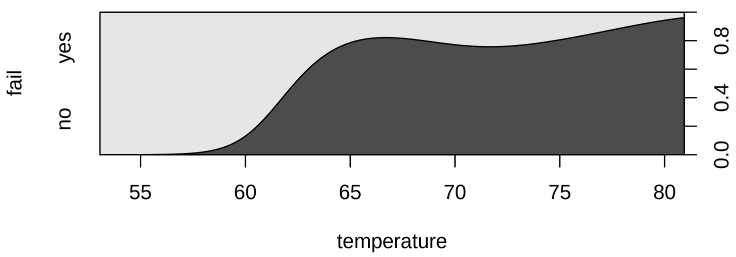


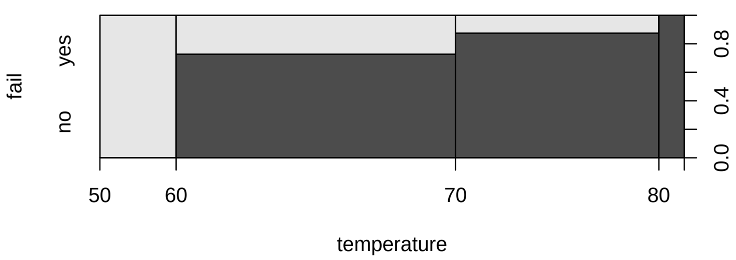

```
> cdplot(fail ~ temperature, bw = "SJ")
```



compare with spinogram on the same graph

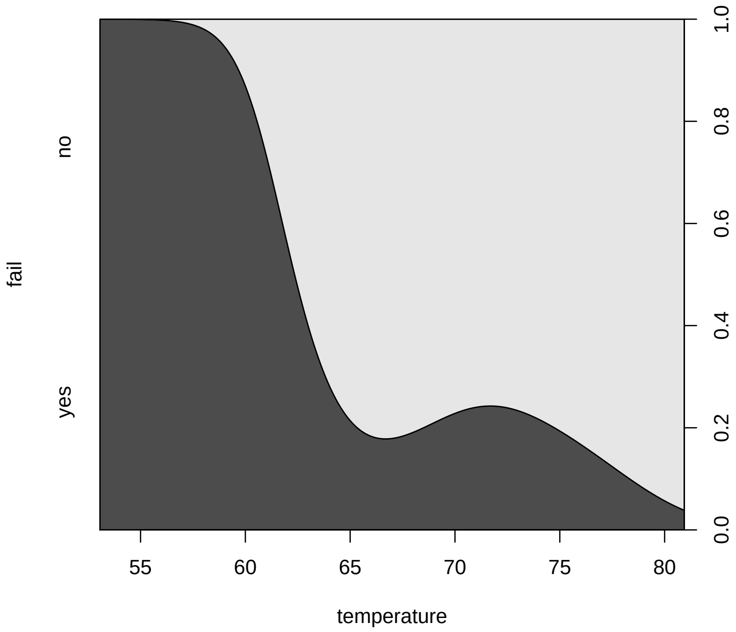
```
> layout(1:2)
> cdplot(fail ~ temperature)
> (spineplot(fail ~ temperature, breaks = 3))
> layout(1)
```





highlighting for failures

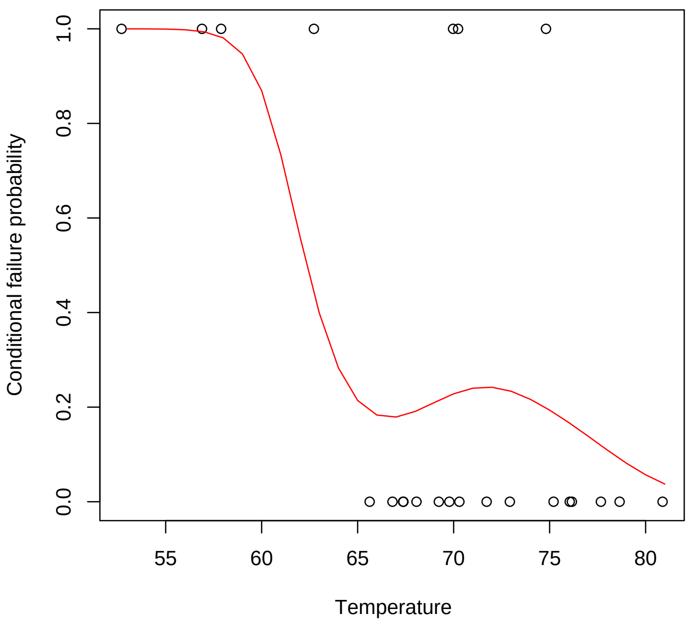
```
> cdplot(fail ~ temperature, ylevels = 2:1)
```



scatter plot with conditional density

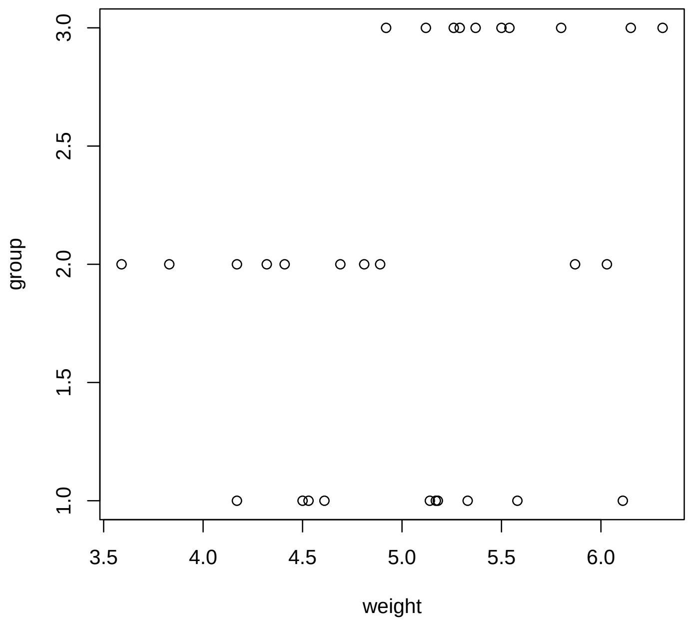
```
> cdens <- cdplot(fail ~ temperature, plot = FALSE)
```

```
> plot(I(as.numeric(fail) - 1) ~ jitter(temperature, factor = 2),
+     xlab = "Temperature", ylab = "Conditional failure probability")
> lines(53:81, 1 - cdens[[1]](53:81), col = 2)
```

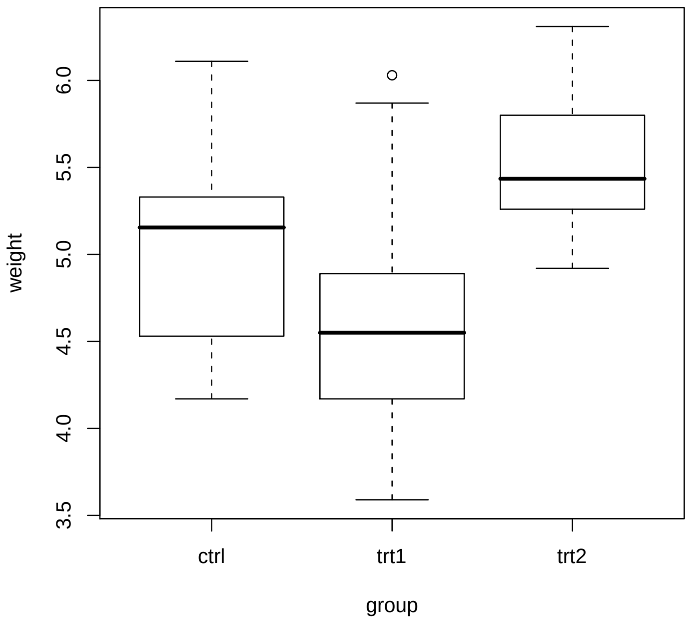


8 Plot factor variables

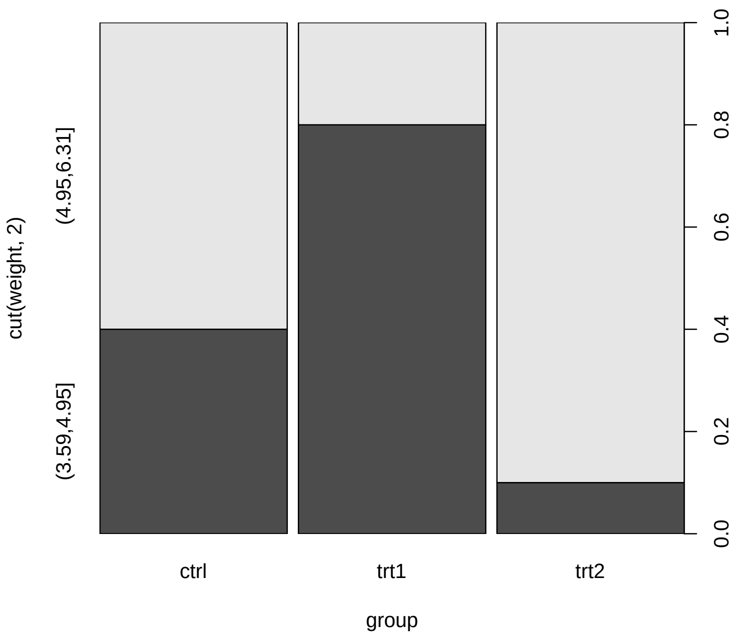
```
> require(grDevices)
> plot(PlantGrowth)
```



```
> plot(weight ~ group, data = PlantGrowth)
```

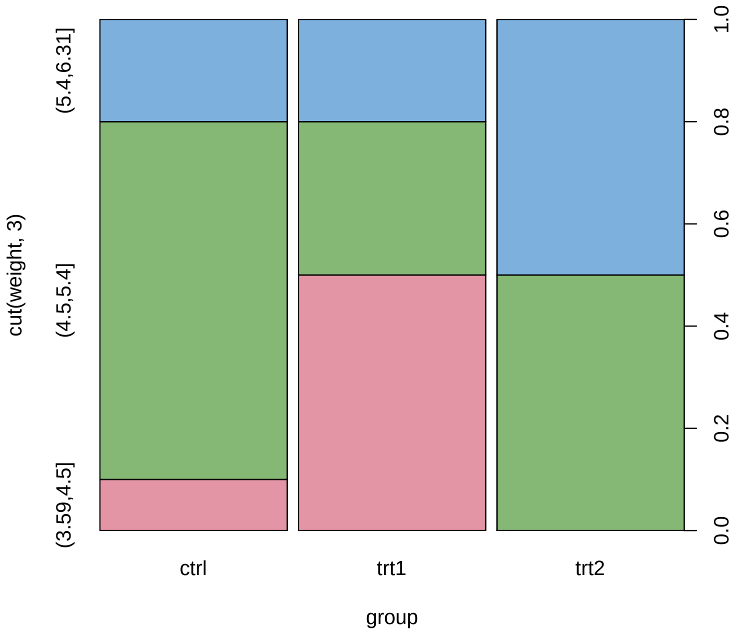



```
> plot(cut(weight, 2) ~ group, data = PlantGrowth)
```



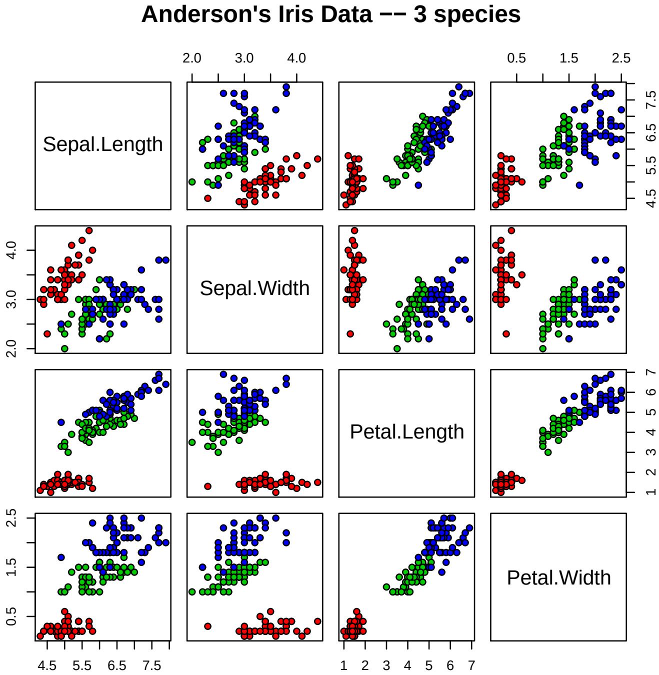
passing "..." to spineplot() eventually :

```
> plot(cut(weight, 3) ~ group, data = PlantGrowth, col = hcl(c(0,
+     120, 240), 50, 70))
```



