

```
> library(MVA)
```

载入需要的程辑包：HSAUR2

载入需要的程辑包：tools

```
> demo("Ch-MVA")
```

```
demo(Ch-MVA)
```

```
---- ~~~~~
```

Type <Return> to start :

```
> ### R code from vignette source 'Ch-MVA.Rnw'
```

```
>
```

```
> #####
```

```
> ### code chunk number 1: setup
```

```
> #####
```

```
> library("MVA")
```

```
> set.seed(280875)
```

```
> library("lattice")
```

```
> lattice.options(default.theme =
```

```
+ function()
```

```
+   standard.theme("pdf", color = FALSE))
```

```
> if (file.exists("deparse.R")) {
```

```
+   if (!file.exists("figs")) dir.create("figs")
```

```
+   source("deparse.R")
```

```
+   options(prompt = "R> ", continue = "+ ", width = 64,
```

```
+     digits = 4, show.signif.stars = FALSE, useFancyQuotes = FALSE)
```

```

+
+ options(SweaveHooks = list(onefig = function() {par(mfrow = c(1,1))},
+       twofig = function() {par(mfrow = c(1,2))},
+       figtwo = function() {par(mfrow = c(2,1))},
+       threefig = function() {par(mfrow = c(1,3))},
+       figthree = function() {par(mfrow = c(3,1))},
+       fourfig = function() {par(mfrow = c(2,2))},
+       sixfig = function() {par(mfrow = c(3,2))},
+       nomar = function() par("mai" = c(0, 0, 0, 0))})
+ }

> #####
> ### code chunk number 2: ch:MVA:tab:hypo
> #####
> hypo <-
+ structure(list(individual = 1:10, sex = structure(c(2L, 2L, 2L,
+ 2L, 2L, 1L, 1L, 1L, 1L, 1L), .Label = c("Female", "Male"), class = "factor"),
+ age = c(21L, 43L, 22L, 86L, 60L, 16L, NA, 43L, 22L, 80L),
+ IQ = c(120L, NA, 135L, 150L, 92L, 130L, 150L, NA, 84L, 70L
+ ), depression = structure(c(2L, 1L, 1L, 1L, 2L, 2L, 2L, 2L,
+ 1L, 1L), .Label = c("No", "Yes"), class = "factor"), health = structure(c(3L,
+ 3L, 1L, 4L, 2L, 2L, 3L, 1L, 1L, 2L), .Label = c("Average",
+ "Good", "Very good", "Very poor"), class = "factor"), weight = c(150L,
+ 160L, 135L, 140L, 110L, 110L, 120L, 120L, 105L, 100L)), .Names = c("individual",
+ "sex", "age", "IQ", "depression", "health", "weight"), class = "data.frame", row.names = c(NA, -
10L))

> toLatex(HSAURtable(hypo), pcol = 1,
+ caption = "Hypothetical Set of Multivariate Data.",
+ label = "ch:MVA:tab:hypo", rownames = FALSE)
\index{hypo data@\Robject{hypo} data}

```

```

\begin{center}
\begin{longtable}{rrrrrr}
\caption{\Object{hypo} data. Hypothetical Set of Multivariate Data. \label{ch:MVA:tab:hypo}}
\\
\hline
\Object{individual} & \Object{sex} & \Object{age} & \Object{IQ} & \Object{depression} &
\Object{health} & \Object{weight} \\ \hline
\endfirsthead
\caption[ ]{\Object{hypo} data (continued).} \\
\hline
\Object{individual} & \Object{sex} & \Object{age} & \Object{IQ} & \Object{depression} &
\Object{health} & \Object{weight} \\ \hline
\endhead
1 & Male & 21 & 120 & Yes & Very good & 150 \\
2 & Male & 43 & NA & No & Very good & 160 \\
3 & Male & 22 & 135 & No & Average & 135 \\
4 & Male & 86 & 150 & No & Very poor & 140 \\
5 & Male & 60 & 92 & Yes & Good & 110 \\
6 & Female & 16 & 130 & Yes & Good & 110 \\
7 & Female & NA & 150 & Yes & Very good & 120 \\
8 & Female & 43 & NA & Yes & Average & 120 \\
9 & Female & 22 & 84 & No & Average & 105 \\
10 & Female & 80 & 70 & No & Good & 100 \\
\hline
\end{longtable}
\end{center}

