

# Package ‘mistat’

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**Maintainer** Daniele Amberti <daniele.amberti@gmail.com>

**Description** Provide all the data sets and statistical analysis applications used in “Modern Industrial Statistics: with applications in R, MINITAB and JMP” by R.S. Kenett and S. Zacks with contributions by D. Amberti, John Wiley and Sons, 2013, which is a second revised and expanded revision of “Modern Industrial Statistics: Design and Control of Quality and Reliability”, R. Kenett and S. Zacks, Duxbury/Wadsworth Publishing, 1998.

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mistat-package

*The Modern Industrial Statistics Package*

---

## Description

This R package is providing all the data sets and statistical analysis of *Modern Industrial Statistics, with applications using R, MINITAB and JMP* by R.S. Kenett and S. Zacks with contributions by D. Amberti, John Wiley and Sons, 2013. This second revised and expanded second edition.

## Details

Package: mistat  
Type: Package  
Date: 2012-08-22  
License: GPL >= 2

## Author(s)

Daniele Amberti

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## See Also

[Bootstrap Resampling](#), [Quality Control Charts](#), [Operating Characteristics of an Acceptance Sampling Plan](#), [Quality Control Charts](#), [Fractional Factorial 2-level designs](#).

## Examples

```
data(OELECT)
data(OELECT1)

randomizationTest(list(a=OELECT, b=OELECT1),
                  R=500, calc=mean,
                  fun=function(x) x[1]-x[2],
                  seed=123)

Ps <- pistonSimulation(
  m = rep(60, 100),
  s = rep(0.02, 100),
  v0 = rep(0.01, 100),
  k = rep(5000, 100),
  p0 = rep(110000, 100),
  t = c(rep(296,35), 296*1.1^(1:65)),
  t0 = rep(360, 100),
  each = 1,
```

```
seed = 123,
check = FALSE)

head(Ps)

cusumArl(mean= 0.0,
          N=100,
          limit=5000,
          seed=123)

powerCircuitSimulation(seed=123, each=3)

set.seed(123)

Ttf <- rgamma(50,
             shape=2,
             scale=100)

Ttr <- rgamma(50,
             shape=2,
             scale=1)

AvailEbd <- availDis(ttf=Ttf,
                    ttr=Ttr,
                    n=1000, seed=123)

RenewEbd <- renewDis(ttf=Ttf,
                    ttr=Ttr,
                    time=1000,
                    n=1000)
```

---

ALMPIN

*Aluminium Pins (6 dimensions)*

---

### **Description**

Records of 6 dimension variables (a subset of 2 in ALMPIN2) measured in *mm* on 70 aluminium pins used in airplanes, in order of production.

### **Usage**

```
data(ALMPIN)
```

### **Format**

A data frame with 70 observations on the following 6 variables.

diam1 pin diameter at specified location, a numeric vector

diam2 pin diameter at specified location, a numeric vector

diam3 pin diameter at specified location, a numeric vector  
 capDiam diameter of the cap on top of the pin, a numeric vector  
 lenNocp length of the pin without the cap, a numeric vector  
 lenWcp length of the pin with the cap, a numeric vector

### Details

The aluminum pins are inserted with air-guns in pre-drilled holes in order to combine critical airplane parts such as wings, engine supports and doors.

The measurements were taken in a computerized numerically controlled (CNC) metal cutting operation. The six variables are Diameter 1, Diameter 2, Diameter 3, Cap Diameter, Lengthncp and Lengthwcp. All the measurements are in millimeters. The first three variables give the pin diameter at three specified locations. Cap Diameter is the diameter of the cap on top of the pin. The last two variables are the length of the pin, without and with the cap, respectively.

### Source

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

### Examples

```
data(ALMPIN)
cor(ALMPIN)
plot(ALMPIN)
```

---

availDis	<i>Availability Distribution</i>
----------	----------------------------------

---

### Description

Provide the Empirical Bootstrap Distribution of the asymptotic availability index  $A_\infty$ , based on observed samples of failure times and repair times.

### Usage

```
availDis(ttf, ttr, n, seed = NA, printSummary = TRUE)
```

### Arguments

ttf	numeric vector of Time To Failure
ttr	numeric vector of Time To Repair
n	the number of bootstrap replicates

seed	a single value, interpreted as an integer. If specified make the simulation replicable.
printSummary	logical, if TRUE print the Mean Time To Failure, Mean Time To Repair and the asymptotic availability

**Value**

A numeric vector of length n with simulated availabilities

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**See Also**

[renewDis](#)

**Examples**

```
set.seed(123)

Ttf <- rgamma(50,
             shape=2,
             scale=100)

Ttr <- rgamma(50,
             shape=2,
             scale=1)

AvailEbd <- availDis(ttf=Ttf,
                    ttr=Ttr,
                    n=1000)
```

---

BLEMISHES

*Number of Blemishes on Ceramic Plates*

---

**Description**

Blemishes found on each of 30 ceramic plates.

**Usage**

```
data(BLEMISHES)
```

**Format**

A data frame with 30 observations:

plateID a factor  
count an integer vector

**Details**

Blemishes will affect the final product's (hybrid micro electronic components) electrical performance and its overall yield

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(BLEMISHES)
table(factor(BLEMISHES$count, levels=0:5))
```

---

CAR

*Car*

---

**Description**

Records on 109 different car models, including number of cylinders, origin, turn diameter, horsepower, and number of miles per gallon in city driving.

**Usage**

```
data(CAR)
```

**Format**

A data frame with 109 observations on the following 5 variables.

cyl Number of cylinders, an integer vector  
origin Car origin, 1 = US; 2 = Europe; 3 = Asia, an integer vector  
turn Turn diameter, a numeric vector  
hp Horsepower, a numeric vector  
mpg Miles per gallon in city driving, a numeric vector

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(CAR)

with(data=CAR, expr=table(cyl, origin))
```

---

COAL

*Number of Coal Mine Disasters*

---

**Description**

Data on the number of coal mine disasters (explosions) in England, per year, for the period 1850 to 1961.

**Usage**

```
data(COAL)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(COAL)
Bp <- barplot(COAL)

axis(side=1,
      labels=seq(
        from=1850,
        to=1960,
        by=10),
      at=Bp[rep(c(TRUE,
                  rep(FALSE, 9)),
              10)])

rm(Bp)
```



**Description**

The experiment described here was part of an extensive effort to optimize a UNIX operating system.

**Usage**

data(COMPURESP)

**Format**

A data frame with 18 observations on the following 10 variables.

