OAT-I
Orientation Analysis Toolbox I

Version 1.2

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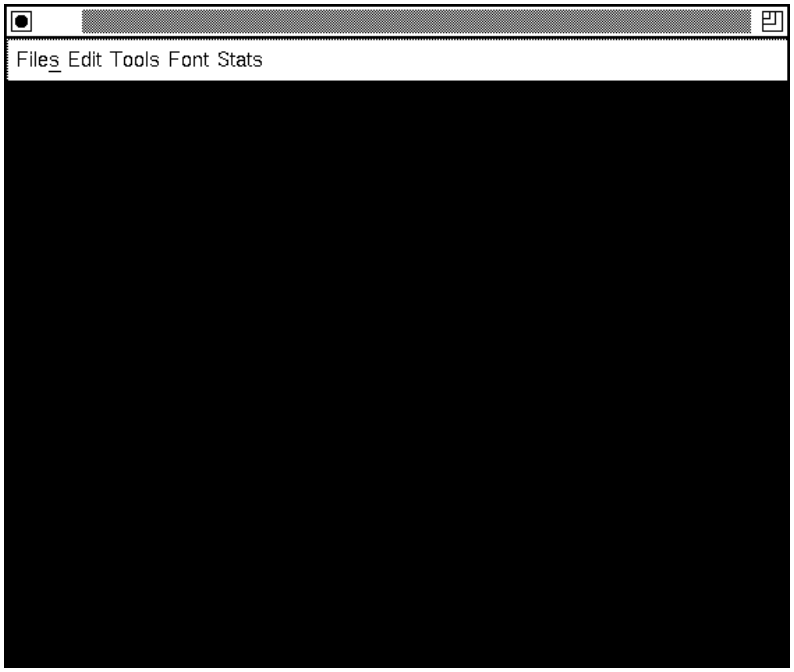
Contents

Chapter 1

Introduction

Writing `circlesh` in the Command Window invokes the Graphics interface. The result should be similar to what is shown in the figure below.

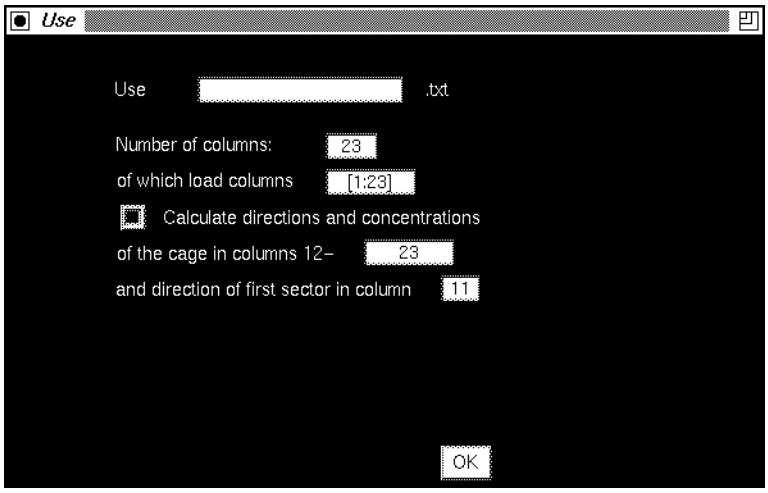


1.1 Loading data

The user should select

`Use file`

in the `Files` menu.



1.2 Explanations

The command `Use file` in the `Files` menu

1. extracts the variable names from the first row in the XL (.txt) document,
2. divides the XL (.txt) document into a number of columns (variables) with names interml.v1, interml.v2 etc.
3. optionally calculates various cage characteristics.