```

```

> #####
> ### code chunk number 3: ch:MVA:hypo:subset
> #####
> hypo[1:2, c("health", "weight")]
  health weight

```

1 Very good 150

2 Very good 160

```
> #####
> ### code chunk number 4: ch:MVA:tab:measure
> #####
> measure <-
+ structure(list(V1 = 1:20, V2 = c(34L, 37L, 38L, 36L, 38L, 43L,
+   40L, 38L, 40L, 41L, 36L, 36L, 34L, 33L, 36L, 37L, 34L, 36L, 38L,
+   35L), V3 = c(30L, 32L, 30L, 33L, 29L, 32L, 33L, 30L, 30L, 32L,
+   24L, 25L, 24L, 22L, 26L, 26L, 25L, 26L, 28L, 23L), V4 = c(32L,
+   37L, 36L, 39L, 33L, 38L, 42L, 40L, 37L, 39L, 35L, 37L, 37L, 34L,
+   38L, 37L, 38L, 37L, 40L, 35L)), .Names = c("V1", "V2", "V3",
+   "V4"), class = "data.frame", row.names = c(NA, -20L))

> measure <- measure[,-1]

> names(measure) <- c("chest", "waist", "hips")

> measure$gender <- gl(2, 10)

> levels(measure$gender) <- c("male", "female")

> toLatex(HSAURtable(measure), pcol = 2,
+ caption = "Chest, waist, and hip measurements on 20 individuals (in inches).",
+ label = "ch:MVA:tab:measure", rownames = FALSE)
\index{measure data@\Robject{measure} data}
\begin{center}
\begin{longtable}{ rrrr | rrrr }
\caption{\Robject{measure} data. Chest, waist, and hip measurements on 20 individuals (in inches).
\label{ch:MVA:tab:measure}}
```

```

\\
\hline
\Robect{chest} & \Robect{waist} & \Robect{hips} & \Robect{gender} & \Robect{chest} &
\Robect{waist} & \Robect{hips} & \Robect{gender} \\ \hline
\endfirsthead
\caption[]{\Robect{measure} data (continued).} \\
\hline
\Robect{chest} & \Robect{waist} & \Robect{hips} & \Robect{gender} & \Robect{chest} &
\Robect{waist} & \Robect{hips} & \Robect{gender} \\ \hline
\endhead
34 & 30 & 32 & male & 36 & 24 & 35 & female \\
37 & 32 & 37 & male & 36 & 25 & 37 & female \\
38 & 30 & 36 & male & 34 & 24 & 37 & female \\
36 & 33 & 39 & male & 33 & 22 & 34 & female \\
38 & 29 & 33 & male & 36 & 26 & 38 & female \\
43 & 32 & 38 & male & 37 & 26 & 37 & female \\
40 & 33 & 42 & male & 34 & 25 & 38 & female \\
38 & 30 & 40 & male & 36 & 26 & 37 & female \\
40 & 30 & 37 & male & 38 & 28 & 40 & female \\
41 & 32 & 39 & male & 35 & 23 & 35 & female \\
\hline
\end{longtable}
\end{center}

```

```

> #####
> ### code chunk number 5: ch:MVA:tab:pottery
> #####
> data("pottery", package = "HSAUR2")

> toLatex(HSAURtable(pottery), pcol = 1,
+ caption = "Romano-British pottery data.",
+ label = "ch:MVA:tab:pottery", rownames = FALSE)