F a factor with levels 1 2, representing KMCs used

B a factor with levels 1 2 3, representing File Distribution

C a factor with levels 1 2 3, representing Memory Size

D a factor with levels 1 2 3, representing System Buffers

E a factor with levels 1 2 3, representing Sticky Bits

A a factor with levels 1 2 3, representing Disk Drives

G a factor with levels 1 2 3, representing INODE Table Entries

H a factor with levels 1 2 3, representing Other System Tables

Mean mean time taken for the system to complete commands execution

SN S/N ratio  $\eta = -10 \log_{10}(\frac{1}{n} \sum_i y_i^2)$

**Details**

The experiment described here was part of an extensive effort to optimize a UNIX operating system running on a VAX 11-780 machine. The machine had 48 user terminal ports, two remote job entry links, four megabytes of memory, and five disk drives. The typical number of users logged on at a given time was between 20 to 30.

**1. Problem Definition.** Users complained that the system performance was very poor, especially in the afternoon. The objective of the improvement effort was to both minimize response time and reduce variability in response.

**2. Response variable.** In order to get an objective measurement of the response time two specific representative commands called 'standard' and 'trivial' were used. The 'standard' command consisted of creating, editing and removing a file. The 'trivial' command was the UNIX system 'date' command. Response times were measured by submitting these commands every 10 minutes and clocking the time taken for the system to complete their execution.

**Source**

Pao, Phadke and Sherrerd (1985)

**Examples**

```
data(COMPURESP)

layout(matrix(1:4, 2, byrow=TRUE))

with(COMPURESP,
      interaction.plot(
        x.factor=F,
        trace.factor=rep(0, length(F)),
        response=SN,
        legend=FALSE,
        type="b",
        pch=15:18,
        ylim=c(-17, -10)))

with(COMPURESP,
      interaction.plot(
        x.factor=B,
        trace.factor=rep(0, length(B)),
        response=SN,
        legend=FALSE,
        type="b",
        pch=15:18,
        ylim=c(-17, -10)))

with(COMPURESP,
      interaction.plot(
        x.factor=C,
        trace.factor=rep(0, length(C)),
        response=SN,
        legend=FALSE,
        type="b",
        pch=15:18,
        ylim=c(-17, -10)))

with(COMPURESP,
      interaction.plot(
        x.factor=D,
        trace.factor=rep(0, length(D)),
        response=SN,
        legend=FALSE,
        type="b",
        pch=15:18,
        ylim=c(-17, -10)))

layout(1)
```

**Description**

length (in *cm*) of the electrical contacts of relays in samples of size five, taken hourly from a running process.

**Usage**

```
data(CONTACTLEN)
```

**Format**

A numeric matrix with five columns representing a sample and twenty rows representing hourly samples.

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(CONTACTLEN)

library(qcc)

qcc(CONTACTLEN, type="xbar")
```

---

cusumArl

*Cumulative Sum Control Charts Average Run Length*

---

**Description**

Computes the ARL function by simulation

**Usage**

```
cusumArl(..., randFunc = rnorm, N = 100, limit = 10000, seed = NA,
          kp = 1, km = -1, hp = 3, hm = -3, side = "both",
          printSummary = TRUE)
```

**Arguments**

...	arguments such as mean, lambda or sd to be passed to the appropriate random generation function
randFunc	a random generation function
N	the number of replicates
limit	safety parameter, stop rule for procedures with very long ARL

seed	a single value, interpreted as an integer. If specified make the simulation replicable.
kp	$K^+$ parameter of the control scheme
km	$K^-$ parameter of the control scheme
hp	$h^+$ parameter of the control scheme
hm	$h^-$ parameter of the control scheme
side	a character string specifying the side of the control scheme, must be one of "both" (default), "upper" or "lower"
printSummary	logical, if TRUE print a summary of the cusum ARL

### Value

a list with elements:

rls	a numeric vector representing the Run Length of the simulation
statistics	a numeric vector with summary statistics
run	a list of length N elements each of which has single numeric elements violationLower, violationUpper and rl

### Author(s)

Daniele Amberti

### References

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

### Examples

```
cusumArl(mean=1, seed=123, N=100, limit=1000)
```

```
cusumArl(size=100, prob=0.05, kp=5.95, km=3.92, hp=12.87, hm=-8.66,
  randFunc=rbinom, seed=123, N=100, limit=2000)
```

```
cusumArl(lambda=10, kp=12.33, km=8.41, hp=11.36, hm=-12.91,
  randFunc=rpois, seed=123, N=100, limit=2000)
```

cusumPfaCed

*Cusum Probability of False Alarm and Conditional Expected Delay***Description**

Compute the Probability of False Alarm, PFA, and the Conditional Expected Delay, CED, for the Normal, Binomial and Poisson distributions

**Usage**

```
cusumPfaCedBinom(size0 = 0, prob0 = 1, size1 = 0, prob1 = 1,
                 tau = 10, N = 100, limit = 10000, seed = NA,
                 kp = 1, km = -1, hp = 3, hm = -3, side = "both",
                 printSummary = TRUE)
```

```
cusumPfaCedNorm(mean0 = 0, sd0=1, mean1=0, sd1=1,
                 tau=10, N=100, limit=10000, seed=NA,
                 kp=1, km=-1, hp=3, hm=-3, side="both",
                 printSummary = TRUE)
```

```
cusumPfaCedPois(lambda0 = 0, lambda1=1,
                 tau=10, N=100, limit=10000, seed=NA,
                 kp=1, km=-1, hp=3, hm=-3, side="both",
                 printSummary = TRUE)
```

**Arguments**

size0	number of trials (zero or more)
prob0	probability of success on each trial
size1	number of trials (zero or more) after a process level change
prob1	probability of success on each trial after a process level change
mean0	distribution mean
sd0	distribution standard deviation
mean1	distribution mean after a process level change
sd1	distribution standard deviation after a process level change
lambda0	(non-negative) mean
lambda1	(non-negative) mean after a process level change
tau	time on which the process level change occurs
N	the number of replicates
limit	safety parameter, stop rule for procedures with very long ARL
seed	a single value, interpreted as an integer. If specified make the simulation replicable.
kp	$K^+$ parameter of the control scheme

km	$K^-$ parameter of the control scheme
hp	$h^+$ parameter of the control scheme
hm	$h^-$ parameter of the control scheme
side	a character string specifying the side of the control scheme, must be one of "both" (default), "upper" or "lower"
printSummary	logical, if TRUE print a summary of the cusum PFA and CED

**Value**

a list with elements:

r1s	a numeric vector representing the Run Length of the simulation
statistics	a numeric vector with summary statistics
run	a list of length N elements each of which has single numeric elements violationLower, violationUpper and r1

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**Examples**

```
cusumPfaCedNorm(mean1=1.5,
                 tau=100,
                 N=100,
                 limit=1000,
                 seed=123)
```

---

CYCLT

*50 Cycle Times*

---

**Description**

50 cycle times (in seconds) of a piston operating at fixed operating conditions set at the minimal levels of seven control factors.

**Usage**

data(CYCLT)

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(CYCLT)
summary(CYCLT)
plot(CYCLT, type="b")
```

---

DISS

*Dissolution Data*

---

**Description**

Dissolution data of a new product and a reference approved product.