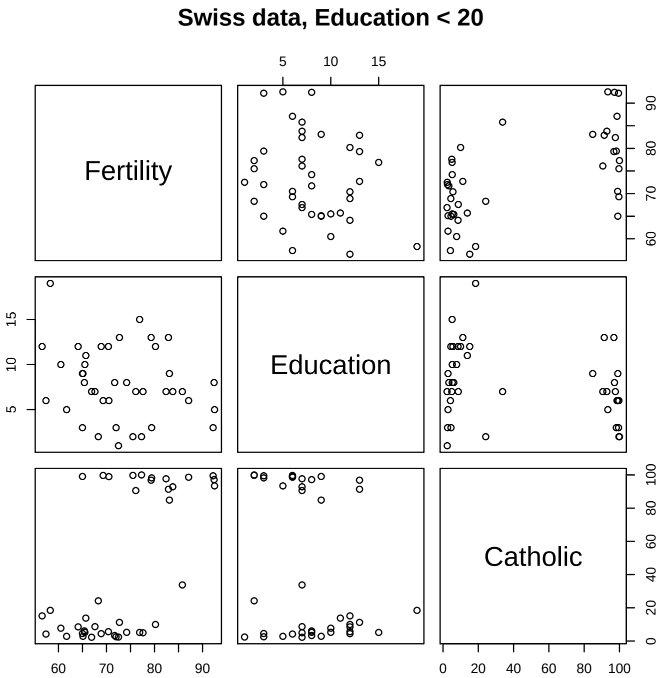
9 Matrix plot

```
> pairs(iris[1:4], main = "Anderson's Iris Data -- 3 species",
+     pch = 21, bg = c("red", "green3", "blue")[unclass(iris$Species)])
```

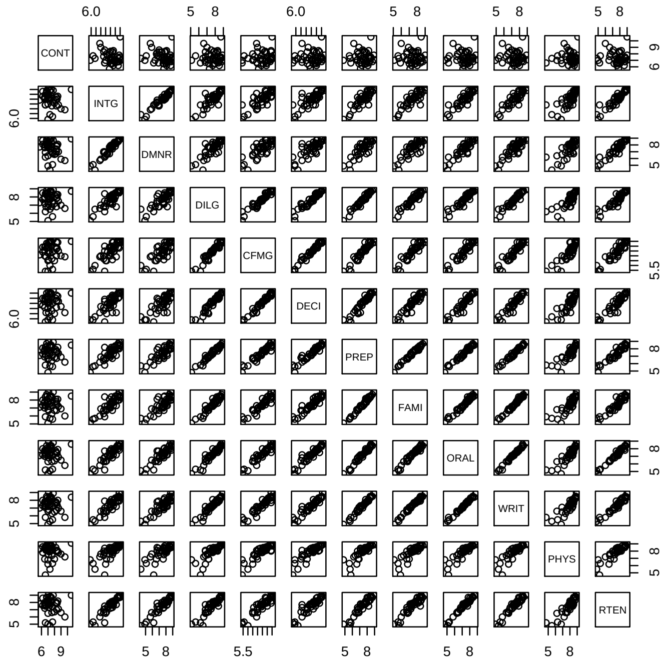


formula method

```
> pairs(~Fertility + Education + Catholic, data = swiss,
+      subset = Education < 20, main = "Swiss data, Education < 20")
```



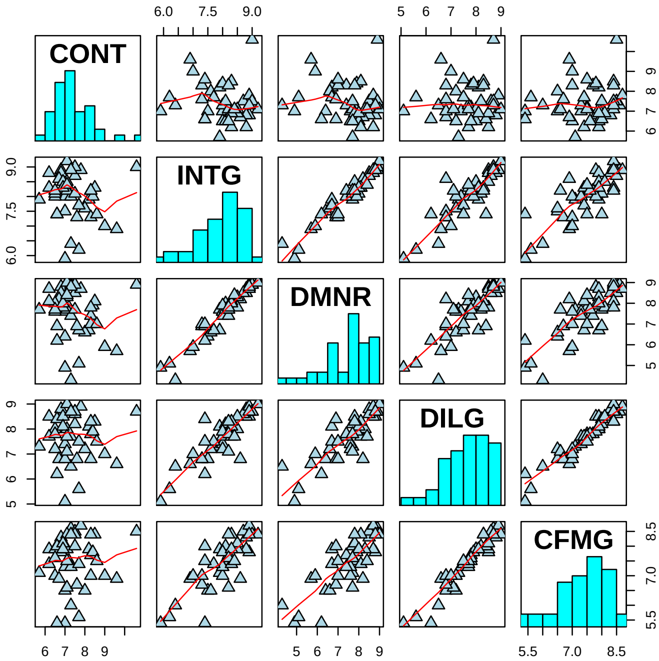

```
> pairs(USJudgeRatings)
```



put histograms on the diagonal

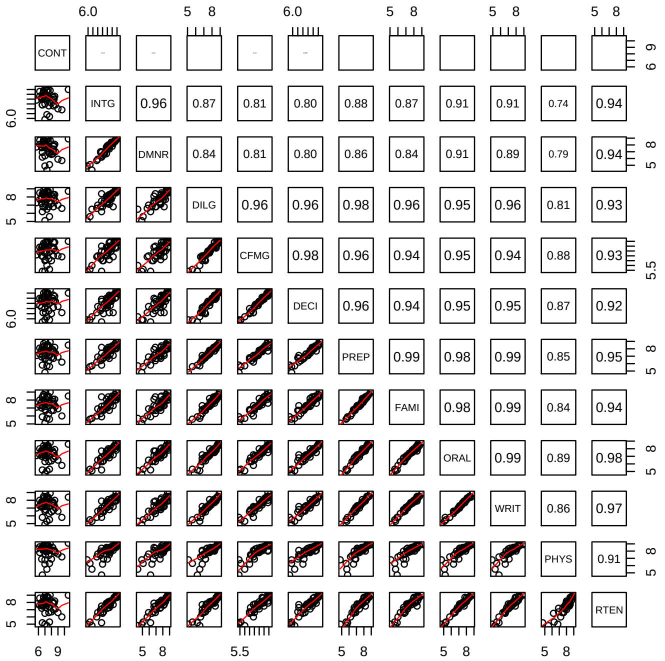
```
> panel.hist <- function(x, ...) {
+     usr <- par("usr")
+     on.exit(par(usr))
+     par(usr = c(usr[1:2], 0, 1.5))
+     h <- hist(x, plot = FALSE)
+     breaks <- h$breaks
+     nB <- length(breaks)
+     y <- h$counts
+     y <- y/max(y)
+     rect(breaks[-nB], 0, breaks[-1], y, col = "cyan",
+         ...)
+ }
```

```
> pairs(USJudgeRatings[1:5], panel = panel.smooth, cex = 1.5,
+     pch = 24, bg = "light blue", diag.panel = panel.hist,
+     cex.labels = 2, font.labels = 2)
```



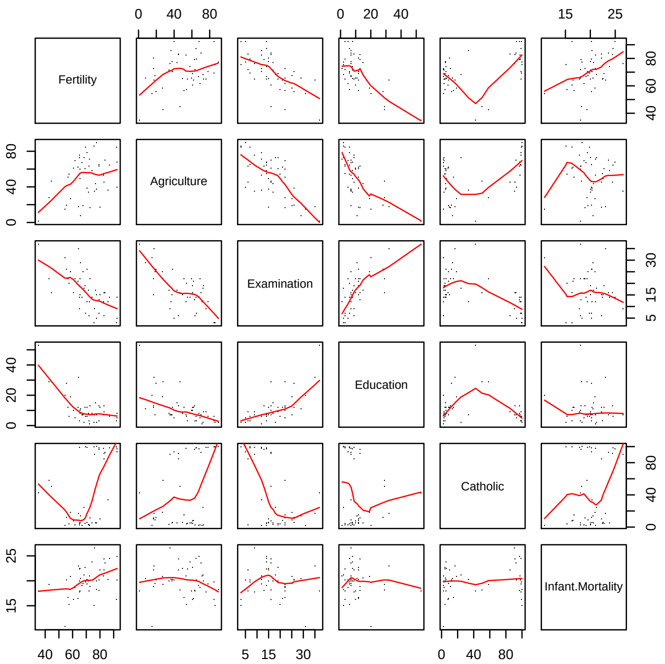
put (absolute) correlations on the upper panels, with size proportional to the correlations.

```
> panel.cor <- function(x, y, digits = 2, prefix = "",
+     cex.cor) {
+     usr <- par("usr")
+     on.exit(par(usr))
+     par(usr = c(0, 1, 0, 1))
+     r <- abs(cor(x, y))
+     txt <- format(c(r, 0.123456789), digits = digits)[1]
+     txt <- paste(prefix, txt, sep = "")
+     if (missing(cex.cor))
+         cex.cor <- 0.8/strwidth(txt)
+     text(0.5, 0.5, txt, cex = cex.cor * r)
+ }

> pairs(USJudgeRatings, lower.panel = panel.smooth, upper.panel =
+     panel.cor)
```

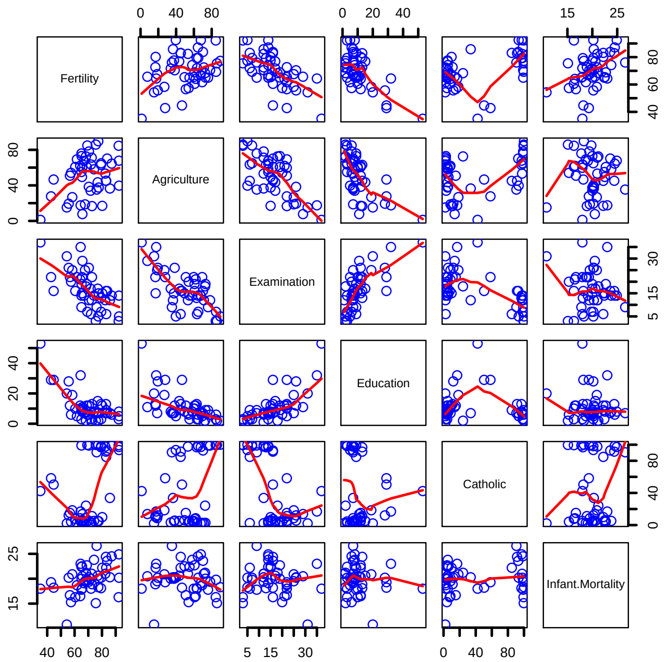


10 Simplepanel plots

```
> pairs(swiss, panel = panel.smooth, pch = ".")
```

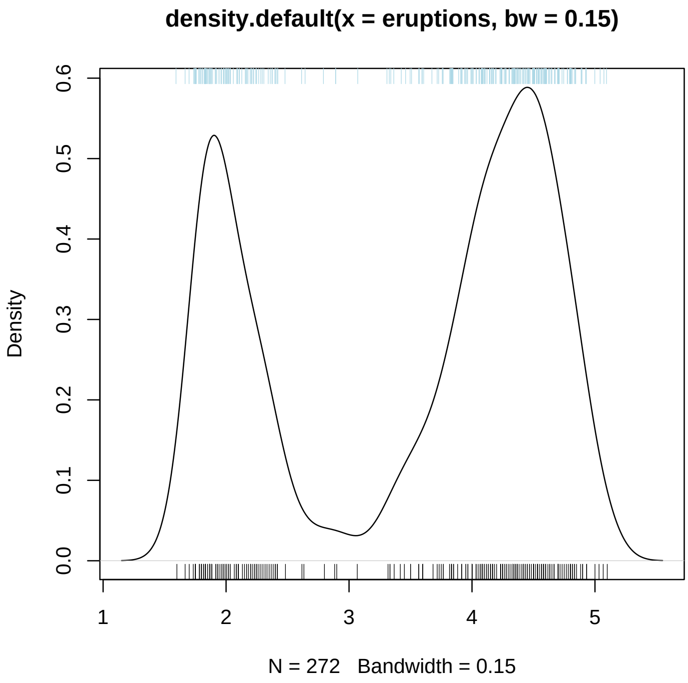


```
> pairs(swiss, panel = panel.smooth, lwd = 2, cex = 1.5,
+     col = "blue")
```