```

```

\index{pottery data@\Object{pottery} data}
\begin{center}
\begin{longtable}{rrrrrrrrr}
\caption{\Object{pottery} data. Romano-British pottery data. \label{ch:MVA:tab:pottery}}
\\
\hline
\Object{Al2O3} & \Object{Fe2O3} & \Object{MgO} & \Object{CaO} & \Object{Na2O} &
\Object{K2O} & \Object{TiO2} & \Object{MnO} & \Object{BaO} & \Object{kiln} \\ \hline
\endfirsthead
\caption[]{\Object{pottery} data (continued).} \\
\hline
\Object{Al2O3} & \Object{Fe2O3} & \Object{MgO} & \Object{CaO} & \Object{Na2O} &
\Object{K2O} & \Object{TiO2} & \Object{MnO} & \Object{BaO} & \Object{kiln} \\ \hline
\endhead
18.8 & 9.52 & 2.00 & 0.79 & 0.40 & 3.20 & 1.01 & 0.077 & 0.015 & 1 \\
16.9 & 7.33 & 1.65 & 0.84 & 0.40 & 3.05 & 0.99 & 0.067 & 0.018 & 1 \\
18.2 & 7.64 & 1.82 & 0.77 & 0.40 & 3.07 & 0.98 & 0.087 & 0.014 & 1 \\
16.9 & 7.29 & 1.56 & 0.76 & 0.40 & 3.05 & 1.00 & 0.063 & 0.019 & 1 \\
17.8 & 7.24 & 1.83 & 0.92 & 0.43 & 3.12 & 0.93 & 0.061 & 0.019 & 1 \\
18.8 & 7.45 & 2.06 & 0.87 & 0.25 & 3.26 & 0.98 & 0.072 & 0.017 & 1 \\
16.5 & 7.05 & 1.81 & 1.73 & 0.33 & 3.20 & 0.95 & 0.066 & 0.019 & 1 \\
18.0 & 7.42 & 2.06 & 1.00 & 0.28 & 3.37 & 0.96 & 0.072 & 0.017 & 1 \\
15.8 & 7.15 & 1.62 & 0.71 & 0.38 & 3.25 & 0.93 & 0.062 & 0.017 & 1 \\
14.6 & 6.87 & 1.67 & 0.76 & 0.33 & 3.06 & 0.91 & 0.055 & 0.012 & 1 \\
13.7 & 5.83 & 1.50 & 0.66 & 0.13 & 2.25 & 0.75 & 0.034 & 0.012 & 1 \\
14.6 & 6.76 & 1.63 & 1.48 & 0.20 & 3.02 & 0.87 & 0.055 & 0.016 & 1 \\
14.8 & 7.07 & 1.62 & 1.44 & 0.24 & 3.03 & 0.86 & 0.080 & 0.016 & 1 \\
17.1 & 7.79 & 1.99 & 0.83 & 0.46 & 3.13 & 0.93 & 0.090 & 0.020 & 1 \\
16.8 & 7.86 & 1.86 & 0.84 & 0.46 & 2.93 & 0.94 & 0.094 & 0.020 & 1 \\
15.8 & 7.65 & 1.94 & 0.81 & 0.83 & 3.33 & 0.96 & 0.112 & 0.019 & 1 \\
18.6 & 7.85 & 2.33 & 0.87 & 0.38 & 3.17 & 0.98 & 0.081 & 0.018 & 1 \\
16.9 & 7.87 & 1.83 & 1.31 & 0.53 & 3.09 & 0.95 & 0.092 & 0.023 & 1 \\