1.3 Variable names

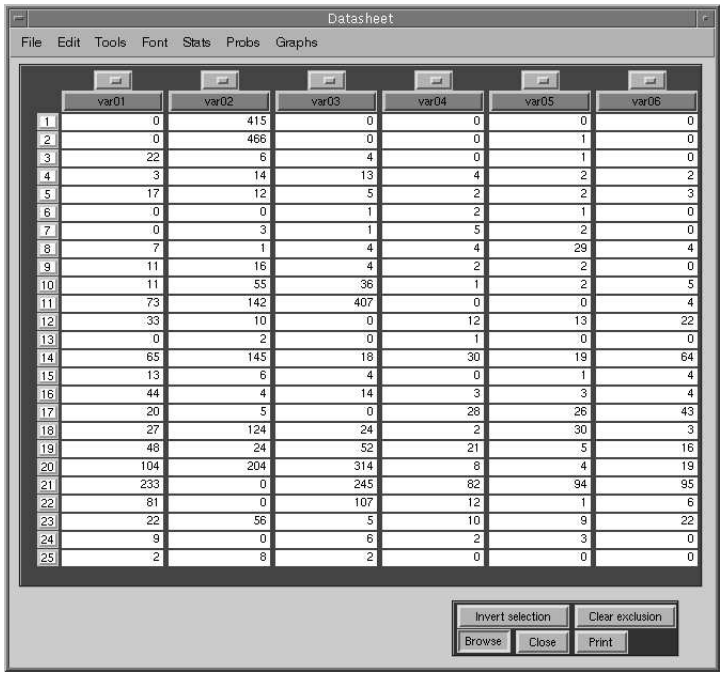
The variable names are extracted from the first row of the XL spreadsheet.
The command

`var`

shows the names of the variables. The command `var(5)` gives the name of variable number 5.

1.4 The data sheet

The data sheet is shown in Figure 1.1. The data sheet consists of data on a number of variables for each of a number of cases. Each case has a number and each variable has a variable name and a variable number. Each data cell can be referred to by case number and variable number. For example `X(3,5)` refer to the value of the 3rd case and 5th variable.



	var01	var02	var03	var04	var05	var06
1	0	415	0	0	0	0
2	0	466	0	0	1	0
3	22	6	4	0	1	0
4	3	14	13	4	2	2
5	17	12	5	2	2	3
6	0	0	1	2	1	0
7	0	3	1	5	2	0
8	7	1	4	4	29	4
9	11	16	4	2	2	0
10	11	55	36	1	2	5
11	73	142	407	0	0	4
12	33	10	0	12	13	22
13	0	2	0	1	0	0
14	65	145	18	30	19	64
15	13	6	4	0	1	4
16	44	4	14	3	3	4
17	20	5	0	28	26	43
18	27	124	24	2	30	3
19	48	24	52	21	5	16
20	104	204	314	8	4	19
21	233	0	245	82	94	95
22	81	0	107	12	1	6
23	22	56	5	10	9	22
24	9	0	6	2	3	0
25	2	8	2	0	0	0

Figure 1.1: *Figure 1.1*

1.5 Selecting subsamples

For example

```
U=(X(:,5)==2)
[Y,sample]=select(X,U)
```

selects those rows such that variable nr 5 is equal to 2.

Criteria can be concatenated using `&`. For example

```
U=(X(:,5)==2)&(X(:,7)>=10)
[Y,sample]=select(X,U)
```

selects those rows such that variable 5 is equal to 2 and variable 7 is at least 10.

Alternative criteria can be assigned using |. For example

```
U=(X(:,5)==2)|(X(:,7)>=10)
[Y,sample]=select(X,U)
```

selects those rows such that variable 5 is equal to 2 or variable 7 is at least 10. Both & and | can be used in the same criteria. Remember that & has higher priority than |:

```
U=(X(:,5)==2)|(X(:,7)>=10)&(X(:,8)<=4)
[Y,sample]=select(X,U)
```

selects those rows such that variable 5 is equal to 2 or (variable 7 is at least 10 and variable 8 is at most 4), e.g. a row (individual) is selected e.g. if variable 7 is 11 and variable 8 is 1.2 or if variable 5 is 2.

1.5.1 Menu driven selection

In version 1.2 or later the slection of subsamples can be obtained by suitable options from the menu.

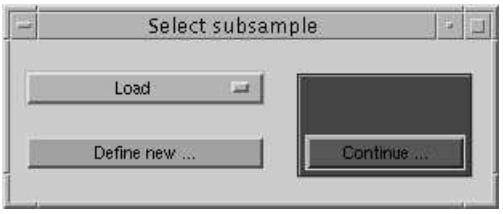


Figure 1.2: *Figure 1.2*

By using **Load**, previously defined subsamples can be selected. Each of the previously defined subsamples have a unique name.