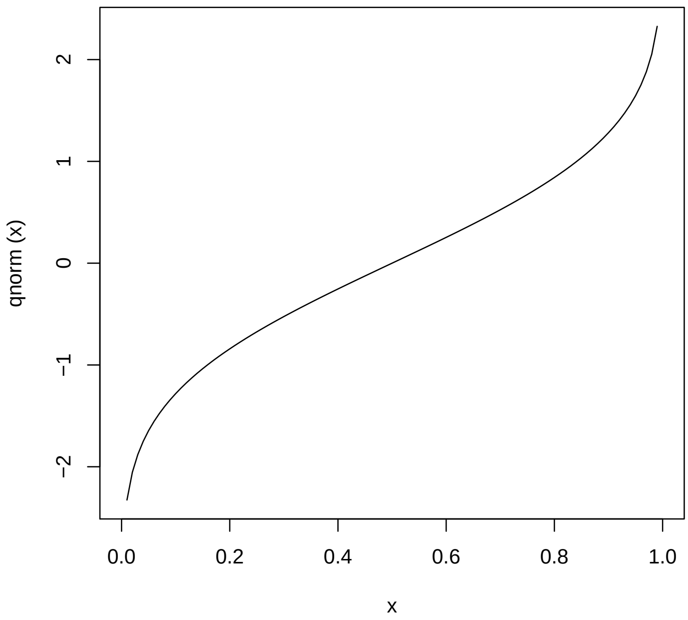
11 jitter

```
> require(stats)
> with(faithful, {
+     plot(density(eruptions, bw = 0.15))
+     rug(eruptions)
+     rug(jitter(eruptions, amount = 0.01), side = 3,
+         col = "light blue")
+ })
```

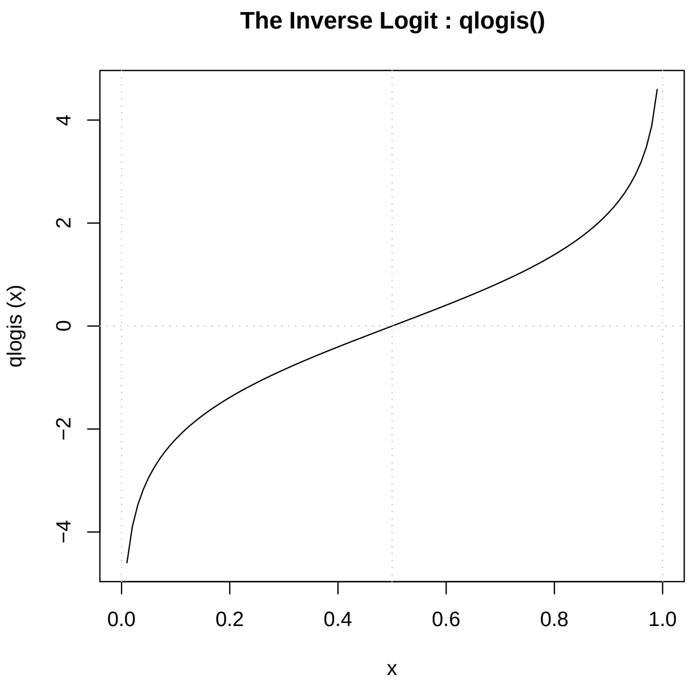


12 curves

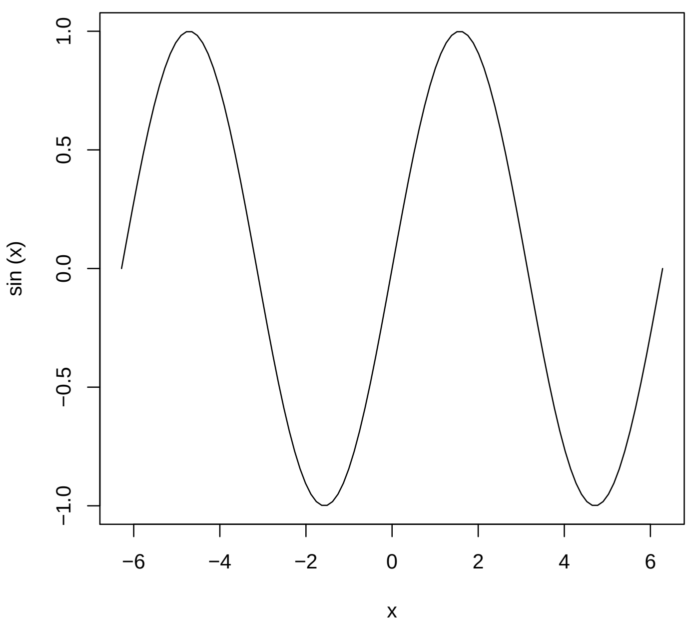
> *plot(qnorm)*



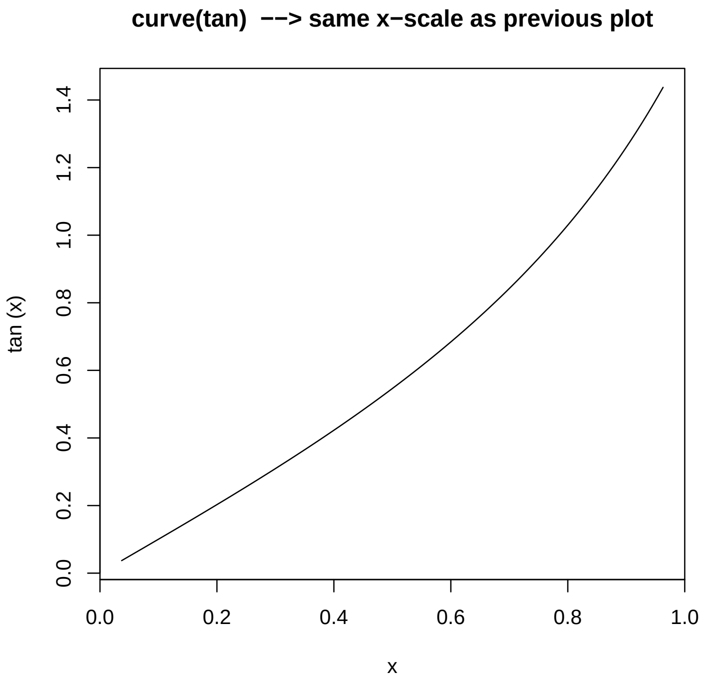
```
> plot(qlogis, main = "The Inverse Logit : qlogis()")
> abline(h = 0, v = 0:2/2, lty = 3, col = "gray")
```



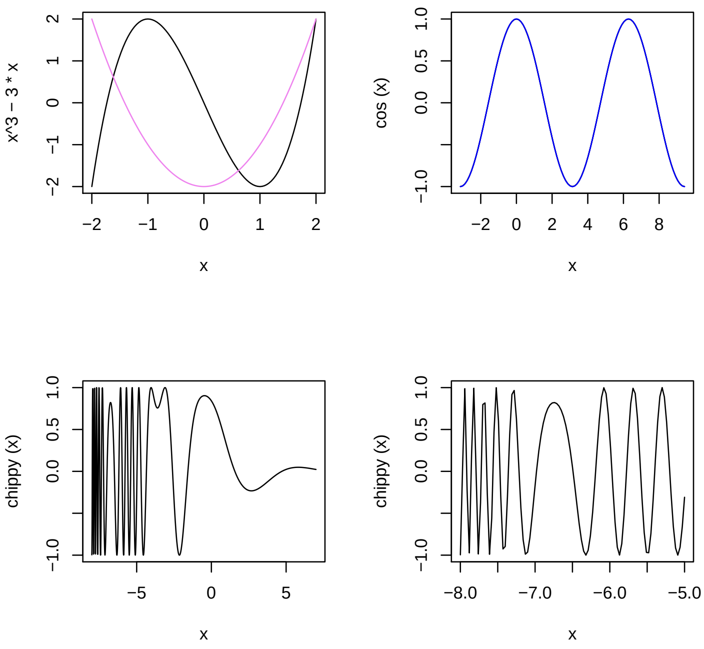

```
> curve(sin, -2 * pi, 2 * pi)
```



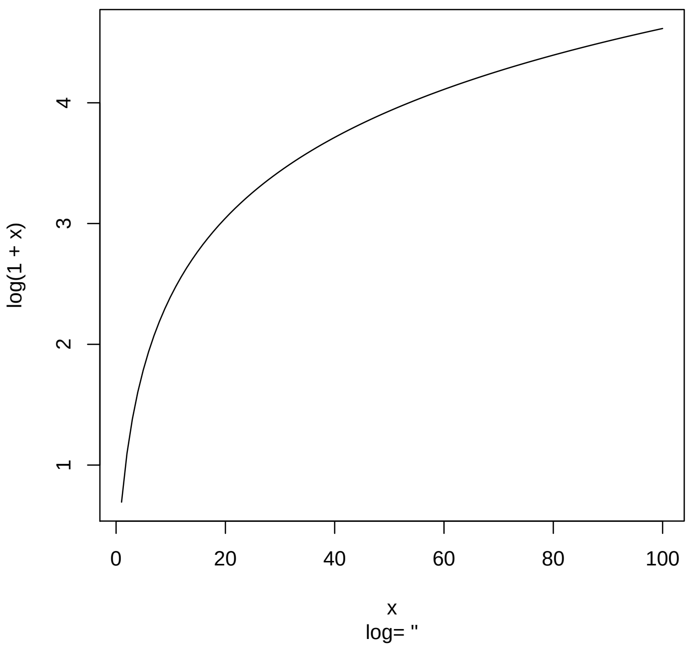

```
> curve(tan, main = "curve(tan)  --> same x-scale as previous plot")
```




```
> op <- par(mfrow = c(2, 2))
> curve(x^3 - 3 * x, -2, 2)
> curve(x^2 - 2, add = TRUE, col = "violet")
> plot(cos, -pi, 3 * pi)
> plot(cos, xlim = c(-pi, 3 * pi), n = 1001, col = "blue",
+     add = TRUE)
> chippy <- function(x) sin(cos(x) * exp(-x/2))
> curve(chippy, -8, 7, n = 2001)
> plot(chippy, -8, -5)
```




```
> for (ll in c("", "x", "y", "xy")) curve(log(1 + x),
+     1, 100, log = ll, sub = paste("log= '", ll, "'",
+         sep = ""))
> par(op)
```