**Usage**

```
data(DISS)
```

**Format**

A data frame with 12 observations on the following 4 variables.

batch a factor with levels REF TEST  
tablet a factor with levels 1 2 3 4 5 6  
min15 a numeric vector  
min90 a numeric vector

**Source**

Tsong et al., (1996).

**Examples**

```
data(DISS)
## maybe str(DISS) ; plot(DISS) ...
```

---

`DOJ01935`*Dow-Jones Financial Index 1935*

---

**Description**

The Dow-Jones financial index for the 300 business days of 1935.

**Usage**

```
data(DOJ01935)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(DOJ01935)

plot(DOJ01935,
      type="b",
      ylab="Dow Jones")
```

---

`DOW1941`*Dow-Jones Financial Index 1941*

---

**Description**

The Dow-Jones daily index of 1941.

**Usage**

```
data(DOW1941)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(DOW1941)

plot(DOW1941,
      type="b",
      ylab="Dow Jones 1941")
```



---

ELECFAIL

*Failures of an Electronic Device*

---

**Description**

50 failure times of an electronic device.

**Usage**

```
data(ELECFAIL)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(ELECFAIL)
```

```
hist(ELECFAIL)
```

---

ELECINDX

*Bernoulli Sample on OELECT Data*

---

**Description**

Bernoulli sample in which, we give a circuit in OELECT the value 1 if its electric output is in the interval (216, 224) and the value 0 otherwise.

**Usage**

```
data(ELECINDX)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**See Also**

[OELECT](#)

**Examples**

```
data(ELECINDX)
```

```
qbinom(p=0.5, size=100, prob=mean(ELECINDX))
```

ETCHRATE

*Data on the Rate of Etching*

---

**Description**

Rate of removal of field oxide in a semiconductor plasma etching process.

**Usage**

```
data(ETCHRATE)
```

**Source**

Digital Equipment Corporation (1988).

**Examples**

```
data(ETCHRATE)
```

```
hist(ETCHRATE)
```

---

ETCHRATETWO

*Data on the Rate of Etching (two samples)*

---

**Description**

Rate of removal of field oxide in two different semiconductor plasma etching processes, A and B.

**Usage**

```
data(ETCHRATETWO)
```

**Format**

A data frame with 12 observations on the following 2 variables.

A a numeric vector, rate of etching, sample A

B a numeric vector, rate of etching, sample B

**Source**

Digital Equipment Corporation (1988).

**Examples**

```
data(ETCHRATETWO)
```

```
boxplot(values ~ ind, data=stack(ETCHRATETWO))
```

---

FAILTIME	<i>Failure Times</i>
----------	----------------------

---

**Description**

Failure times of 20 electric generators (in *hr*).

**Usage**

```
data(FAILTIME)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(FAILTIME)

library(survival)

SuRe <- survreg(
  Surv(time=FAILTIME) ~ 1 ,
  dist = "exponential")

summary(SuRe)
```

---

FILMSP	<i>Film Speed</i>
--------	-------------------

---

**Description**

Data gathered from 217 rolls of film. The data consists of the film speed as measured in a special lab.

**Usage**

```
data(FILMSP)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(FILMSP)
```

```
hist(FILMSP)
```

---

FLEXPROD

*The Quinlan Experiment at Flex Products*

---

**Description**

Flex Products is a subcontractor of General Motors, manufacturing mechanical speedometer cables. The basic cable design has not changed for fifteen years and General Motors had experienced many disappointing attempts at reducing the speedometer noise level.

**Usage**

```
data(FLEXPROD)
```

**Format**

A data frame with 16 observations on the following 16 variables.

A Liner O.D., a factor with levels 1 2

B Liner Die, a factor with levels 1 2

C Liner Material, a factor with levels 1 2

D Liner Line Speed, a factor with levels 1 2

E Wire Braid Type, a factor with levels 1 2

F Braiding Tension, a factor with levels 1 2

G Wire Diameter, a factor with levels 1 2

H Liner Tension, a factor with levels 1 2

I Liner Temperature, a factor with levels 1 2

J Coating Material, a factor with levels 1 2

K Coating Dye Type, a factor with levels 1 2

L Melt Temperature, a factor with levels 1 2

M Screen Pack, a factor with levels 1 2

N Cooling Method, a factor with levels 1 2

O Line Speed, a factor with levels 1 2

SN Signal to noise ratio, a numeric vector

**Details**

*Problem Definition:* the product under investigation is an extruded thermoplastic speedometer casing used to cover the mechanical speedometer cable on automobiles. Excessive shrinkage of the casing is causing noise in the mechanical speedometer cable assembly.

*Response variable:* the performance characteristic in this problem is the post extrusion shrinkage of the casing. The percent shrinkage is obtained by measuring approximately 600mm of casing that has been properly conditioned ( $A$ ), placing that casing in a two hour heat soak in an air circulating oven, reconditioning the sample and measuring the length ( $B$ ). Shrinkage is computed as:  $Shrinkage = 100 * (A - B)/A$ .

*Factor Levels:* Existing (1) - Changed (2)

*Number of Replications:* four random samples of 600mm from the 3000 feet manufactured at each experimental run.

*Data Analysis:* signal to noise ratios ( $SN$ ) are computed for each experimental run and analyzed using main effect plots and an ANOVA. Savings are derived from Loss function computations.

The signal to noise formula used by Quinlan is:

$$\eta = -10 \log_{10} \left( \frac{1}{n} \sum y^2 \right)$$

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(FLEXPROD)

aov(SN ~ . , data=FLEXPROD)
```

---

 GASOL

*Distillation Properties of Crude Oils*


---

**Description**

32 measurements of distillation properties of crude oils.

**Usage**

```
data(GASOL)
```

**Format**

A data frame with 32 observations on the following 5 variables.

x1 crude oil gravity (*API*), a numeric vector

x2 crude oil vapour pressure (*psi*), a numeric vector

astm crude oil ASTM 10% point (*Fahrenheit*), a numeric vector

endPt gasoline ASTM endpoint (*Fahrenheit*), a numeric vector

yield yield of gasoline (in percentage of crude oil), a numeric vector

**Source**

Daniel and Wood (1971) pp. 165

**Examples**

```
data(GASOL)
```

```
LmYield <- lm(yield ~ 1 + astm + endPt,  
             data=GASOL)
```

```
summary(LmYield)
```

---

GASTURBINE

*Gas Turbine Cycle Times*

---

**Description**

125 gas turbine cycle times divided in 25 samples of 5 observations.