1.6 Hierarchy

In this section we describe the stucture (hierarchy) of the different tests and methods given. The primary choice in the **Stats** menu is between univariate statistics, multivariate statistics and circular statistics (Fig 1.3).

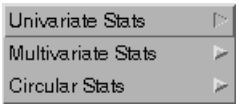


Figure 1.3: *Figure 1.3: Stats*

1.6.1 Univariate statistics

Among the univariate statistics, choose between one sample, two samples and multi samples etc., cf Fig 1.4.

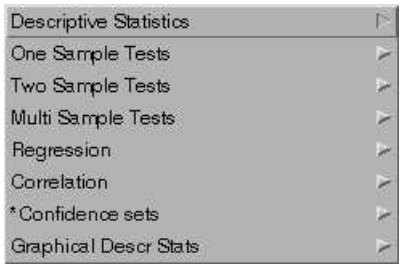


Figure 1.4: *Figure 1.4: Stats > Univariate Stats*

1.6.2 Multivariate statistics

The multivariate statistics have the following choices:

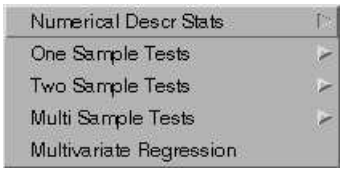


Figure 1.5: *Figure 1.5: Stats > Multivariate Stats*

The one sample tests have the following options (see Figure 1.6):

Figure 1.6: *Figure 1.6: Stats > Multivariate Stats > One Sample Tests*

At this moment there is only one choice. This is the one-sample Hotelling's T^2-test.

The two samples tests have the following options (see Figure 1.7):

At this moment there is only one choice. This is the two-sample Hotelling's T^2-test.

The multi samples tests have the following options (see Figure 1.8):

Figure 1.7: *Figure 1.7: Stats > Multivariate Stats > Two Sample Tests*

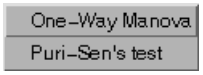


Figure 1.8: *Figure 1.8: Stats > Multivariate Stats > Multi Sample Tests*

1.6.3 Circular statistics

The circular statistics have the following choices:

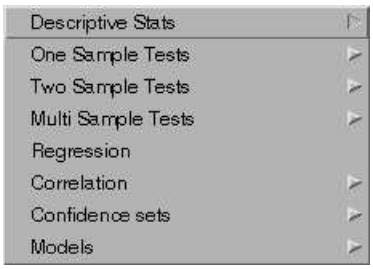


Figure 1.9: *Figure 1.9: Stats > Circular Stats*

The one-sample test have the following choices:
The different one-sample test for uniformity are (see Figure 1.11):

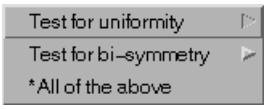


Figure 1.10: *Figure 1.10: Stats > Circular Stats > One Sample Tests*

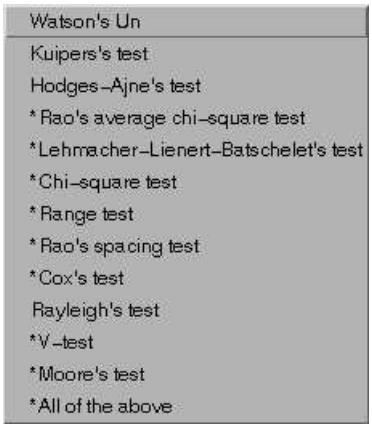


Figure 1.11: *Figure 1.11: Stats > Circular Stats > One Sample Tests > Tests for uniformity*

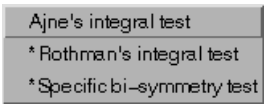


Figure 1.12: *Figure 1.11: Stats > Circular Stats > One Sample Tests > Tests for bi-symmetry*

Chapter 2

Tutorial

The Orientation Analysis Toolbox I for use with MATLAB, supplies statistical capability of orientation data on the intermediate and advanced level.

The Orientation Analysis Toolbox I has a large number of M-files in 5 basic categories.