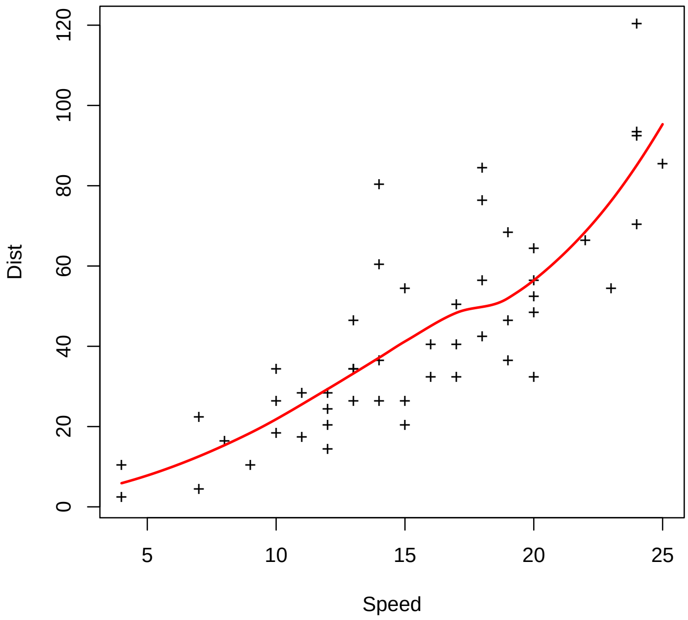
13 loess (régression non-paramétrique)

```
> cars.lo <- loess(dist ~ speed, cars)
> predict(cars.lo, data.frame(speed = seq(5, 30, 1)),
+     se = TRUE)

$fit
 [1]  7.810489 10.041808 12.567960 15.369183 18.425712 21.828039
 [7] 25.539675 29.350386 33.230660 37.167935 41.205226 45.055736
[13] 48.355889 49.824812 51.986702 56.445263 62.008703 68.529340
[19] 76.193111 85.142467 95.323096        NA        NA        NA
[25]        NA        NA

$se.fit
 [1] 7.568539 5.943649 4.976453 4.515801 4.316362 4.030120 3.750561
 [8] 3.715593 3.776298 4.091044 4.708759 4.244697 4.035236 3.752765
[15] 4.004017 4.056945 4.005540 4.065234 4.579053 5.948757 8.300416
[22]       NA       NA       NA       NA       NA

$residual.scale
[1] 15.29233

$df
[1] 44.62733
```

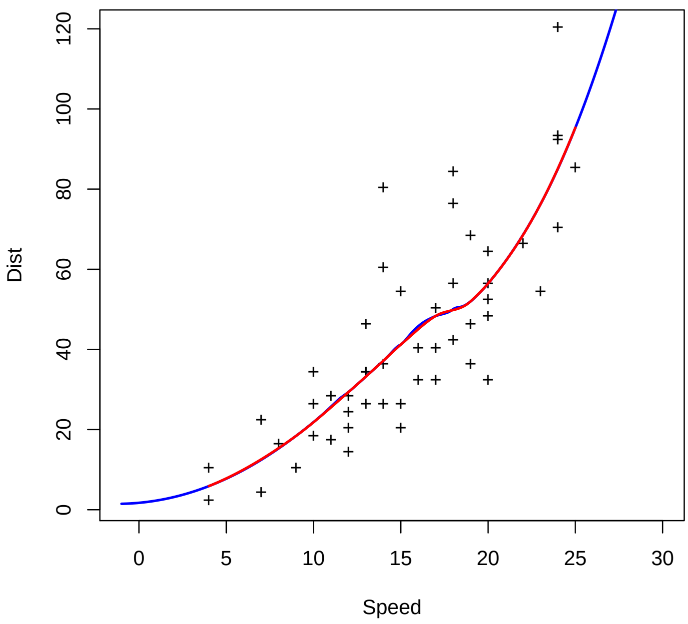
to allow extrapolation

```
> cars.lo2 <- loess(dist ~ speed, cars,
+     control = loess.control(surface = "direct"))
> predict(cars.lo2, data.frame(speed = seq(5, 30, 1)),
+     se = TRUE)

$fit
 [1]   7.741006   9.926596  12.442424  15.281082  18.425712
 [6]  21.865315  25.713413  29.350386  33.230660  37.167935
[11]  41.205226  45.781544  48.355889  50.067148  51.986702
[16]  56.445263  62.025404  68.569313  76.193111  85.053364
[21]  95.300523 106.974661 120.092581 134.665851 150.698545
[26] 168.190283

$se.fit
 [1]  7.565991  5.959097  5.012013  4.550013  4.321596  4.119331
 [7]  3.939804  3.720098  3.780877  4.096004  4.714469  4.398936
[13]  4.040129  4.184257  4.008873  4.061865  4.033998  4.078904
[19]  4.584606  5.952480  8.306901 11.601911 15.792480 20.864660
[25] 26.823827 33.683999
```

```
$residual.scale
[1] 15.31087

$df
[1] 44.55085

> plot(cars.lo, xlab = "Speed", ylab = "Dist", pch = "+")
> lines(seq(min(cars$speed), max(cars$speed), 0.1), predict(cars.lo,
+     data.frame(speed = seq(min(cars$speed), max(cars$speed),
+         0.1)), se = TRUE)$fit, col = "red", lwd = 2)
```

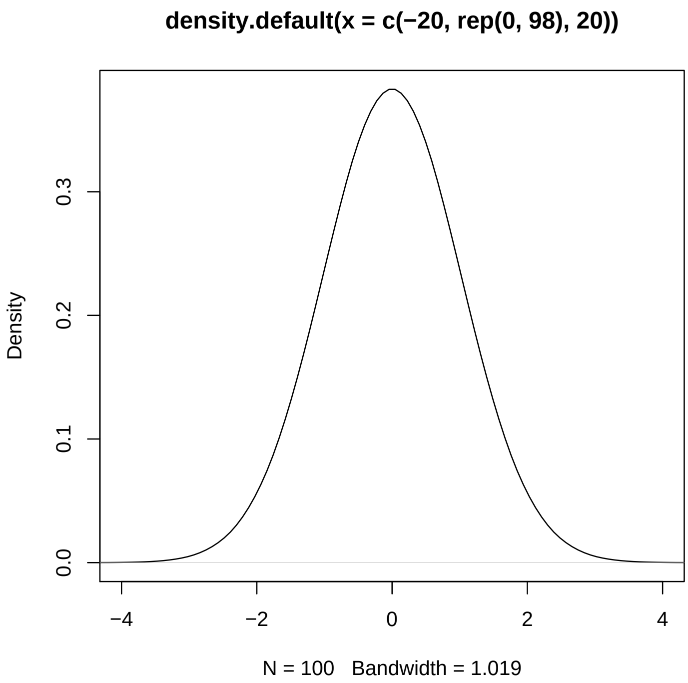



```
> plot(cars.lo2, xlab = "Speed", ylab = "Dist", pch = "+",
+     xlim = c(min(cars$speed) - 5, max(cars$speed) +
+         5))
> lines(seq(min(cars$speed) - 5, max(cars$speed) + 5,
+     0.1), predict(cars.lo2, data.frame(speed = seq(min(cars$speed) -
+     5, max(cars$speed) + 5, 0.1)), se = TRUE)$fit, col = "blue",
+     lwd = 2)
> lines(seq(min(cars$speed) - 5, max(cars$speed) + 5,
+     0.1), predict(cars.lo, data.frame(speed = seq(min(cars$speed) -
+     5, max(cars$speed) + 5, 0.1)), se = TRUE)$fit, col = "red",
+     lwd = 2)
```

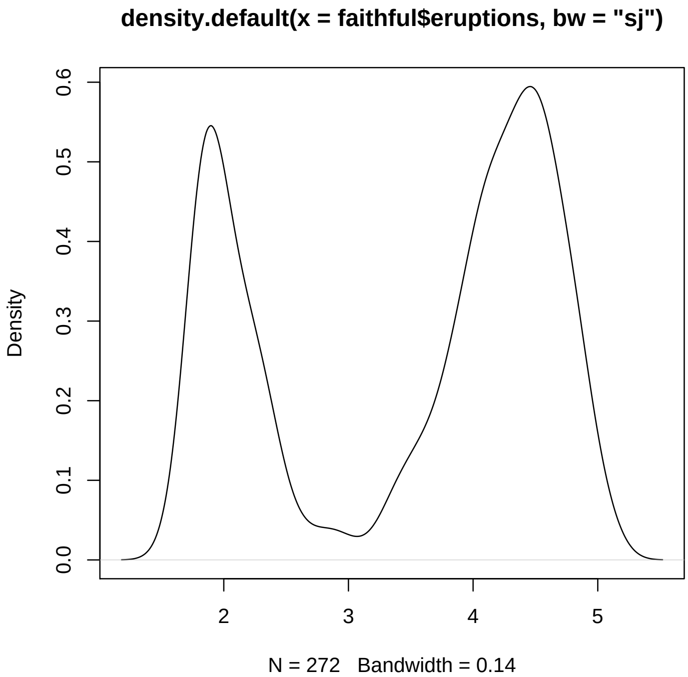


14 density estimation

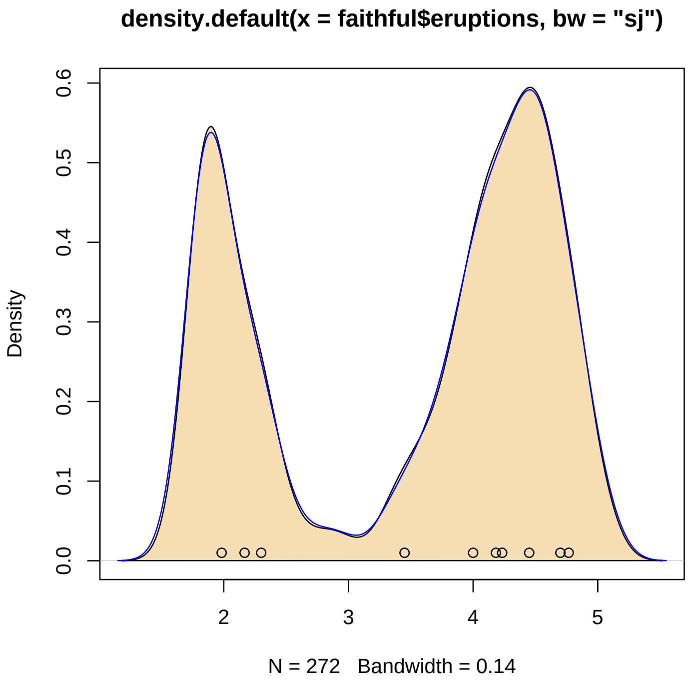
```
> require(graphics)
> plot(density(c(-20, rep(0, 98), 20)), xlim = c(-4, 4))
```



```
> d <- density(faithful$eruptions, bw = "sj")
> d

Call:
        density.default(x = faithful$eruptions, bw = "sj")

Data: faithful$eruptions (272 obs.);        Bandwidth 'bw' = 0.14

       x                y
 Min.   :1.180   Min.   :0.0001834
 1st Qu.:2.265   1st Qu.:0.0422638
 Median :3.350   Median :0.1709243
 Mean   :3.350   Mean   :0.2301726
 3rd Qu.:4.435   3rd Qu.:0.4134348
 Max.   :5.520   Max.   :0.5945634

> plot(d)
```




```
> plot(d, type = "n")
> polygon(d, col = "wheat")
> x <- xx <- faithful$eruptions
> x[i.out <- sample(length(x), 10)] <- NA
> doR <- density(x, bw = 0.15, na.rm = TRUE)
> lines(doR, col = "blue")
> points(xx[i.out], rep(0.01, 10))
```

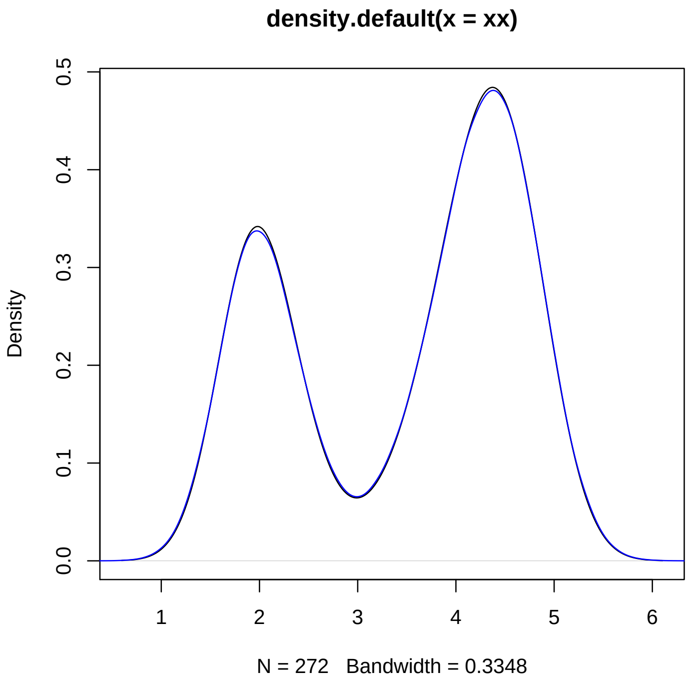



```
> fe <- sort(faithful$eruptions)
> dw <- density(unique(fe), weights = table(fe)/length(fe),
+     bw = d$bw)
> utils::str(dw)
```