**Usage**

```
data(GASTURBINE)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(GASTURBINE)
```

```
plot(rowMeans(GASTURBINE), type="b")
```

---

HADPAS

*Resistance Values of Hybrids*

---

### Description

Several resistance measurements ( $\Omega$ ) of five types of resistances (Res 3, Res 18, Res 14, Res 7 and Res 20), which are located in six hybrid micro circuits simultaneously manufactured on ceramic substrates. There are altogether 192 records for 32 ceramic plates.

### Usage

```
data(HADPAS)
```

### Format

A data frame with 192 observations on the following 7 variables.

diska ceramic plate, a numeric vector

hyb hybrid micro circuit, a numeric vector

res3 a numeric vector

res18 a numeric vector

res14 a numeric vector

res7 a numeric vector

res20 a numeric vector

### Source

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

### Examples

```
data(HADPAS)
```

```
boxplot(HADPAS$res3 ~ HADPAS$hyb)
```

---

HYBRID

*Resistance Values of Res 3*

---

### Description

A subset of data in HADPAS, only variable `res3` is recorded. HYBRID contains values for hybrids 1 to 3, HYBRID1 contains hybrid 1 data and HYBRID2 contains values of hybrids 1 and 2.

### Usage

```
data(HYBRID)
```

### Format

A data frame (a vector for HYBRID1) with 32 observations on the following variables.

hyb1 resistance measurements ( $\Omega$ ) of Res 3, a numeric vector

hyb2 resistance measurements ( $\Omega$ ) of Res 3, a numeric vector

hyb3 resistance measurements ( $\Omega$ ) of Res 3, a numeric vector

### Source

See [HADPAS](#)

### Examples

```
data(HYBRID)
```

```
lapply(HYBRID, var)
```

---

INSERTION

*Components Insertions into a Board*

---

### Description

Data represents a large number of insertions with  $k = 9$  different components. The result of each trial (insertion) is either Success (no insertion error) or Failure (insertion error).

### Usage

```
data(INSERTION)
```



**Format**

A data frame with 9 ( $k$ ) observations on the following 3 variables.

comp Component, a factor with levels C1 C2 C3 C4 C5 C6 C7 C8 C9

fail Failure, a numeric vector

succ Success, a numeric vector

**Details**

Components are:

C1: Diode

C2: 1/2 Watt Canister

C3: Jump Wire

C4: Small Corning

C5: Large Corning

C6: Small Bullet

C7: 1/8 Watt Dogbone

C8: 1/4 Watt Dogbone

C9: 1/2 Watt Dogbone

**Source**

See [PLACE](#)

**Examples**

```
data(INSERTION)

barplot(INSERTION$fail /
        (INSERTION$fail + INSERTION$succ) *
        100,
        names.arg=INSERTION$comp,
        ylab= "Percentage")
```

---

IPL

*Number of Computer Crashes per Month*

---

**Description**

Number of computer crashes per month, due to power failures experienced at a computer center, over a period of 28 months. After a crash, the computers are made operational with an "Initial Program Load".

**Usage**

```
data(IPL)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(IPL)
```

```
plot(IPL, type="b")
```

---

JANDEFECT

*January Number of Defects in Daily Samples*

---

**Description**

Number of defective items found in random samples of size  $n = 100$ , drawn daily from a production line in January.

**Usage**

```
data(JANDEFECT)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(JANDEFECT)
```

```
plot(JANDEFECT, type="b")
```

---

KEYBOARDS

*New Designs of Feyboards for Desktop Computers*

---

**Description**

The design of the keyboard might have effect on the speed of typing or on the number of typing errors. Noisy factors are typist or type of job. Letters A, B, C, D of variable keyboard denote the designs.

**Usage**

```
data(KEYBOARDS)
```

**Format**

A data frame with 25 observations on the following 4 variables.

typist The typist, a factor with levels 1 2 3 4 5

job The type of job, a factor with levels 1 2 3 4 5

keyboard Keyboard design, a factor with levels A B C D E

errors Number of typing errors, a numeric vector

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(KEYBOARDS)
```

```
boxplot(errors ~ keyboard, data=KEYBOARDS, ylab="Errors")
```

---

LATHYPPISTON

*Latin Hypercube Design for the Piston Simulator*

---

**Description**

A Latin Hypercube Design for the 7 pistonSimulation arguments and Its response in seconds.

**Usage**

```
data(LATHYPPISTON)
```

**Format**

A data frame with 14 observations on the following 8 variables.

`m` a numeric vector

`s` a numeric vector

`v0` a numeric vector

`k` a numeric vector

`p0` a numeric vector

`t` a numeric vector

`t0` a numeric vector

`seconds` a numeric vector

**Source**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**See Also**

[pistonSimulation](#)

**Examples**

```
data(LATHYPPISTON)

library(DiceEval)

library(DiceView)

Dice <- km(design=LATHYPPISTON[, !names(LATHYPPISTON) %in% "seconds"],
          response=LATHYPPISTON[, "seconds"])

sectionview(Dice,
            center=colMeans(LATHYPPISTON[, !names(LATHYPPISTON) %in% "seconds"]),
            conf_lev=c(0.5, 0.9, 0.95),
            title="", col_sur="darkgrey", lwd=2,
            Xname=colnames(LATHYPPISTON[, !names(LATHYPPISTON) %in% "seconds"]))

layout(1)
```

---

mahalanobisT2	<i>Mahalanobis <math>T^2</math></i>
---------------	-------------------------------------

---

**Description**

Mahalanobis  $T^2$  and Confidence Region

**Usage**

```
mahalanobisT2(x, factor.name, response.names = names(x)[!names(x) %in% factor.name],
  conf.level=0.95, compare.to = NA, plot = FALSE)
```

**Arguments**

x	a data frame
factor.name	single character indicating column name of the experiment factor to test, the first level is used as a reference
response.names	vector of characters indicating columns names of the responses
conf.level	confidence level for the Confidence Region
compare.to	a vector of length length(response.names) to be compared to the result in terms of Mahalanobis $T^2$
plot	logical, if TRUE also a plot is produced

**Value**

a list with components:

coord	matrix with transformed coordinates of variables in response.names
mahalanobis	vector containing Lower Control Region, Center and Upper Control Region of Mahalanobis $T^2$
mahalanobis.compare	single value, Mahalanobis $T^2$ of compare.to

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

Tsong et al, (1996).

**Examples**

```
data(DISS)

mahalanobisT2(DISS[, c("batch", "min15", "min90")],
              factor.name="batch",
              conf.level=0.90,
              compare.to=c(15, 15))
```

---

MPG

*Gasoline Consumption of Cars by Origin*

---

**Description**

Gasoline consumption (in miles per gallon in city driving) of cars by origin. There are 3 variables representing samples of sizes  $n_1 = 58$ ,  $n_2 = 14$  and  $n_3 = 37$ .

**Usage**

```
data(MPG)
```

**Format**

A data frame with 58 observations on the following 3 variables.