Introduction

The central features of the Orientation Analysis Toolbox I are functions for

- parametric hypothesis testing
- non-parametric hypothesis testing
- parametric estimation
- analysis of circular data

Continuous	Discrete
von Mises	
wrapped Cauchy	

Overview of the Distributions

Measure of Central Direction

The following measures are available in the Orientation Analysis Toolbox to characterize centrality (direction) of data.

Measures of Direction	
`circmed`	Circular median direction.
`circmean`	Circular mean direction.
`circaxis`	Circular axial direction.

Centrality (location) can be described in various ways. The circular mean and the circular median are different measures of directional location.

The circular mean is defined by

$$\bar{\theta} = \text{atan2}(\sum_{i=1}^{n} \cos\theta_i, \sum_{i=1}^{n} \sin\theta_i)$$

The circular median $\tilde{\theta}$ is defined by

$$\left\lceil \frac{n+1}{2} \right\rceil \leq N(\tilde{\theta}) \leq \left\lceil \frac{n}{2} \right\rceil + 1$$

Measure of Directional Dispersion

The following measures are available in the Orientation Analysis Toolbox to characterize the dispersion (spread) of data.

Measures of Dispersion	
`circvar`	Circular variance.
`sphervar`	Spherical variance.

The circular variance of circular data is given by

$$D = 1 - \bar{r}.$$

where

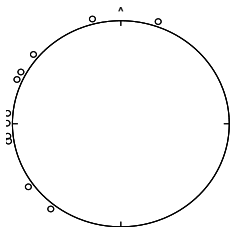
$$\bar{r}. = \sqrt{(\sum_{i=1}^{n} \cos\theta_i)^2 + (\sum_{i=1}^{n} \sin\theta_i)^2}/n$$

The half-circle dispersion is defined by $1 - \frac{1}{n}V(\hat{\theta})$ and the half-circle concentration, $\frac{1}{n}V(\hat{\theta})$.

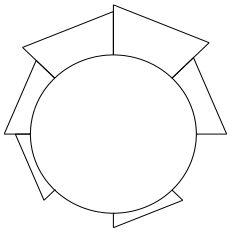
The Orientation Analysis Toolbox I adds specialized plots to the graphic capabilities of MATLAB.

Circular plots are graphs for sample description of circular data.

Circular Case Plot



Circular Histogram



Rose diagram

Hypothesis testing plays an important part in statistical analysis.

Tests	
`ajneAn`	Ajne's A_n-test.
`chi2`	Chi-square significance and homogeneity test.
`hodgajne`	Hodges-Ajne's test for uniformity.
`kuiper`	Kuiper's test for equality in distribution.
`maag`	Maag's U_k-test.
`mardia`	Mardia's test for equal concentration.
`maxspace`	Maximum spacing test for uniformity
`raospace`	Rao's spacing test for uniformity
`raytest`	Rayleigh test for uniformity
`vtest`	Modified Rayleigh test for uniformity
`watsonu2`	Watson's U^2-test.
`watsonun`	Watson's U_n-test.

Pearson's chi-square test

The Pearson chi-square statistic for one sample calculates

$$Q = \sum_{i=1}^{s} \frac{(y_i - np_i)^2}{np_i}$$

where $\sum y_i = n$, is used for testing the hypothesis that data is in conformity with the cell probabilities $p_1, \ldots, p_s$. The statement

```
Q=chi2(y,p)
```

returns the calculated chi-square test statistic of the sample `y`.

A vector `y` of cell observation can be obtained from a sample `x` by classifying into disjunct intervals. E.g

```
y=nofcases(x,[20,40,60],'split')
```

returns in the 4 by 1 vector `y` the number of values of `x` in the intervals $(-\infty, 20], (20, 40], (40, 60], (60, \infty)$.

The Pearson chi-square statistic for several samples calculates the statistic

$$Q = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(y_{ij} - np^*_{i\cdot}p^*_{\cdot j})^2}{np^*_{i\cdot}p^*_{\cdot j}}$$

where $\sum y_{ij} = n$, $p^*_{i\cdot} = \sum_j y_{ij}/n$ and $p^*_{\cdot j} = \sum_i y_{ij}/n$. It is used for testing the hypothesis that the distributions of the rows of y_{ij} are homogeneous.