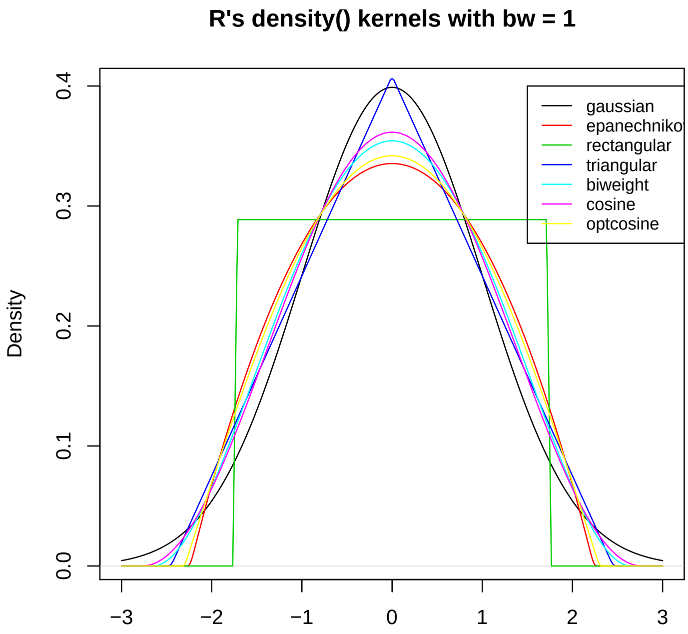
```
List of 7
 $ x        : num [1:512] 1.18 1.19 1.2 1.21 1.21 ...
 $ y        : num [1:512] 0.000183 0.000223 0.00027 0.000328 0.000397 ...
 $ bw       : num 0.14
 $ n        : int 126
 $ call     : language density.default(x = unique(fe), bw = d$bw,
              weights = table(fe)/length(fe))
 $ data.name: chr "unique(fe)"
 $ has.na   : logi FALSE
 - attr(*, "class")= chr "density"
```

```
> stopifnot(all.equal(d[1:3], dw[1:3]))
```

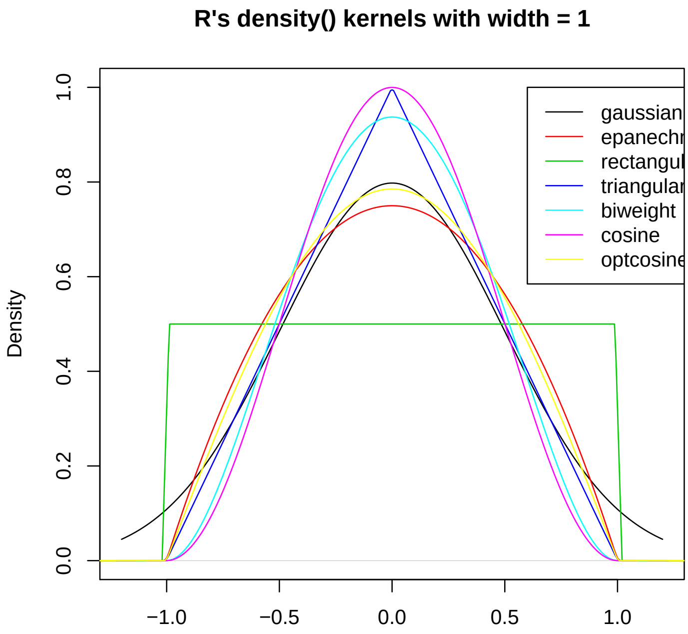
```
> fit <- density(xx)
> N <- 1e+06
> x.new <- rnorm(N, sample(xx, size = N, replace = TRUE),
+     fit$bw)
> plot(fit)
> lines(density(x.new), col = "blue")
```




```
> (kernels <- eval(formals(density.default)$kernel))

[1] "gaussian"     "epanechnikov" "rectangular"  "triangular"
[5] "biweight"     "cosine"       "optcosine"

> plot(density(0, bw = 1), xlab = "", main = "R's density() kernels
+     with bw = 1")
> for (i in 2:length(kernels)) lines(density(0, bw = 1,
+     kernel = kernels[i]), col = i)
> legend(1.5, 0.4, legend = kernels, col = seq(kernels),
+     lty = 1, cex = 0.8, y.intersp = 1)
```




```
> plot(density(0, from = -1.2, to = 1.2, width = 2, kernel =
+     "gaussian"), type = "l", ylim = c(0, 1), xlab = "",
+     main = "R's density() kernels with width = 1")
> for (i in 2:length(kernels)) lines(density(0, width = 2,
+     kernel = kernels[i]), col = i)
> legend(0.6, 1, legend = kernels, col = seq(kernels),
+     lty = 1)
```




```
> (RKs <- cbind(sapply(kernels, function(k) density(kernel = k,
+     give.Rkern = TRUE))))
```

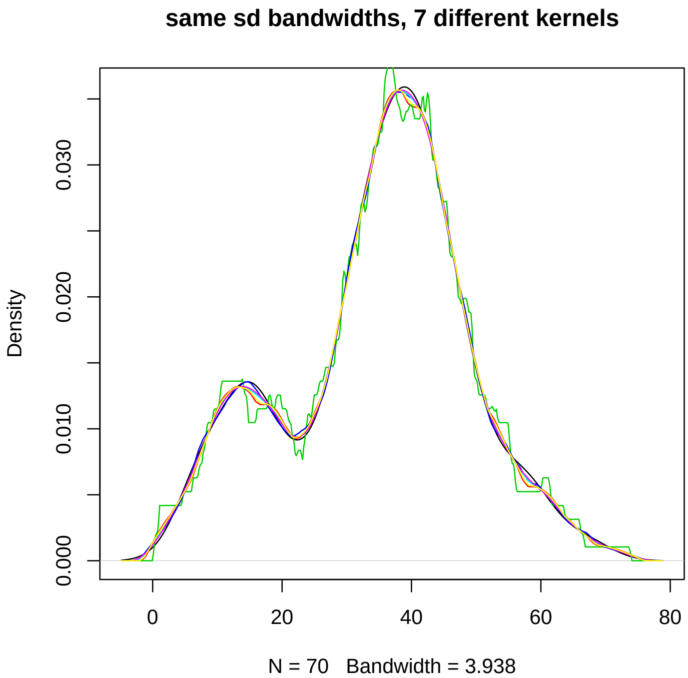
```
                  [,1]
gaussian     0.2820948
epanechnikov 0.2683282
rectangular  0.2886751
triangular   0.2721655
biweight     0.2699746
cosine       0.2711340
optcosine    0.2684756
```

```
> 100 * round(RKs["epanechnikov", ]/RKs, 4)
```

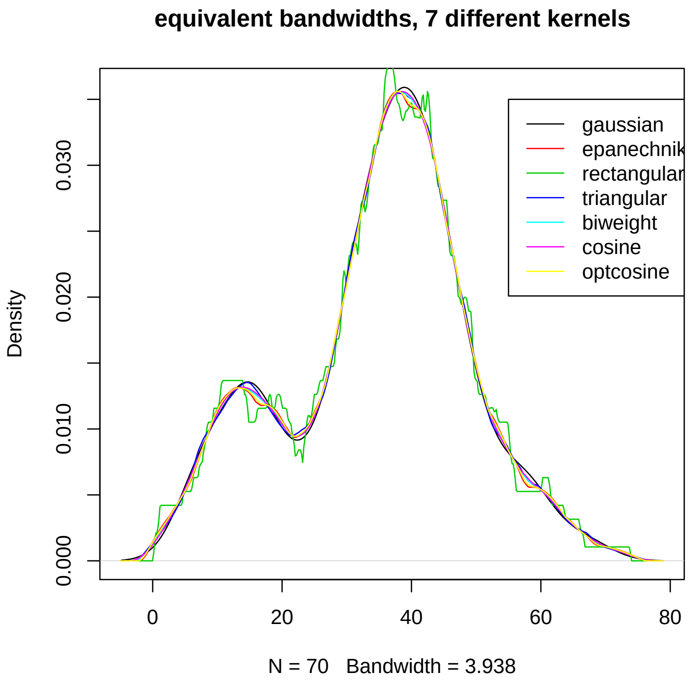
```
               [,1]
gaussian      95.12
epanechnikov 100.00
rectangular   92.95
triangular    98.59
biweight      99.39
cosine        98.97
optcosine     99.95
```

```
> bw <- bw.SJ(precip)
> plot(density(precip, bw = bw), main = "same sd bandwidths,
+     7 different kernels")
```

```
> for (i in 2:length(kernels)) lines(density(precip, bw = bw,
+     kernel = kernels[i]), col = i)
```

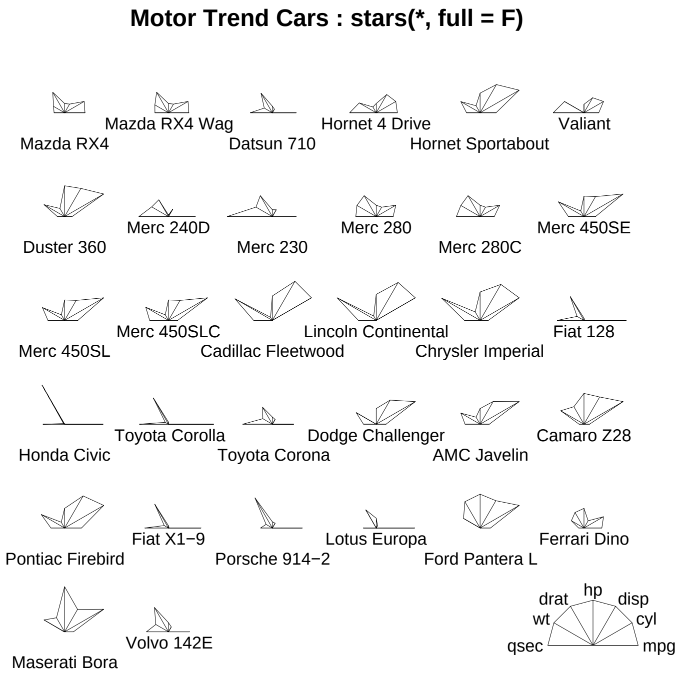



```
> h.f <- sapply(kernels, function(k) density(kernel = k,
+     give.Rkern = TRUE))
> (h.f <- (h.f["gaussian"]/h.f)^0.2)

    gaussian epanechnikov  rectangular   triangular     biweight
   1.0000000    1.0100567    0.9953989    1.0071923    1.0088217
      cosine    optcosine
   1.0079575    1.0099458

> plot(density(precip, bw = bw), main = "equivalent bandwidths,
+     7 different kernels")
> for (i in 2:length(kernels)) lines(density(precip, bw = bw,
+     adjust = h.f[i], kernel = kernels[i]), col = i)
> legend(55, 0.035, legend = kernels, col = seq(kernels),
+     lty = 1)
```