```
origin1 Gasoline consumption, a numeric vector
origin2 Gasoline consumption, a numeric vector
origin3 Gasoline consumption, a numeric vector
```

**Source**

See [CAR](#)

**Examples**

```
data(MPG)

library(boot)

set.seed(123)

B <- apply(MPG, MARGIN=2,
           FUN=boot,
           statistic=function(x, i){
             var(x[i], na.rm = TRUE)
           },
           R = 500)

Bt0 <- sapply(B,
```

```
FUN=function(x) x$t0)

Bt <- sapply(B,
             FUN=function(x) x$t)

Bf <- max(Bt0)/min(Bt0)

FBoot <- apply(Bt, MARGIN=1,
              FUN=function(x){
                max(x)/min(x)
              })

Bf

quantile(FBoot, 0.95)

sum(FBoot >= Bf)/length(FBoot)

rm(Bt0, Bt, Bf, FBoot)
```

---

OELECT

*Electric Voltage Outputs of Rectifying Circuits*

---

### Description

99 electric voltage outputs of a rectifying circuit ( $V$ ).

### Usage

```
data(OELECT)
```

### Source

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

### Examples

```
data(OELECT)
```

```
summary(OELECT)
```

```
mean(OELECT)
```

---

OELECT1

*Electric Voltage Outputs of Another Rectifying Circuit*

---

**Description**

25 electric voltage outputs of a rectifying circuit ( $V$ ).

**Usage**

```
data(OELECT1)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(OELECT)
```

```
data(OELECT1)
```

```
randomizationTest(list(a=OELECT, b=OELECT1),  
                  R=500, calc=mean,  
                  fun=function(x) x[1]-x[2])
```

---

OTURB

*Cycle Times of a Piston*

---

**Description**

100 cycle times ( $s$ ) of a piston, as from `pistonSimulation`.

**Usage**

```
data(OTURB)
```

**References**

See [pistonSimulation](#)

**Examples**

```
data(OTURB)
```

```
plot(OTURB, type="b")
```



---

OTURB1

*Cycle Times of a Piston from the Piston Simulator*

---

**Description**

50 cycle times (in *s*) of a piston generated with `pistonSimulation(seed=123)`. Cycle times are rounded to 3 decimals.

**Usage**

```
data(OTURB1)
```

**References**

See [pistonSimulation](#)

**Examples**

```
data(OTURB1)

REF <- round(pistonSimulation(seed=123)$seconds, 3)

plot(OTURB1, type="b", lwd=6)

lines(REF, col=2, lwd=2)

sum(OTURB1 - REF)
```

---

OTURB2

*Sample Mean and Standard Deviation of Cycle Times of a Piston*

---

**Description**

In this data frame we have three variables. In the first we have the sample size. In the second and third we have the sample means and standard deviation.

**Usage**

```
data(OTURB2)
```

**Format**

A data frame with 10 observations on the following 3 variables.

`groupSize` a numeric vector  
`xbar` a numeric vector  
`std` a numeric vector

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(OTURB2)
plot(OTURB2$xbar, type="b")
plot(OTURB2$std, type="b")
```

---

PBX

*Software Errors Found in Testing a PBX*

---

**Description**

Software errors found in testing a Private Branch Exchange electronic switch. Errors are labeled according to the software unit where they occurred (e.g. "EKT", Electronic Key Telephone).

**Usage**

```
data(PBX)
```

**Format**

The format is: Named num [1:5] 473 252 110 100 65 - attr(\*, "names")= chr [1:5] "GEN" "VHS" "HI" "LO" ...

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(PBX)
barplot(PBX)
```

---

pistonSimulation      *The Piston Simulator*

---

### Description

A simulator of a piston moving within a cylinder. The piston's performance is measured by the time it takes to complete one cycle, in seconds. Several factors can affect the piston's performance, they are listed in the arguments section.

### Usage

```
pistonSimulation(m = 60, s = 0.02, v0 = 0.01,
                 k = 5000, p0 = 110000, t = 296,
                 t0 = 360, each = 50, seed = NA,
                 check = TRUE)
```

### Arguments

m	the impact pressure determined by the piston weight ( <i>kg</i> ). A single value or a vector of length <i>n</i> .
s	the piston surface area ( $m^2$ ). A single value or a vector.
v0	the initial volume of the gas inside the piston ( $m^3$ ). A single value or a vector of length <i>n</i> .
k	the spring coefficient ( $N/m^3$ ). A single value or a vector of length <i>n</i> .
p0	the atmospheric pressure ( $N/m^2$ ). A single value or a vector of length <i>n</i> .
t	the surrounding ambient temperature ( <i>K</i> ). A single value or a vector of length <i>n</i> .
t0	the filling gas temperature ( <i>K</i> ). A single value or a vector of length <i>n</i> .
each	non-negative integer. Each element of previous parameters is repeated each times.
seed	a single value, interpreted as an integer. If specified make the simulation replicable.
check	if TRUE (the default) then a formal check on piston parameters is performed

### Details

Factors affect the Cycle Time *s* via a chain of nonlinear equations:

$$s = 2\pi \sqrt{\frac{M}{k + S^2 \frac{P_0 V_0}{T_0} \frac{T}{V^2}}}$$

where

$$V = \frac{S}{2k} \sqrt{A^2 + 4k \frac{P_0 V_0}{T_0} T - a}$$

and

$$A = P_0 S + 19.62M - \frac{kV_0}{S}$$

**Value**

A data frame, a matrix-like structure, with each \*  $n$  rows and with columns:

m	numeric	value of m
s	numeric	value of s
v0	numeric	value of v0
k	numeric	value of k
p0	numeric	value of p0
t	numeric	value of t
t0	numeric	value of t0
seconds	numeric	time to complete one cycle (s)

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**See Also**

[powerCircuitSimulation](#), [simulationGroup](#), [LATHYPISTON](#)

**Examples**