```

18.9 & 7.58 & 2.05 & 0.83 & 0.13 & 3.29 & 0.98 & 0.072 & 0.015 & 1 \\
18.0 & 7.50 & 1.94 & 0.69 & 0.12 & 3.14 & 0.93 & 0.035 & 0.017 & 1 \\
17.8 & 7.28 & 1.92 & 0.81 & 0.18 & 3.15 & 0.90 & 0.067 & 0.017 & 1 \\
14.4 & 7.00 & 4.30 & 0.15 & 0.51 & 4.25 & 0.79 & 0.160 & 0.019 & 2 \\
13.8 & 7.08 & 3.43 & 0.12 & 0.17 & 4.14 & 0.77 & 0.144 & 0.020 & 2 \\
14.6 & 7.09 & 3.88 & 0.13 & 0.20 & 4.36 & 0.81 & 0.124 & 0.019 & 2 \\
11.5 & 6.37 & 5.64 & 0.16 & 0.14 & 3.89 & 0.69 & 0.087 & 0.009 & 2 \\
13.8 & 7.06 & 5.34 & 0.20 & 0.20 & 4.31 & 0.71 & 0.101 & 0.021 & 2 \\
10.9 & 6.26 & 3.47 & 0.17 & 0.22 & 3.40 & 0.66 & 0.109 & 0.010 & 2 \\
10.1 & 4.26 & 4.26 & 0.20 & 0.18 & 3.32 & 0.59 & 0.149 & 0.017 & 2 \\
11.6 & 5.78 & 5.91 & 0.18 & 0.16 & 3.70 & 0.65 & 0.082 & 0.015 & 2 \\
11.1 & 5.49 & 4.52 & 0.29 & 0.30 & 4.03 & 0.63 & 0.080 & 0.016 & 2 \\
13.4 & 6.92 & 7.23 & 0.28 & 0.20 & 4.54 & 0.69 & 0.163 & 0.017 & 2 \\
12.4 & 6.13 & 5.69 & 0.22 & 0.54 & 4.65 & 0.70 & 0.159 & 0.015 & 2 \\
13.1 & 6.64 & 5.51 & 0.31 & 0.24 & 4.89 & 0.72 & 0.094 & 0.017 & 2 \\
11.6 & 5.39 & 3.77 & 0.29 & 0.06 & 4.51 & 0.56 & 0.110 & 0.015 & 3 \\
11.8 & 5.44 & 3.94 & 0.30 & 0.04 & 4.64 & 0.59 & 0.085 & 0.013 & 3 \\
18.3 & 1.28 & 0.67 & 0.03 & 0.03 & 1.96 & 0.65 & 0.001 & 0.014 & 4 \\
15.8 & 2.39 & 0.63 & 0.01 & 0.04 & 1.94 & 1.29 & 0.001 & 0.014 & 4 \\
18.0 & 1.50 & 0.67 & 0.01 & 0.06 & 2.11 & 0.92 & 0.001 & 0.016 & 4 \\
18.0 & 1.88 & 0.68 & 0.01 & 0.04 & 2.00 & 1.11 & 0.006 & 0.022 & 4 \\
20.8 & 1.51 & 0.72 & 0.07 & 0.10 & 2.37 & 1.26 & 0.002 & 0.016 & 4 \\
17.7 & 1.12 & 0.56 & 0.06 & 0.06 & 2.06 & 0.79 & 0.001 & 0.013 & 5 \\
18.3 & 1.14 & 0.67 & 0.06 & 0.05 & 2.11 & 0.89 & 0.006 & 0.019 & 5 \\
16.7 & 0.92 & 0.53 & 0.01 & 0.05 & 1.76 & 0.91 & 0.004 & 0.013 & 5 \\
14.8 & 2.74 & 0.67 & 0.03 & 0.05 & 2.15 & 1.34 & 0.003 & 0.015 & 5 \\
19.1 & 1.64 & 0.60 & 0.10 & 0.03 & 1.75 & 1.04 & 0.007 & 0.018 & 5 \\

\hline

\end{longtable}

\end{center}

```

> #####
> ### code chunk number 6: ch:MVA:tab:exam
> #####
> exam <-
+ structure(list(subject = 1:5, math = c(60L, 80L, 53L, 85L, 45L
+ ), english = c(70L, 65L, 60L, 79L, 80L), history = c(75L, 66L,
+ 50L, 71L, 80L), geography = c(58L, 75L, 48L, 77L, 84L), chemistry = c(53L,
+ 70L, 45L, 68L, 44L), physics = c(42L, 76L, 43L, 79L, 46L)), .Names = c("subject",
+ "maths", "english", "history", "geography", "chemistry", "physics"
+ ), class = "data.frame", row.names = c(NA, -5L))

> toLatex(HSAURtable(exam), pcol = 1,
+ caption = "Exam scores for five psychology students.",
+ label = "ch:MVA:tab:exam", rownames = FALSE)
\index{exam data@\Robject{exam} data}
\begin{center}
\begin{longtable}{rrrrrr}
\caption{\Robject{exam} data. Exam scores for five psychology students. \label{ch:MVA:tab:exam}}
\\
\hline
\Robject{subject} & \Robject{maths} & \Robject{english} & \Robject{history} & \Robject{geography}
& \Robject{chemistry} & \Robject{physics} \\ \hline
\endfirsthead
\caption[[]{\Robject{exam} data (continued).} \\
\hline
\Robject{subject} & \Robject{maths} & \Robject{english} & \Robject{history} & \Robject{geography}
& \Robject{chemistry} & \Robject{physics} \\ \hline
\endhead
1 & 60 & 70 & 75 & 58 & 53 & 42 \\
2 & 80 & 65 & 66 & 75 & 70 & 76 \\
3 & 53 & 60 & 50 & 48 & 45 & 43 \\
4 & 85 & 79 & 71 & 77 & 68 & 79 \\