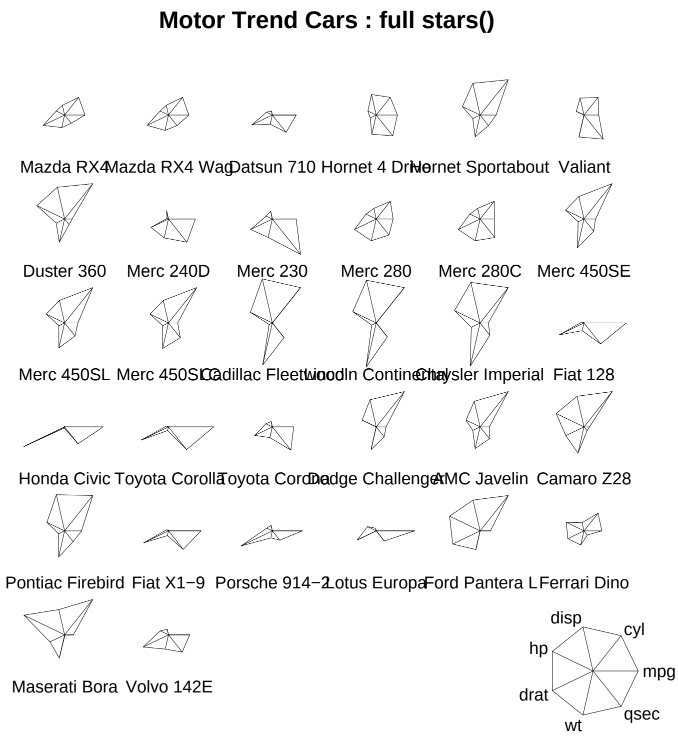


15 Radar plots

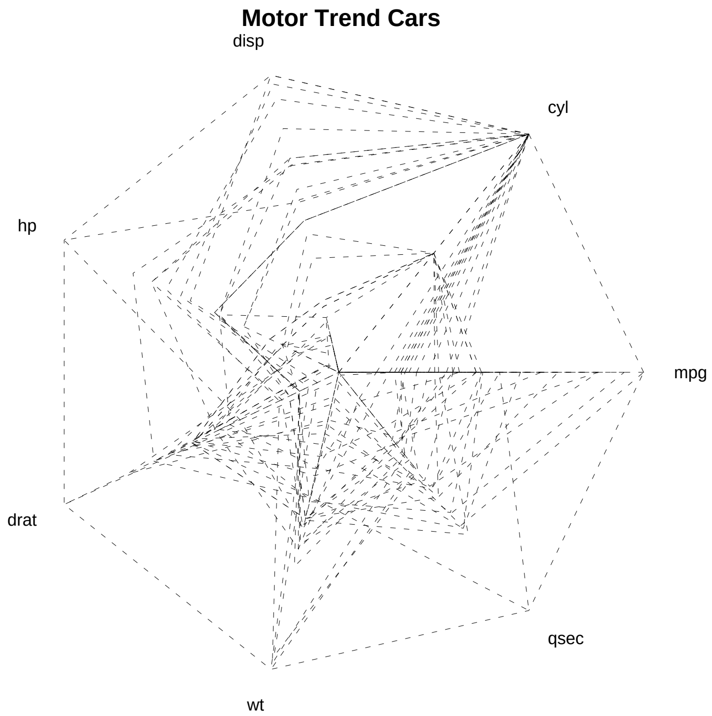
```
> require(grDevices)
> stars(mtcars[, 1:7], key.loc = c(14, 2), main = "Motor Trend Cars :
+     stars(*, full = F)", full = FALSE)
```



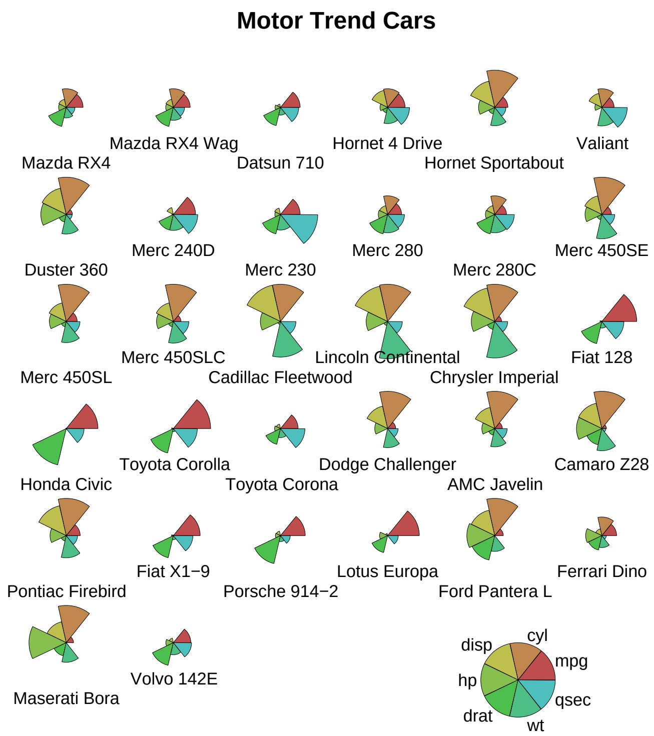

```
> stars(mtcars[, 1:7], key.loc = c(14, 1.5), main = "Motor Trend Cars :
+     full stars()", flip.labels = FALSE)
```




```
> stars(mtcars[, 1:7], locations = c(0, 0), radius = FALSE,
+     key.loc = c(0, 0), main = "Motor Trend Cars", lty = 2)
```

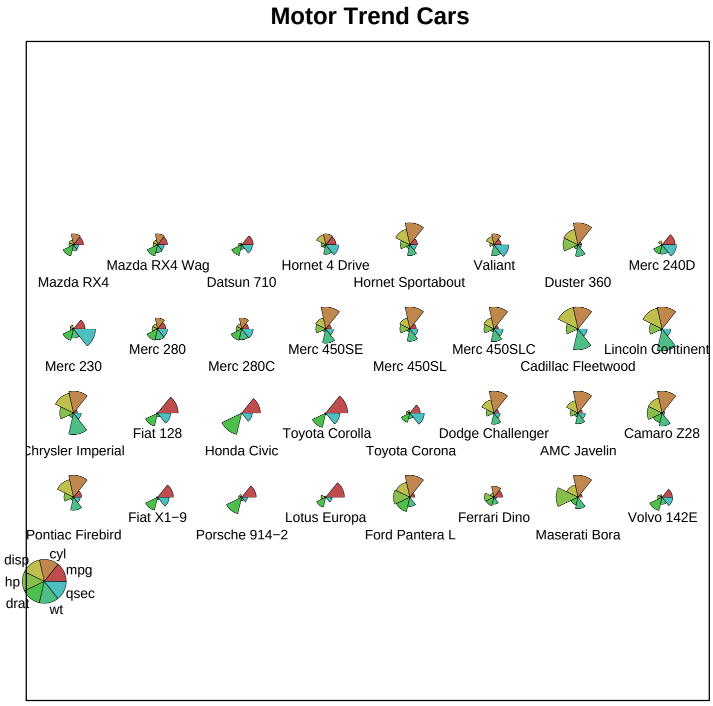



```
> palette(rainbow(12, s = 0.6, v = 0.75))
> stars(mtcars[, 1:7], len = 0.8, key.loc = c(12, 1.5),
+     main = "Motor Trend Cars", draw.segments = TRUE)
```

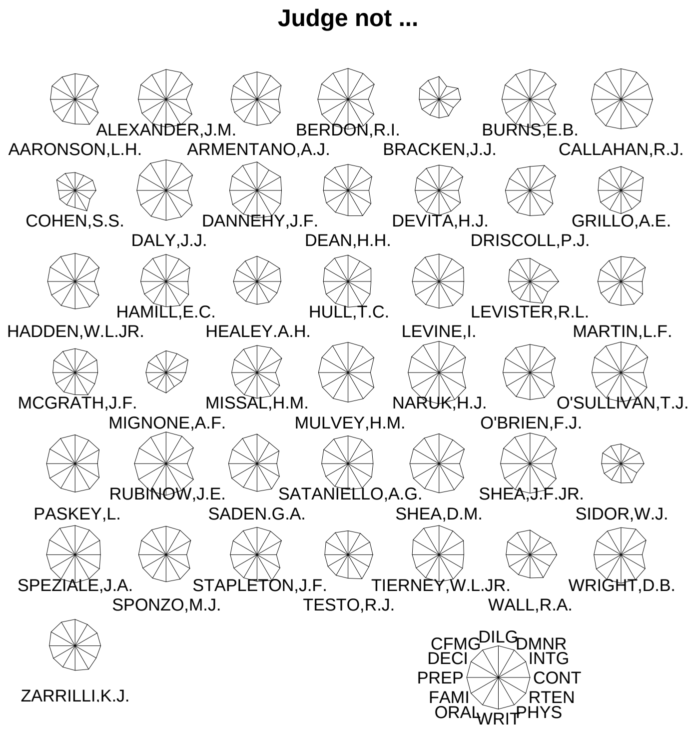



```
> stars(mtcars[, 1:7], len = 0.6, key.loc = c(1.5, 0),
+     main = "Motor Trend Cars", draw.segments = TRUE,
```

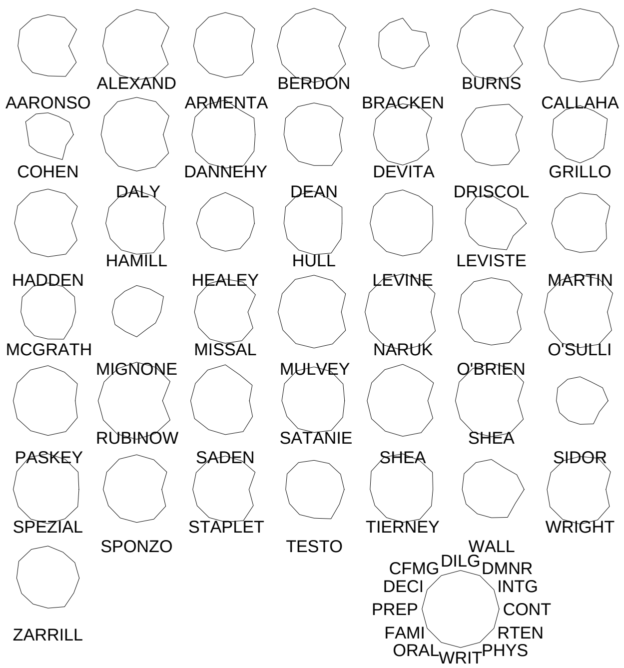
```
+     frame.plot = TRUE, nrow = 4, cex = 0.7)
```




```
> USJudge <- apply(USJudgeRatings, 2, function(x) x/max(x))
> Jnam <- row.names(USJudgeRatings)
> Snam <- abbreviate(substring(Jnam, 1, regexpr("[,.]",
+     Jnam) - 1), 7)
> stars(USJudge, labels = Jnam, scale = FALSE, key.loc = c(13,
+     1.5), main = "Judge not ...", len = 0.8)
```

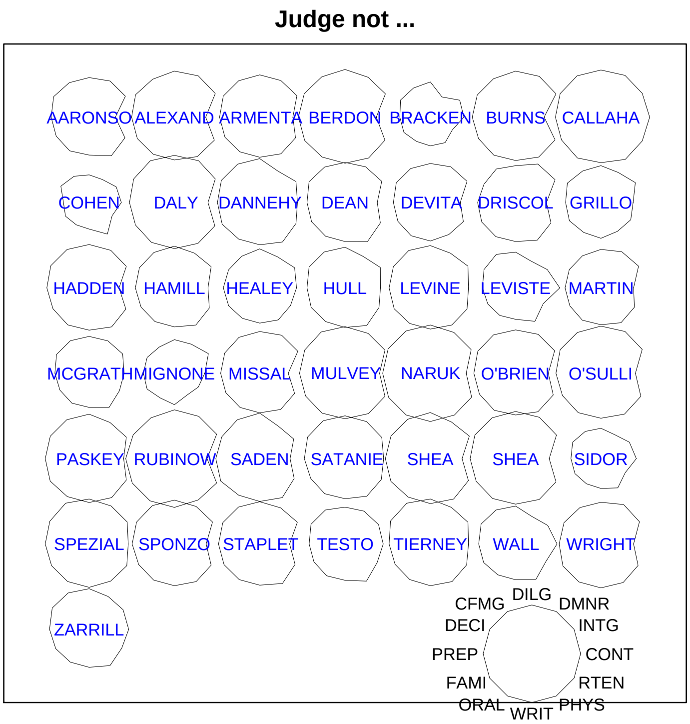



```
> stars(USJudge, labels = Snam, scale = FALSE, key.loc = c(13,
+     1.5), radius = FALSE)
```