```
Ps <- pistonSimulation(
  m = rep(60, 100),
  s = rep(0.02, 100),
  v0 = rep(0.01, 100),
  k = rep(5000, 100),
  p0 = rep(110000, 100),
  t = c(rep(296, 35), 296*1.1^(1:65)),
  t0 = rep(360, 100),
  each = 1,
  seed = 123,
  check = FALSE)
head(Ps)
tail(Ps)
plot(Ps$seconds)
```

**Description**

The observations are the displacements (position errors) of electronic components on printed circuit boards. There are 26 boards. 16 components are placed on each board. Each component has to be placed at a specific location  $(x, y)$  on a board and with correct orientation  $\theta$ .

**Usage**

```
data(PLACE)
```

**Format**

A data frame with 416 observations on the following 4 variables.

crcBrd Circuit board number, a numeric vector  
xDev Error in placement along the  $x$ -axis, a numeric vector  
yDev Error in placement along the  $y$ -axis, a numeric vector  
tDev Error in orientation  $\theta$ , a numeric vector

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(PLACE)

plot(PLACE[, -1])

boxplot(xDev ~ crcBrd, data=PLACE,
        ylab="xDev", xlab="crcBrd")

PLACE$code <- factor(c(rep("lDev", 9*16),
                      rep("mDev", 3*16),
                      rep("hDev", 14*16)))

plot(PLACE[, "xDev"], PLACE[, "yDev"],
     pch=as.integer(PLACE[, "code"]),
     main="", xlab="xDev", ylab="yDev")

grid()
```

---

powerCircuitSimulation

*The Power Circuit Simulator*

---

## Description

A simulator of a voltage conversion power circuit. The target output voltage of the power circuit is 220 volts DC. The circuit consists of 10 resistances labeled *A* to *J*, and 3 transistors, labeled *K* to *M*. These components can be purchased with different tolerance grades.

## Usage

```
powerCircuitSimulation(rsA = 8200, rsB = 220000, rsC = 1000,
                      rsD = 33000, rsE = 56000, rsF = 5600,
                      rsG = 3300, rsH = 58.5, rsI = 1000,
                      rsJ = 120, trK = 130, trL = 100,
                      trM = 130,
                      tlA = 5, tlB = 10, tlC = 10,
                      tlD = 5, tlE = 5, tlF = 5,
                      tlG = 10, tlH = 5, tlI = 5,
                      tlJ = 5, tlK = 5, tlL = 10,
                      tlM = 5,
                      each = 50, seed = NA)
```

## Arguments

rsA	the resistance ( $\Omega$ ) of <i>A</i> . A single value or a vector of length <i>n</i> .
rsB	the resistance ( $\Omega$ ) of <i>B</i> . A single value or a vector of length <i>n</i> .
rsC	the resistance ( $\Omega$ ) of <i>C</i> . A single value or a vector of length <i>n</i> .
rsD	the resistance ( $\Omega$ ) of <i>D</i> . A single value or a vector of length <i>n</i> .
rsE	the resistance ( $\Omega$ ) of <i>E</i> . A single value or a vector of length <i>n</i> .
rsF	the resistance ( $\Omega$ ) of <i>F</i> . A single value or a vector of length <i>n</i> .
rsG	the resistance ( $\Omega$ ) of <i>G</i> . A single value or a vector of length <i>n</i> .
rsH	the resistance ( $\Omega$ ) of <i>H</i> . A single value or a vector of length <i>n</i> .
rsI	the resistance ( $\Omega$ ) of <i>I</i> . A single value or a vector of length <i>n</i> .
rsJ	the resistance ( $\Omega$ ) of <i>J</i> . A single value or a vector of length <i>n</i> .
trK	the resistance ( $\Omega$ ) of <i>K</i> . A single value or a vector of length <i>n</i> .
trL	the resistance ( $\Omega$ ) of <i>L</i> . A single value or a vector of length <i>n</i> .
trM	the resistance ( $\Omega$ ) of <i>M</i> . A single value or a vector of length <i>n</i> .
tlA	the tolerance of <i>A</i> . It is a number $> 0$ (e.g. 5% is 5.0)
tlB	the tolerance of <i>B</i> . It is a number $> 0$ (e.g. 5% is 5.0)
tlC	the tolerance of <i>C</i> . It is a number $> 0$ (e.g. 5% is 5.0)

t1D	the tolerance of $D$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1E	the tolerance of $E$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1F	the tolerance of $F$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1G	the tolerance of $G$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1H	the tolerance of $H$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1I	the tolerance of $I$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1J	the tolerance of $J$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1K	the tolerance of $K$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1L	the tolerance of $L$ . It is a number $> 0$ (e.g. 5% is 5.0)
t1M	the tolerance of $M$ . It is a number $> 0$ (e.g. 5% is 5.0)
each	non-negative integer. Each element of previous parameters is repeated each times.
seed	a single value, interpreted as an integer. If specified make the simulation replicable.

### Details

Factors affect the voltage output  $V$  via a chain of nonlinear equations:

$$V = \frac{136.67(a + \frac{b}{Z(10)}) + d(c + e)\frac{g}{f} - h}{1 + d\frac{e}{f} + b[\frac{1}{Z(10)} + 0.006(1 + \frac{13.67}{Z(10)})] + 0.08202a}$$

where

$$a = \frac{Z(2)}{Z(1) + Z(2)}$$

$$b = \frac{1}{Z(12) + Z(13)}(Z(3) + \frac{Z(1)Z(2)}{Z(1) + Z(2)}) + Z(9)$$

$$c = Z(5) + Z(7)/2$$

$$d = Z(11) \frac{Z(1)Z(2)}{Z(1) + Z(2)}$$

$$e = Z(6) + Z(7)/2$$

$$f = (c + e)(1 + Z(11))Z(8) + ce$$

$$g = 0.6 + Z(8)$$

$$h = 1.2$$

with  $Z(1), \dots, Z(10)$  resistances in  $\Omega$  of the 10 resistances and  $Z(11), Z(12), Z(13)$  are the  $h_{FE}$  values of three transistors.

**Value**

A data frame, a matrix-like structure, with each \*  $n$  rows and with columns:

rsA	numeric	value of rsA
rsB	numeric	value of rsB
rsC	numeric	value of rsC
rsD	numeric	value of rsD
rsE	numeric	value of rsE
rsF	numeric	value of rsF
rsG	numeric	value of rsG
rsH	numeric	value of rsH
rsI	numeric	value of rsI
rsJ	numeric	value of rsJ
trK	numeric	value of trK
trL	numeric	value of trL
trM	numeric	value of trM
t1A	numeric	value of t1A
t1B	numeric	value of t1B
t1C	numeric	value of t1C
t1D	numeric	value of t1D
t1E	numeric	value of t1E
t1F	numeric	value of t1F
t1G	numeric	value of t1G
t1H	numeric	value of t1H
t1I	numeric	value of t1I
t1J	numeric	value of t1J
t1K	numeric	value of t1K
t1L	numeric	value of t1L
t1M	numeric	value of t1M
volts	numeric	output in volts (V)

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**See Also**

[pistonSimulation](#), [simulationGroup](#)

**Examples**

```
powerCircuitSimulation(seed=123, each=3)
```



---

PRED

*Soldering Points*

---

### Description

1,000 records on variable  $x$  and  $y$ .  $x$  is the number of soldering points on a board, and  $y$  is the number of defective soldering points.