The command

```
Q=chi2(Y)
```

returns the calculated chi-square test statistic of the sample `Y`.

Chapter 3

Reference

The Orientation Analysis Toolbox I provide 5 main categories of functions. These categories appear in the table below.

The Orientation Analysis Toolbox's Main Categories of Functions	
distributions	Probability distribution functions.
descriptive	Descriptive statistics for data samples.
plots	Statistical plots.
circular	Fitting circular models to data.
hypotheses	Statistical tests of hypotheses.

The following pages contain tables of functions from each of these specific areas. The first 3 tables contain probability distribution functions. The remaining tables descibe the other four categories of functions.

Cumulative Distribution Functions (cdf)	
wccdf	wrapped Cauchy cdf.

Probability Mass Functions (pmf)	
wsrpmf	
s1unif	

Probability Density Functions (pdf)	
vonmises	von Mises pdf.
wcpdf	Wrapped Cauchy pdf.

Percentiles	
chi2pct	Chi-square upper percentile.
raypct	Rayleigh statistic upper percentile.
vpct	Modified Rayleigh statistic upper percentile.

Descriptive Statistics	
circaxis	Circular axis direction.
circmean	Circular mean direction.
circmed	Circular median direction.
circvar	Circular variance.
Atheta	
N	half circle number of cases.
r	Mean vector length
r1	Mean vector length
r2	Mean vector length of doubled angles
rmax	
s2axis	
s2mean	
s2median	
s2range	

Statistical Plots	
circplot	Circular case plot.
sectplot	Circular histogram plot.
s2hist	Circular histogram plot.
s2plot	Circular function plot.
s2cplot1	One-way classification circular case plot.

Random Number Generators	
randfish	Unit sphere Fisher random numbers
rands2	Unit circle uniform random numbers
rands3	Unit sphere uniform random numbers
randvm	Von Mises random numbers
randwatg	Unit sphere Watson girdle random numbers
randwc	multimodal wrapped Cauchy random numbers
randvmam	

Circular Models	
`vmod, x`	Directional correlation.
`vmodp`	Multiple directional correlations.
`raymod, r`	Directional clustering.
`raymodp`	Multiple directional clustering.
`pcdmod`	Directional correlation and clustering.

Hypothesis Tests	
`ajneAn`	Ajne's integral test.
`broken`	
`chi2`	Chi-square significance and homogeneity test.
`hodgajne`	Hodges-Ajne's test for uniformity
`kuiper`	Kuiper's test.
`maag`	Maag's U_k test.
`mardia`	Mardia's test.
`maxspace`	Maximum spacing test (circular).
`raospace`	Rao's spacing test (circular).
`raytest`	Rayleigh test.
`vtest`	Modified Rayleigh test.
`watsonu2`	Watson's U^2 test.
`watsonun`	Watson's U_n test.

Regression, correlation
`circreg`
`circreg1`
`lccorrI`
`lccorrII`
`lincorr`
`mardiacor`
`mardiacrp`
`moore`
`sphreg`

Menu shells	
`circlesh`	Menu shell for circular plots and analysis.
`tabmenu`	Menu shell for tabular printouts.
`selmenu`	Menu shell for selection criteria.
`usemenu`	Menu shell for selection criteria.

Varia	
aktiv	....
buildtab	....
chkld	....
chi2sim	....
dir2rk	....
dotest	Evaluate test probability.
fac	Factorial.
fnifn	....
i0	Modified bessel function of first kind and order 0.
i1	Modified bessel function of first kind and order 1.
lexico	....
permut	....
sector	....
spin	....
sect2rk	....
tabell	....
vnrld	....
fpct	Snedecor's F upper percentile (small df's nonxact)
classify	Classify vector into categories.
nofcases	Calculate cases in categories.
valuesof	Enumerate different values of a vector.
valunion	Set union of discrete sets.
circclassif	....
s2classif	....

Tables	
raytest.tab	Mardia Table 2.6.
vtest.tab	Mardia Table 2.4.

```
File name

Save table as

Variables:
```

Purpose

Ratio of the modified Bessel function of first kind of order 1 to order 0.