```



```
5 & 45 & 80 & 80 & 84 & 44 & 46 \\
```

```
\hline
```

```
\end{longtable}
```

```
\end{center}
```

```
> #####
```

```
> ### code chunk number 7: ch:MVA:USairpollution:tab
```

```
> #####
```

```
> data("USairpollution", package = "HSAUR2")
```

```
> toLatex(HSAURtable(USairpollution), pcol = 1,
```

```
+ caption = paste("Air pollution in $41$ US cities."),
```

```
+ label = "ch:MVA:USairpollution:tab", rownames = TRUE)
```

```
\index{USairpollution data@\Robject{USairpollution} data}
```

```
\begin{center}
```

```
\begin{longtable}{l rrrrrr }
```

```
\caption{\Robject{USairpollution} data. Air pollution in $41$ US cities.
```

```
\label{ch:MVA:USairpollution:tab}}
```

```
\\
```

```
\hline
```

```
& \Robject{SO2} & \Robject{temp} & \Robject{manu} & \Robject{popul} & \Robject{wind} &  
\Robject{precip} & \Robject{predays} \\ \hline
```

```
\endfirsthead
```

```
\caption[{}]{\Robject{USairpollution} data (continued).} \\
```

```
\hline
```

```
& \Robject{SO2} & \Robject{temp} & \Robject{manu} & \Robject{popul} & \Robject{wind} &  
\Robject{precip} & \Robject{predays} \\ \hline
```

```
\endhead
```

```
Albany & 46 & 47.6 & 44 & 116 & 8.8 & 33.36 & 135 \\
```

```
Albuquerque & 11 & 56.8 & 46 & 244 & 8.9 & 7.77 & 58 \\
```

```
Atlanta & 24 & 61.5 & 368 & 497 & 9.1 & 48.34 & 115 \\
```

```
Baltimore & 47 & 55.0 & 625 & 905 & 9.6 & 41.31 & 111 \\
```