### Usage

```
data(PRED)
```

### Format

A data frame with 1000 observations on the following 2 variables.

$x$  Number of soldering points, a numeric vector

$y$  Number of defective soldering points, a numeric vector

### Details

Electronic systems such as television sets, radios or computers contain printed circuit boards with electronic components positioned in patterns determined by design engineers. After assembly (either by automatic insertion machines or manually) the components are soldered to the board. In the relatively new Surface Mount Technology minute components are simultaneously positioned and soldered to the boards. The occurrence of defective soldering points impacts the assembly plant productivity and is therefore closely monitored

### Source

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

### Examples

```
data(PRED)
```

```
library(boot)
```

```
set.seed(123)
```

```
YRatioPred <- boot(data=PRED$x,  
                  statistic=function(x,i){  
                    mean(x[i[1:100]])*7.495/148.58  
                  },  
                  R=1000)$t
```

```
hist(YRatioPred, main="",  
     xlab="",  
     xlim=c(7, 8))
```

---

randomizationTest      *Randomization Test*

---

### Description

A function to perform randomization test

### Usage

```
randomizationTest(list, R = 500, calc, fun = NA,  
                  seed = NA, printSummary = TRUE)
```

### Arguments

list	a list with two or more numeric vectors
R	
calc	a function to be applied to every vector in list
fun	a function to be applied to a vector (e.g. x) of length length(list), containing result of function calc
seed	a single value, interpreted as an integer. If specified make the simulation replicable.
printSummary	logical, if TRUE print a summary of the randomization test

### Value

The silently returned value is an object of class "boot"

### Author(s)

Daniele Amberti

### References

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

### See Also

[boot](#)

**Examples**

```

data(OELECT)
data(OELECT1)

# test difference in mean:
randomizationTest(list(a=OELECT, b=OELECT1),
                  R=500, calc=mean,
                  fun=function(x) x[1]-x[2],
                  seed=123)

```

---

renewDis	<i>Renewals Distribution</i>
----------	------------------------------

---

**Description**

Provide the Empirical Bootstrap Distribution of the number of renewals in a specified time interval.

**Usage**

```
renewDis(ttf, ttr, time, n, printSummary = TRUE)
```

**Arguments**

ttf	numeric vector of Time To Failure
ttr	numeric vector of Time To Repair
time	numeric value representing the time horizon on which number of renewals are calculated
n	the number of bootstrap replicates
printSummary	logical, if TRUE print the Mean Number of Renewals, and a summary of renewals values

**Value**

A numeric vector of length n with simulated number of renewals

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**See Also**

[availDis](#)

**Examples**

```
set.seed(123)

Ttf <- rgamma(50,
             shape=2,
             scale=100)

Ttr <- rgamma(50,
             shape=2,
             scale=1)

RenewEbd <- renewDis(ttf=Ttf,
                    ttr=Ttr,
                    time=1000,
                    n=1000)
```

---

RNORM10

*Random Sample from  $N(10, 1)$*

---

**Description**

Random sample of size  $n = 28$  from the normal distribution  $N(10, 1)$ .

**Usage**

```
data(RNORM10)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(RNORM10)

plot(RNORM10, type="b")

abline(h=10, lwd=2, col=2)
```

shroAr1PfaCed

*ARL, PFA and CED of Shiriyayev-Roberts procedure***Description**

Average Run Length, the Probability of False Alarm and the Conditional Expected Delay, given that the alarm is given after the change-point for Normal and Poisson cases

**Usage**

```
shroAr1PfaCedNorm(mean0 = 0, mean1 = NA, sd = 1, n = 10,
                  delta = 1, tau = NA, N = 100, limit = 10000,
                  seed = NA, w = 19, printSummary = TRUE)
```

```
shroAr1PfaCedPois(lambda0 = 10, lambda1 = NA, delta = 1,
                  tau = NA, N = 100, limit = 10000, seed = NA,
                  w = 19, printSummary = TRUE)
```

**Arguments**

mean0	value of the mean of a normal distributed process
mean1	optional value of the mean after a shift in a normal process, ignored if del ta is not NA
sd	standard deviation of a normal distributed process
n	sample size
lambda0	mean of a Poisson distributed process
lambda1	optional value of the mean after a shift in a Poisson process, ignored if del ta is not NA
delta	value of the shift from mean0 or lambda0, set to NA if the alternative specification with mean1 or lambda1 is needed
tau	location of the point of change in the process parameter mean0 or lambda0, if NA simulation is perfomed without any shift: mean1, lambda1 and delta are ignored
N	the number of replicates
limit	safety parameter, stop rule for procedures with very long ARL
seed	a single value, interpreted as an integer. If specified make the simulation repli-cable.
w	Shiryayev-Roberts statistics used as the stopping threshold
printSummary	logical, if TRUE print a summary of the Shiriyayev-Roberts ARL, PFA and CED

**Value**

a list with elements:

rls	a numeric vector representing the Run Length of the simulation
statistics	a numeric vector with summary statistics
run	a list of length N elements each of which has single numeric elements violationLower, violationUpper and rl

**Author(s)**

Daniele Amberti

**References**

Kenett, R., Zacks, S. with contributions by Amberti, D. *Modern Industrial Statistics: with applications in R, MINITAB and JMP*. Wiley.

**Examples**

```
shroAr1PfaCedNorm(mean0=10,
                   sd=3,
                   n=5,
                   delta=0.5,
                   tau=10,
                   w=99,
                   seed=123)
```

```
shroAr1PfaCedPois(lambda0=5,
                   delta=0.5,
                   tau=10,
                   w=99,
                   seed=123)
```

```
shroAr1PfaCedNorm(mean0=15,
                   sd=3,
                   n=5,
                   delta=0.5,
                   tau=NA,
                   w=99,
                   seed=123)
```

---

simulationGroup

*Simulation Group*

---

**Description**

Add a column named group to an object of class "mistatSimulation".

**Usage**

```
simulationGroup(x, n)
```

**Arguments**

x                    an object of class "mistatSimulation"  
n                    size of the group or sample

**Value**

Add a column named group to an object of class "mistatSimulation".