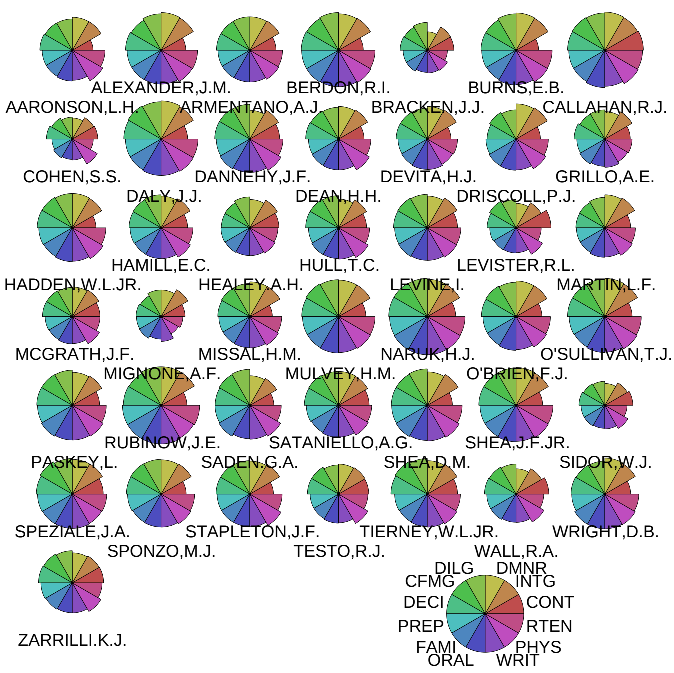



```
> loc <- stars(USJudge, labels = NULL, scale = FALSE,
+     radius = FALSE, frame.plot = TRUE, key.loc = c(13,
```

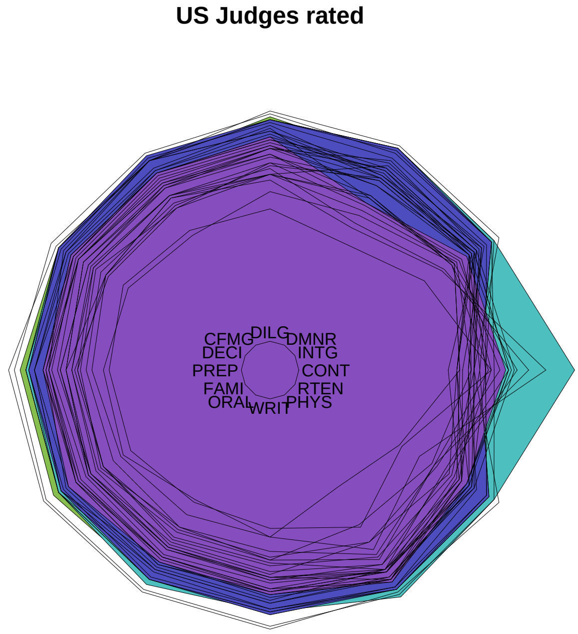
```
+           1.5), main = "Judge not ...", len = 1.2)
> text(loc, Snam, col = "blue", cex = 0.8, xpd = TRUE)
```



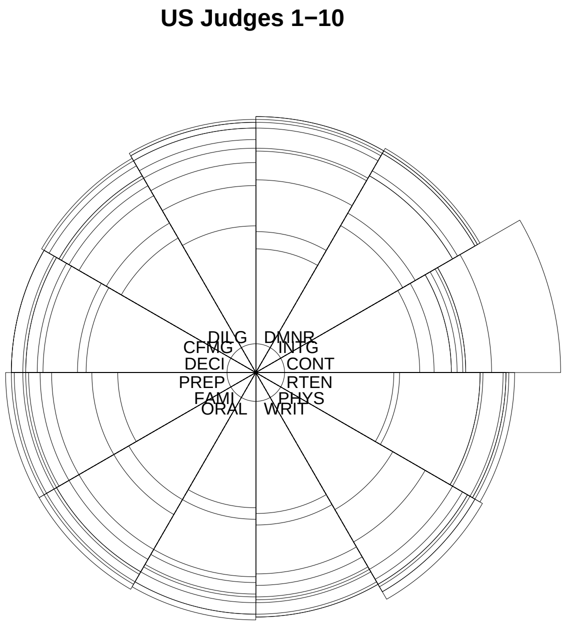

```
> stars(USJudge, draw.segments = TRUE, scale = FALSE,
+      key.loc = c(13, 1.5))
```



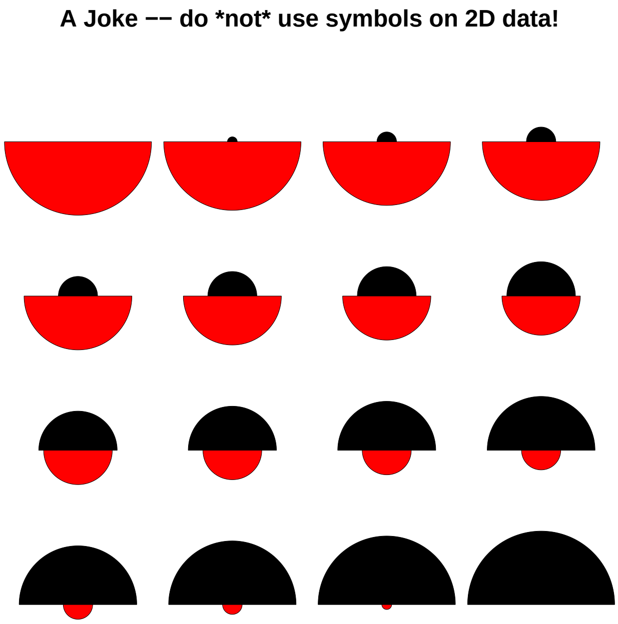
```
> stars(USJudgeRatings, locations = c(0, 0), scale = FALSE,
+     radius = FALSE, col.stars = 1:10, key.loc = c(0,
+         0), main = "US Judges rated")
```




```
> stars(USJudgeRatings[1:10, ], locations = 0:1, scale = FALSE,
+     draw.segments = TRUE, col.segments = 0, col.stars = 1:10,
+     key.loc = 0:1, main = "US Judges 1-10 ")
```




```
> palette("default")
> stars(cbind(1:16, 10 * (16:1)), draw.segments = TRUE,
+     main = "A Joke -- do *not* use symbols on 2D data!")
```

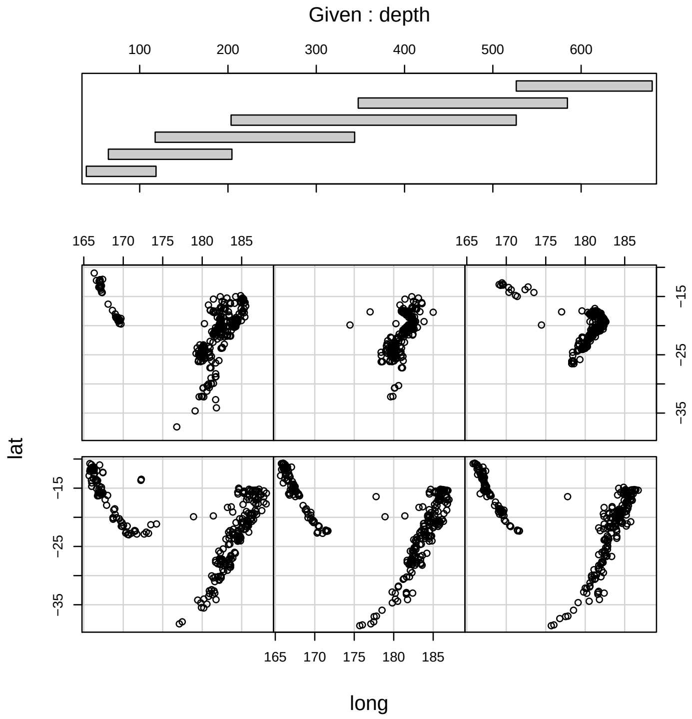


16 Steam and leaf

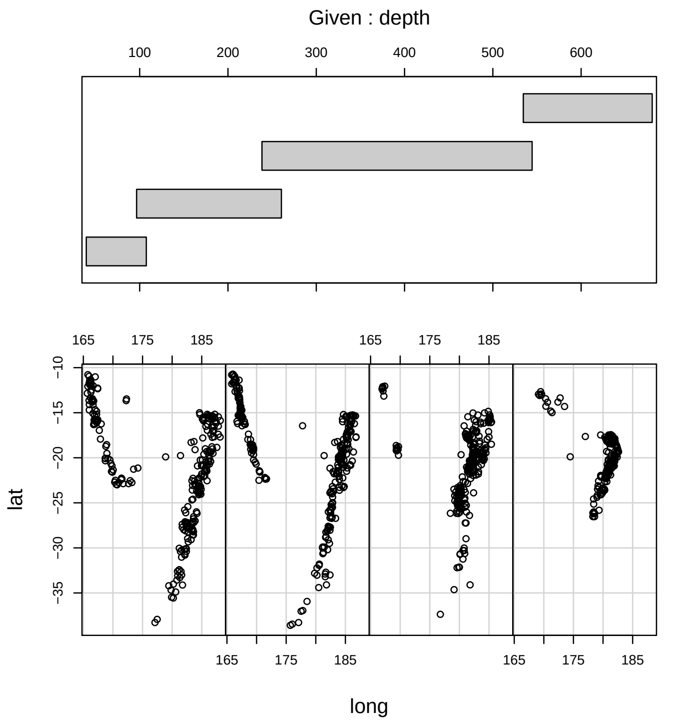
```
> stem(islands)

  The decimal point is 3 digit(s) to the right of the |

   0 | 00000000000000000000000000000111111222338
   2 | 07
   4 | 5
   6 | 8
   8 | 4
  10 | 5
  12 |
  14 |
  16 | 0

> stem(log10(islands))

  The decimal point is at the |

  1 | 1111112222233444
  1 | 5555556666667899999
  2 | 3344
  2 | 59
  3 |
  3 | 5678
  4 | 012
```

17 Conditioning plots

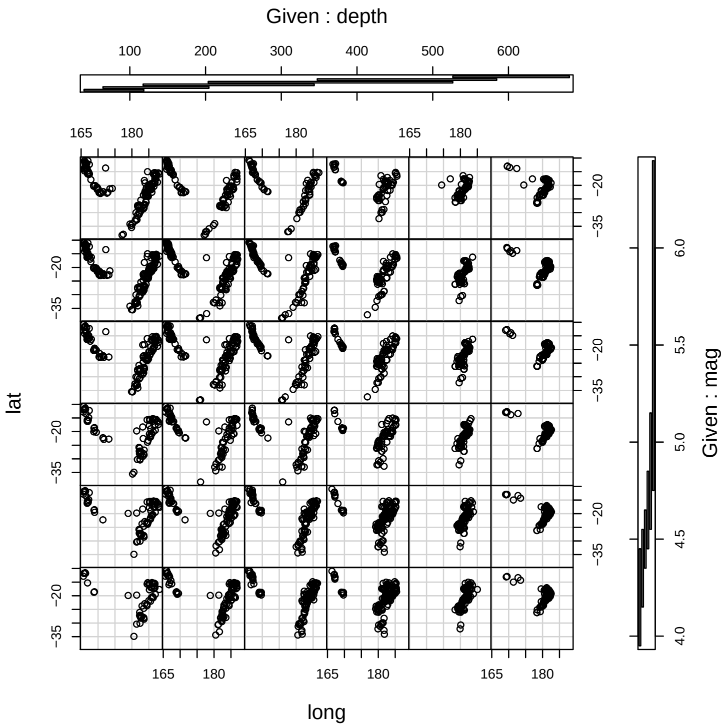
```
> coplot(lat ~ long | depth, data = quakes)
```