Buffalo & 11 & 47.1 & 391 & 463 & 12.4 & 36.11 & 166 \\

Charleston & 31 & 55.2 & 35 & 71 & 6.5 & 40.75 & 148 \\

Chicago & 110 & 50.6 & 3344 & 3369 & 10.4 & 34.44 & 122 \\

Cincinnati & 23 & 54.0 & 462 & 453 & 7.1 & 39.04 & 132 \\

Cleveland & 65 & 49.7 & 1007 & 751 & 10.9 & 34.99 & 155 \\

Columbus & 26 & 51.5 & 266 & 540 & 8.6 & 37.01 & 134 \\

Dallas & 9 & 66.2 & 641 & 844 & 10.9 & 35.94 & 78 \\

Denver & 17 & 51.9 & 454 & 515 & 9.0 & 12.95 & 86 \\

Des Moines & 17 & 49.0 & 104 & 201 & 11.2 & 30.85 & 103 \\

Detroit & 35 & 49.9 & 1064 & 1513 & 10.1 & 30.96 & 129 \\

Hartford & 56 & 49.1 & 412 & 158 & 9.0 & 43.37 & 127 \\

Houston & 10 & 68.9 & 721 & 1233 & 10.8 & 48.19 & 103 \\

Indianapolis & 28 & 52.3 & 361 & 746 & 9.7 & 38.74 & 121 \\

Jacksonville & 14 & 68.4 & 136 & 529 & 8.8 & 54.47 & 116 \\

Kansas City & 14 & 54.5 & 381 & 507 & 10.0 & 37.00 & 99 \\

Little Rock & 13 & 61.0 & 91 & 132 & 8.2 & 48.52 & 100 \\

Louisville & 30 & 55.6 & 291 & 593 & 8.3 & 43.11 & 123 \\

Memphis & 10 & 61.6 & 337 & 624 & 9.2 & 49.10 & 105 \\

Miami & 10 & 75.5 & 207 & 335 & 9.0 & 59.80 & 128 \\

Milwaukee & 16 & 45.7 & 569 & 717 & 11.8 & 29.07 & 123 \\

Minneapolis & 29 & 43.5 & 699 & 744 & 10.6 & 25.94 & 137 \\

Nashville & 18 & 59.4 & 275 & 448 & 7.9 & 46.00 & 119 \\

New Orleans & 9 & 68.3 & 204 & 361 & 8.4 & 56.77 & 113 \\

Norfolk & 31 & 59.3 & 96 & 308 & 10.6 & 44.68 & 116 \\

Omaha & 14 & 51.5 & 181 & 347 & 10.9 & 30.18 & 98 \\

Philadelphia & 69 & 54.6 & 1692 & 1950 & 9.6 & 39.93 & 115 \\

Phoenix & 10 & 70.3 & 213 & 582 & 6.0 & 7.05 & 36 \\

Pittsburgh & 61 & 50.4 & 347 & 520 & 9.4 & 36.22 & 147 \\

Providence & 94 & 50.0 & 343 & 179 & 10.6 & 42.75 & 125 \\

Richmond & 26 & 57.8 & 197 & 299 & 7.6 & 42.59 & 115 \\

Salt Lake City & 28 & 51.0 & 137 & 176 & 8.7 & 15.17 & 89 \\

```

San Francisco & 12 & 56.7 & 453 & 716 & 8.7 & 20.66 & 67 \\
Seattle & 29 & 51.1 & 379 & 531 & 9.4 & 38.79 & 164 \\
St. Louis & 56 & 55.9 & 775 & 622 & 9.5 & 35.89 & 105 \\
Washington & 29 & 57.3 & 434 & 757 & 9.3 & 38.89 & 111 \\
Wichita & 8 & 56.6 & 125 & 277 & 12.7 & 30.58 & 82 \\
Wilmington & 36 & 54.0 & 80 & 80 & 9.0 & 40.25 & 114 \\
\hline
\end{longtable}
\end{center}

```

```

> #####
> ### code chunk number 8: ch:MVA:measure:cov
> #####
> cov(measure[, c("chest", "waist", "hips")])
      chest  waist  hips
chest 6.631579 6.368421 3.000000
waist 6.368421 12.526316 3.578947
hips 3.000000 3.578947 5.944737

> #####
> ### code chunk number 9: ch:MVA:measure:cov
> #####
> cov(subset(measure, gender == "female"),
+      c("chest", "waist", "hips"))
      chest  waist  hips
chest 2.277778 2.166667 1.555556
waist 2.166667 2.988889 2.755556
hips 1.555556 2.755556 3.066667

> cov(subset(measure, gender == "male"),
+      c("chest", "waist", "hips"))