**Author(s)**

Daniele Amberti

**See Also**

[pistonSimulation](#), [powerCircuitSimulation](#)

**Examples**

```
simulationGroup(pistonSimulation(each=20), 5)  
simulationGroup(powerCircuitSimulation(each=20), 5)
```

---

SOCELL

*Short Circuit Current of Solar Cells*

---

**Description**

Short circuit current (ISC) of 16 solar cells measured at three time epochs, one month apart.

**Usage**

```
data(SOCELL)
```

**Format**

A data frame with 16 observations on the following 3 variables.

t1 ISC at time epoch 1, a numeric vector

t2 ISC at time epoch 2, a numeric vector

t3 ISC at time epoch 3, a numeric vector

**Details**

Telecommunication satellites are powered while in orbit by solar cells. Tadicell, a solar cells producer that supplies several satellite manufacturers, was requested to provide data on the degradation of its solar cells over time. Tadicell engineers performed a simulated experiment in which solar cells were subjected to temperature and illumination changes similar to those in orbit and measured the short circuit current ISC (ampers), of solar cells at three different time periods, in order to determine their rate of degradation.

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(SOCELL)

LmISC <- lm(t2 ~ 1 + t1,
           data=SOCELL)

summary(LmISC)
```

---

SOLDEF

*Solder Defects*

---

**Description**

Solder defects on 380 printed circuits boards of varying size.

**Usage**

```
data(SOLDEF)
```

**Details**

In SOLDEF we present results of testing batches of circuit boards for defects in solder points, after wave solderings. The batches includes boards of similar design. There were close to 1,000 solder points on each board. The results  $X_t$  are number of defects per  $10^6$  points (*PPM*). The quality standard is  $\lambda_0 = 100$  (*PPM*).  $\lambda_t$  values below  $\lambda_0$  represent high quality soldering. In this data file there are  $N = 380$  test results. Only 78 batches had an  $X_t$  value greater than  $\lambda_0 = 100$ .

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.



**Examples**

```
data(SOLDEF)
```

```
hist(SOLDEF)
```

---

STEELROD

*50 Measurements of the Length of Steel Rods in cm*

---

**Description**

Steel rods are used in the car and truck industry to strengthen vehicle structures. Steel rods supplied by Urdon Industries are produced by a process adjusted to obtain rods of length 20 cm. However, due to natural fluctuations in the production process, the actual length of the rods varies around the nominal value of 20 cm.

**Usage**

```
data(STEELROD)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(STEELROD)
```

```
plot(STEELROD,  
      ylab = "Steel rod Length",  
      xlab = "Index")
```

---

STRESS

*Stress Levels*

---

**Description**

Results of a 33 factorial experiment to investigate the effects of three factors  $A, B, C$  on the stress levels of a membrane  $Y$ . The first three columns of the data provide the levels of the three factors, and column 4 presents the stress values.

**Usage**

```
data(STRESS)
```

**Format**

A data frame with 27 observations on the following 4 variables.

A levels of factor *A*, a numeric vector

B levels of factor *B*, a numeric vector

C levels of factor *C*, a numeric vector

stress stress levels of a membrane *Y*, a numeric vector

**Source**

Oikawa and Oka (1987)

**Examples**

```
data(STRESS)

summary(
  aov(stress ~ (A+B+C)^3 + I(A^2)+I(B^2)+I(C^2),
      data=STRESS))
```

---

THICKDIFF

*Difference in Thickness*

---

**Description**

Difference between the thickness of the grown silicon layer and its target value.

**Usage**

```
data(THICKDIFF)
```

**Source**

E. Yashchin (1991)

**Examples**

```
data(THICKDIFF)

plot(THICKDIFF, type="b")
```

---

TSQ	<i>T<sup>2</sup> values of PLACE data</i>
-----	---

---

**Description**

368  $T^2$  values corresponding to the vectors  $(x, y, \theta)$  of displacements (position errors) of electronic components on printed circuit boards.

**Usage**

```
data(TSQ)
```

**Source**

See [PLACE](#)

**Examples**

```
data(TSQ)
plot(TSQ, type="b")
```

---

VENDOR	<i>Number of cycles required until latch failure</i>
--------	--

---

**Description**

Number of cycles required until latch failure in 30 floppy disk drives from three different disk vendors.

**Usage**

```
data(VENDOR)
```

**Format**

A data frame with 10 observations on the following 3 variables.

vendor1 number of cycles required until latch failure for vendor  $A_1$ , a numeric vector

vendor2 number of cycles required until latch failure for vendor  $A_2$ , a numeric vector

vendor3 number of cycles required until latch failure for vendor  $A_3$ , a numeric vector

### Details

Three different vendors are considered for supplying cases for floppy disk drives. The question is whether the latch mechanism that opens and closes the disk loading slot is sufficiently reliable. In order to test the reliability of this latch, three independent samples of cases, each of size  $n = 10$ , were randomly selected from the production lots of these vendors. The testing was performed on a special apparatus that opens and closes a latch, until it breaks. The number of cycles required until latch failure was recorded. In order to avoid uncontrollable environmental factors to bias the results, the order of testing of cases of different vendors was completely randomized. In data VENDOR there are the results of this experiment, arranged in 3 columns. Column 1 represents the sample from vendor  $A_1$ ; column 2 that of vendor  $A_2$  and column 3 of vendor  $A_3$ .

### Source

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

### Examples

```
data(VENDOR)

VENDOR <- stack(VENDOR)

VENDOR$ind <- as.factor(VENDOR$ind)

VENDOR$values <- sqrt(VENDOR$values)

confint(lm(values ~ -1 + ind,
           data=VENDOR))
```

---

WEIBUL

*Random sample from a Weibull distribution*

---

### Description

Values of a random sample of size  $n = 50$  from a Weibull distribution.

### Usage

```
data(WEIBUL)
```

### Source

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(WEIBUL)
```

```
hist(WEIBUL)
```

---

YARNSTRG

*Yarn strength*

---

**Description**

Yarn strength is typically analyzed on a logarithmic scale. This logarithmic transformation produces data that is more symmetrically distributed. In YARNSTRG data there are  $n = 100$  values of  $Y = \ln(X)$  where  $X$  is the yarn-strength in *lb./22yarns* of woolen fibers.

**Usage**

```
data(YARNSTRG)
```

**Source**

Kenett, R. and Zacks, S. (1998) *Modern Industrial Statistics: The Design and Control of Quality and Reliability*. Duxbury Press.

**Examples**

```
data(YARNSTRG)
```

```
hist(YARNSTRG,  
     breaks=6,  
     main="",  
     xlab = "Log yarn strength")
```

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