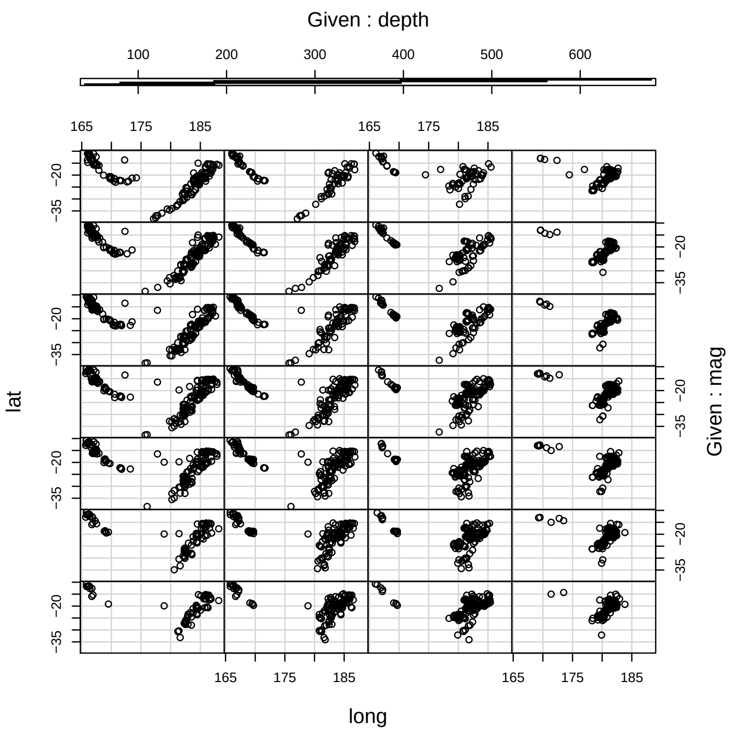

```
> given.depth <- co.intervals(quakes$depth, number = 4,
+      overlap = 0.1)
> coplot(lat ~ long | depth, data = quakes, given.v = given.depth,
+      rows = 1)
```



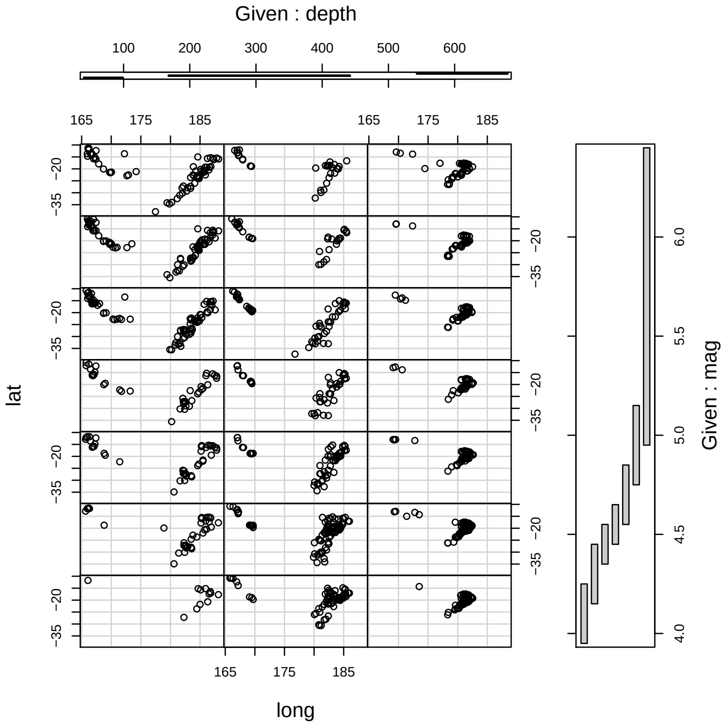
```
> ll.dm <- lat ~ long | depth * mag
> coplot(ll.dm, data = quakes)
```



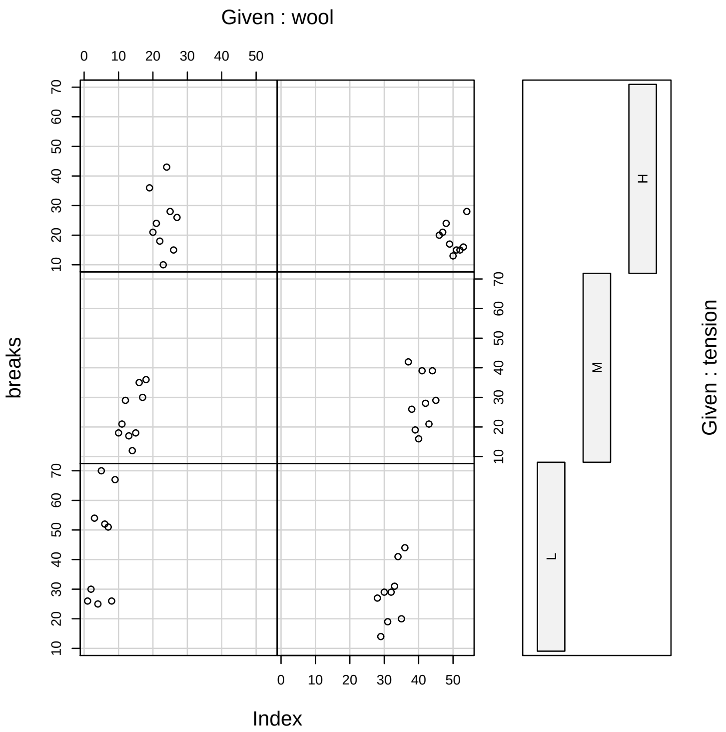

```
> coplot(ll.dm, data = quakes, number = c(4, 7), show.given = c(TRUE,
+     FALSE))
```



```
> coplot(ll.dm, data = quakes, number = c(3, 7), overlap = c(-0.5,
+     0.1))
```



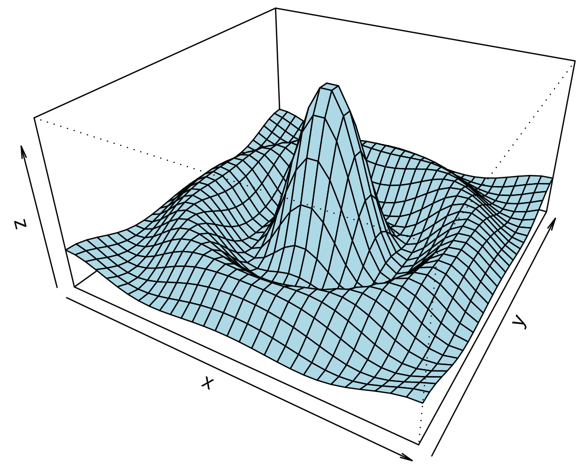

```
> Index <- seq(length = nrow(warpbreaks))
> coplot(breaks ~ Index | wool * tension, data = warpbreaks,
+     show.given = 0:1)
```



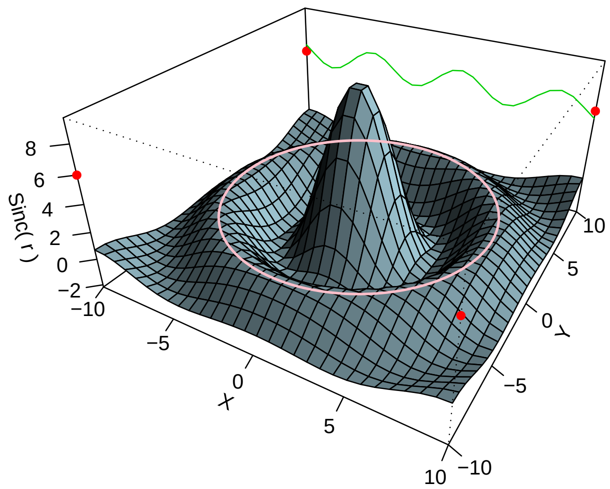
```
> coplot(breaks ~ Index | wool * tension, data = warpbreaks,
+     col = "red", bg = "pink", pch = 21, bar.bg = c(fac = "light blue"))

> with(data.frame(state.x77), {
+     coplot(Life.Exp ~ Income | Illiteracy * state.region,
+         number = 3, panel = function(x, y, ...) panel.smooth(x,
+             y, span = 0.8, ...))
+ })

> with(data.frame(state.x77), {
+     coplot(Life.Exp ~ state.region | Income * state.division,
+         panel = panel.smooth)
+ })
```

18 persp

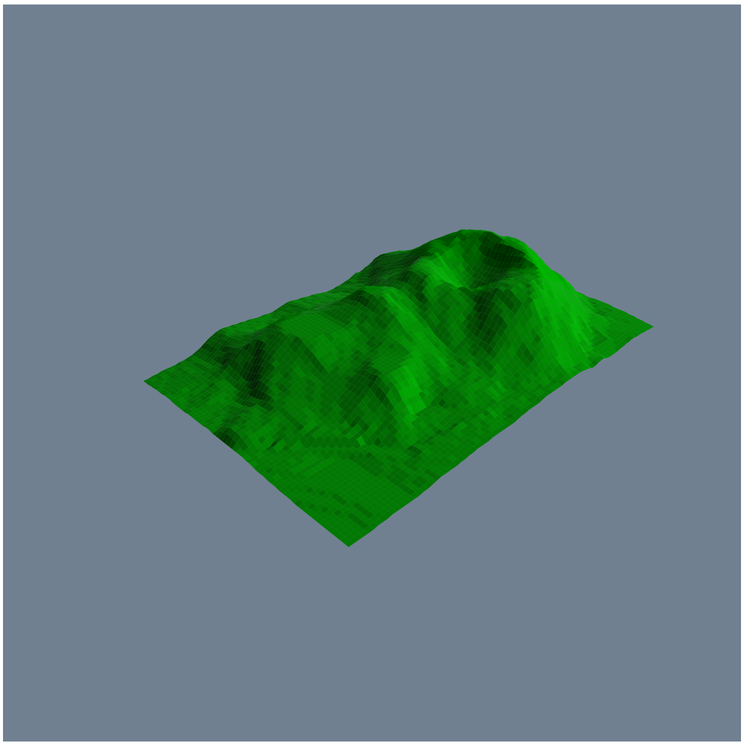
```
> require(grDevices)
> x <- seq(-10, 10, length = 30)
> y <- x
> f <- function(x, y) {
+     r <- sqrt(x^2 + y^2)
+     10 * sin(r)/r
+ }
> z <- outer(x, y, f)
> z[is.na(z)] <- 1
> op <- par(bg = "white")

> persp(x, y, z, theta = 30, phi = 30, expand = 0.5, col = "lightblue")
```




```
> res <- persp(x, y, z, theta = 30, phi = 30, expand = 0.5,
+     col = "lightblue", ltheta = 120, shade = 0.75, ticktype =
+     "detailed", xlab = "X", ylab = "Y", zlab = "Sinc( r )")
> round(res, 3)

      [,1]   [,2]   [,3]   [,4]
[1,] 0.087 -0.025  0.043 -0.043
[2,] 0.050  0.043 -0.075  0.075
[3,] 0.000  0.074  0.042 -0.042
[4,] 0.000 -0.273 -2.890  3.890

> xE <- c(-10, 10)
> xy <- expand.grid(xE, xE)
> points(trans3d(xy[, 1], xy[, 2], 6, pmat = res), col = 2,
+     pch = 16)
> lines(trans3d(x, y = 10, z = 6 + sin(x), pmat = res),
+     col = 3)
> phi <- seq(0, 2 * pi, len = 201)
> r1 <- 7.725
> xr <- r1 * cos(phi)
> yr <- r1 * sin(phi)
> lines(trans3d(xr, yr, f(xr, yr), res), col = "pink",
+     lwd = 2)
```




```
> z <- 2 * volcano
> x <- 10 * (1:nrow(z))
> y <- 10 * (1:ncol(z))
> par(bg = "slategray")
> persp(x, y, z, theta = 135, phi = 30, col = "green3",
+      scale = FALSE, ltheta = -120, shade = 0.75, border = NA,
+      box = FALSE)
> par(op)
```



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