Synopsis

```
A(k)
```

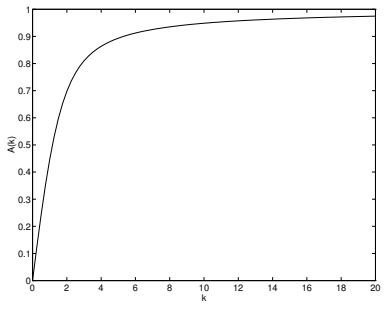
Description

For vector or matrix `k`, `A(k)` returns a vector or matrix of function values.

Examples

Plot the function $A(\cdot)$.

```
x=[0:0.25:20];
plot(x,A(x))
```



Algorithm

```
A(k)=I1(k)./I0(k)
```

See Also

`I1, I0`

Ainv, ainv

Purpose

Calculate the inverse function of `A`.

Synopsis

```
Ainv(r)
```

Description

For vector or matrix `r`, `Ainv(r)` returns a vector or matrix of function values.

Examples

Plot the function $A^{-1}(\cdot)$.

```
x=[0:0.05:0.95];
plot(x,Ainv(x))
```

See Also

`A, I1, I0`

broken

Purpose

Broken axis analysis.

Synopsis

```
[r,k,n,a1,a2,a]=broken(x)
```

References

Holmquist, B. and Sandberg, R. (1991). The broken axis approach – a new way to analyze bi-directional circular data. Experientia 47, 845-851.

Purpose

Calculate the axial mean direction and concentration of a circular sample.

Synopsis

```
[a,r]=circaxis(x)
```

Description

If `x` is a vector of angular directions, in degrees, `circaxis(x)` calculates the cos and sin of the mean axis.

See Also

`circmean`

Purpose

Synopsis

```
circle
```

Description

Examples

Algorithm

See Also

References

Purpose

Generate a menu shell for circular analysis.

Synopsis

```
circlesh
```

Description

Examples

Algorithm

See Also

References

Purpose

Calculates mean direction and concentration and confidence interval for mean direction of a circular sample.

Synopsis

```
[A,r]=circmean(x)
[A,r,n]=circmean(x)
[A,r,n,c]=circmc(x)
[A,r,n,c]=circmc(x,qnt)
```

Description

`[A,r]=circmean(x)` calculates the circular mean and concentration of the angles in `x` given in degrees. The cosine and sine of mean direction are given in `A(1)` and `A(2)`, and the concentration is given in `r`.

`[A,r,n]=circmean(x)` calculates the circular mean and concentration of the angles in `x` given in degrees. The cosine and sine of mean direction are given in `A(1)` and `A(2)`, and the concentration is given in `r`. The number of angles are given in `n`.

`[A,r,n,c]=circmc(x)` calculates the circular mean and concentration of the angles in `x` given in degrees. The cosine and sine of mean direction are given in `A(1)` and `A(2)`, and the concentration is given in `r`. In `c(1)` and `c(2)` are given values such that $(c(1), c(2))$ is a approximate confidence interval.

See Also

`circaxis, circmean`

Purpose

Calculates median direction and concentration and confidence interval for median direction of a circular sample.

Synopsis

```
[med,d,n,thr,ths]=circmed(x)
[med,d,n,thr,ths]=circmed(x,qnt)
```

Description

`[med,d,n,thr,ths]=circmed(x)` calculates the circular median and concentration of the angles given in degrees in `x` and with confidence level `qnt`. `med` is a median direction, `thr, ths` are the limits of a confidence set for the median direction.

See Also

`circaxis, circmean`

Purpose

Plot a circular diagram.

Synopsis

```
circplot(x)
circplot(x,'deg',pos)
circplot(x,'deg',pos,tot)
```

Description

`circplot(x,'deg',0)` or `circplot(x,'deg')` plots a circular diagram based on the angles given in `x`.

`circplot(x,'deg',2)` plots a circular diagram in position 2 (of a total 6) based on the angles given in `x`.

`circplot(x,'deg',2,tot)` plots a circular diagram in position 2 (of a total `tot`) based on the angles given in `x`.

See Also

`s2cplot1`

Purpose

Calculate the circular variance of circular data.