```

```
chest waist hips
chest 6.7222222 0.9444444 3.944444
waist 0.9444444 2.1000000 3.077778
hips 3.9444444 3.0777778 9.344444
```

```
> #####
```

```
> ### code chunk number 10: ch:MVA:hypo:cor
```

```
> #####
```

```
> cor(measure[, c("chest", "waist", "hips")])
```

```
chest waist hips
chest 1.0000000 0.6987336 0.4778004
waist 0.6987336 1.0000000 0.4147413
hips 0.4778004 0.4147413 1.0000000
```

```
> #####
```

```
> ### code chunk number 11: ch:MVA:measure:dist (eval = FALSE)
```

```
> #####
```

```
> ## dist(scale(measure[, c("chest", "waist", "hips")],
```

```
> ## center = FALSE))
```

```
>
```

```
>
```

```
> #####
```

```
> ### code chunk number 12: ch:MVA:measure:dist
```

```
> #####
```

```
> x <- dist(scale(measure[, c("chest", "waist", "hips")],
```

```
+ center = FALSE))
```

```
> as.dist(round(as.matrix(x), 2)[1:12, 1:12])
```

```
1 2 3 4 5 6 7 8 9 10 11
```

```
2 0.17
```

```
3 0.15 0.08
```

```
4 0.22 0.07 0.14
5 0.11 0.15 0.09 0.22
6 0.29 0.16 0.16 0.19 0.21
7 0.32 0.16 0.20 0.13 0.28 0.14
8 0.23 0.11 0.11 0.12 0.19 0.16 0.13
9 0.21 0.10 0.06 0.16 0.12 0.11 0.17 0.09
10 0.27 0.12 0.13 0.14 0.20 0.06 0.09 0.11 0.09
11 0.23 0.28 0.22 0.33 0.19 0.34 0.38 0.25 0.24 0.32
12 0.22 0.24 0.18 0.28 0.18 0.30 0.32 0.20 0.20 0.28 0.06
```

```
> cat("...")
```

```
...
```

```
> #####
```

```
> ### code chunk number 13: ch:MVA:fig:dmvnorm
```

```
> #####
```

```
> library("mvtnorm")
```

```
> x <- y <- seq(from = -3, to = 3, length = 50)
```

```
> dat <- as.matrix(expand.grid(x, y))
```

```
> d <- dmvnorm(dat, mean = c(0, 0),
```

```
+   sigma = matrix(c(1, 0.5, 0.5, 1), ncol = 2))
```

```
> d <- matrix(d, ncol = length(x))
```

```
> persp(x = x, y = y, z = d, xlab = "x1", ylab = "x2",
```

```
+   zlab = "f(x)")
```

等待页面改变的确认...

```
> #####
```

```

> ### code chunk number 14: ch:MVA:fig:cdf
> #####
> x <- seq(from = -3, to = 3, length = 1000)

> Fx <- pnorm(x)

> Fy <- pnorm(x, mean = -1)

> plot(x, Fx, type = "l", axes = FALSE, xlab = "",
+   ylab = "Cumulative distribution function")
等待页面改变的确认...

> lines(x, Fy, type = "l")

> x0 <- which.min((x - 1.2)^2)

> x05 <- which.min((x + 0.5)^2)

> x08 <- which.min((x + 0.9)^2)

> xx <- which.min(abs(Fy - Fx[x0]))

> arrows(x0 = c(min(x), x[x0], x[xx], x[x08], x[x08], x[x08]),
+   y0 = c(Fx[x0], Fx[x0], Fy[xx], 0, Fx[x08], Fy[x08]),
+   x1 = c(x[x0], x[x0], x[xx], x[x08], -3, -3),
+   y1 = c(Fx[x0], 0, 0, Fy[x08], Fx[x08], Fy[x08]))

> mtext(at = c(x[x08], x[xx], x[x0]), side = 1, line = 1, text =
+   c(expression(q), expression(q[2](p)), expression(q[1](p))))

> mtext(at = c(0, Fx[x08], Fy[x08], Fx[x0], 1), line = 1, side = 2, text =

```

```
+ c(0, expression(p[1](q)), expression(p[2](q)), expression(p), 1))
```

```
> box()
```

```
> #####
```

```
> ### code chunk number 15: ch:MVA:fig:measure:chisq:setup1
```

```
> #####
```

```
> x <- measure[, c("chest", "waist", "hips")]
```

```
> #####
```

```
> ### code chunk number 16: ch:MVA:fig:measure:chisq:setup2
```

```
> #####
```

```
> cm <- colMeans(x)
```

```
> S <- cov(x)
```

```
> #####
```

```
> ### code chunk number 17: ch:MVA:fig:measure:chisq:setup3
```

```
> #####
```

```
> d <- apply(x, MARGIN = 1, function(x)
```

```
+ t(x - cm) %*% solve(S) %*% (x - cm))
```

```
> #####
```

```
> ### code chunk number 18: ch:MVA:fig:measure:qq
```

```
> #####
```

```
> qqnorm(measure[, "chest"], main = "chest"); qqline(measure[, "chest"])
```

等待页面改变的确认...

```
> qqnorm(measure[, "waist"], main = "waist"); qqline(measure[, "waist"])
```

等待页面改变的确认...

```
> qqnorm(measure["hips"], main = "hips"); qqline(measure["hips"])
```

等待页面改变的确认...

```
> #####
```

```
> ### code chunk number 19: ch:MVA:fig:measure:chisq
```

```
> #####
```

```
> plot(qchisq((1:nrow(x) - 1/2) / nrow(x), df = 3), sort(d),
```

```
+ xlab = expression(paste(chi[3]^2, " Quantile")),
```

```
+ ylab = "Ordered distances")
```

等待页面改变的确认...

```
> abline(a = 0, b = 1)
```

```
> #####
```

```
> ### code chunk number 20: ch:MVA:fig:USairpollution:qq:setup (eval = FALSE)
```

```
> #####
```

```
> ## layout(matrix(1:8, nc = 2))
```

```
> ## sapply(colnames(USairpollution), function(x) {
```

```
> ##   qqnorm(USairpollution[[x]], main = x)
```

```
> ##   qqline(USairpollution[[x]])
```

```
> ## })
```

```
>
```

```
>
```

```
> #####
```

```
> ### code chunk number 21: ch:MVA:fig:USairpollution:qq
```

```
> #####
```

```
> layout(matrix(1:8, nc = 2))
```

```
> sapply(colnames(USairpollution), function(x) {
```

```
+   qqnorm(USairpollution[[x]], main = x)
```

```
+   qqline(USairpollution[[x]])
```



```
+ })
```

```
等待页面改变的确认...
```

```
$SO2
```

```
NULL
```

```
$temp
```

```
NULL
```

```
$manu
```

```
NULL
```

```
$popul
```

```
NULL
```

```
$wind
```

```
NULL
```

```
$precip
```

```
NULL
```

```
$predays
```

```
NULL
```

```
> #####
```

```
> ### code chunk number 22: ch:MVA:fig:USairpollution:chisq
```

```
> #####
```

```
> x <- USairpollution
```

```
> cm <- colMeans(x)
```

```

> S <- cov(x)

> d <- apply(x, 1, function(x) t(x - cm) %*% solve(S) %*% (x - cm))

> plot(qc <- qchisq((1:nrow(x) - 1/2) / nrow(x), df = 7),
+   sd <- sort(d),
+   xlab = expression(paste(chi[7]^2, " Quantile")),
+   ylab = "Ordered distances", xlim = range(qc) * c(1, 1.1))

> oups <- which(rank(abs(qc - sd), ties = "random") > nrow(x) - 3)

> text(qc[oups], sd[oups] - 1.5, names(oups))

> abline(a = 0, b = 1)

> #####

> ### code chunk number 23: ex

> #####

> s <- c(3.8778,
+   2.8110, 2.1210,
+   3.1480, 2.2669, 2.6550,
+   3.5062, 2.5690, 2.8341, 3.2352)

> S <- diag(4)

> S[!lower.tri(S)] <- s

> S <- S + t(S)

> diag(S) <- diag(S) / 2

```

```
> writeLines(apply(S, 1, function(x) paste(paste(formatC(x, format = "f"), collapse = "&"), "\\\\")))
3.8778&2.8110&3.1480&3.5062 \\
2.8110&2.1210&2.2669&2.5690 \\
3.1480&2.2669&2.6550&2.8341 \\
3.5062&2.5690&2.8341&3.2352 \\
```

```
> #####
```

```
> ### code chunk number 24: ex
```

```
> #####
```

```
> X <- matrix(
+ c(3, 4, 4, 6, 1,
+ 5, 1, 1, 7, 3,
+ 6, 2, 0, 2, 6,
+ 1, 1, 1, 0, 3,
+ 4, 7, 3, 6, 2,
+ 2, 2, 5, 1, 0,
+ 0, 4, 1, 1, 1,
+ 0, 6, 4, 3, 5,
+ 7, 6, 5, 1, 4,
+ 2, 1, 4, 3, 1), ncol = 5)
```

```
> writeLines(apply(X, 1, function(x) paste(paste(x, collapse = "&"), "\\\\")))
```

```
3&6&4&0&7 \\
4&2&7&4&6 \\
4&0&3&1&5 \\
6&2&6&1&1 \\
1&6&2&1&4 \\
5&1&2&0&2 \\
1&1&2&6&1 \\
1&1&5&4&4 \\
7&0&1&3&3 \\
```

3&3&0&5&1 \\