Synopsis

```
circvar(th)
circvar(x,y)
circvar(X)
```

Description

`circvar(theta)` calculates the circular variance of the data with directions in degrees given by `theta`.

`circvar(x,y)` calculates the circular variance of the data whose cosine are in `x` and sine in `y`.

`circvar(X)` calculates the circular variance of the data whose cosine are in `X(:,1)` and sine in `X(:,2)`.

Examples

Calculate the circular variance of a uniform sample of size 10 on the circle:
`circvar(rands2(10))`

Calculate the circular variance of a sample of size 10 from the von Mises distribution $M(2, 20)$ on the circle:
`circvar(randvm(2,20,10))`

Algorithm

`circvar(theta)` can be described as
`n=length(theta); x=cos(theta); y=sin(theta);`
`circvar(theta)=1-sqrt(sum(x)^ 2+sum(y)^ 2)/n`

`circvar(x,y)` can be described as
`n=length(x); circvar(x,y)=1-sqrt(sum(x)^ 2+sum(y)^ 2)/n`

`circvar(X)` can be described as
`[n,two]=size(X); circvar(X)=1-sqrt(sum(X)*sum(X)')/n`

See Also

`circmean`

Purpose

Classify a vector into categories.

Synopsis

```
classify(x,f,'equal')
classify(x,f,'split')
classify(x,F)
[a,b]=classify(x,f,'equal')
[a,b]=classify(x,f,'split')
[a,b]=classify(x,F)
```

Description

`classify(x,f,'equal')` returns the category number of the values of `x` with categories in `f`.

Examples

```
classify([1,3,1,2,1,2,3],[3,1,2],'equal')
```
returns `[2,1,2,3,2,3,1]`.

```
classify([1,3,1,4,1,2,3],[3,1,2],'equal')
```
returns `[2,1,2,0,2,3,1]`.

```
classify([6,8,6,9,6,7,8],[8,6,7],'equal')
```
returns `[2,1,2,0,2,3,1]`.

```
classify([1,3,1,2,1,2,3],[1.5],'split')
```
returns `[1,2,1,2,1,2,2]`.

```
classify([1,3,1,2,1,2,3],[2],'split')
```
returns `[1,2,1,1,1,1,2]`.

See Also

`nofcases, valuesof`

Purpose

The modified Bessel function of first kind of order 0.

Synopsis

```
I0(k)
```

Description

For vector `x`, `I0(x)` returns a vector of function values.

Examples

Plot the modified Bessel function of the first kind and order 0:

```
x=[0:0.25:10];
plot(x,I0(x))
```

Algorithm

```
I0(k)=bessel(0,i*k)
```

See Also

`A`, `I1`

I1, i1

Purpose

The modified Bessel function of first kind of order 1.

Synopsis

```
I1(k)
```

Description

For vector `x`, `I1(x)` returns a vector of function values.

Algorithm

```
I1(k)=-i*bessel(1,i*k)
```

See Also

`A, I0`

Purpose

Performs Hodges-Ajne's test for uniformity.

Synopsis

```
[Nmax,P,Pa]=hodgajne(x)
```

Description

`[Nmax]=hodgajne(x)` calculates the maximum number of observations in `x` (in degrees) within a half-circle.

`[Nmax,P]=hodgajne(x)` calculates the maximum number of observations `Nmax` in `x` (in degrees) within a half-circle and the probability `P` of achieving such a extree number.

Purpose

Perform Mardia's test in two circular samples for test of equal concentration.

Synopsis

```
[P]=mardia(x,y)
[P,test]=mardia(x,y)
```

Description

`[P]=mardia(x,y)` calculates and returns the extreme probability of the test statistic for equality in concentrations.

Purpose

Calculates the number of observations in a semi-circle.

Synopsis

```
[no]=N(x,theta)
```

where `x` and `theta` are in radians.

Description

`[no]=N(x,theta)` calculates the number of observations in `x` (in radians) within a half-circle $(\theta - \pi, \theta]$. If `theta` is a vector this procedure is repeated for each element of `theta`.

Purpose

Synopsis

```
[r,b]=pcdmod(x,u)
```

Description

`pcdmod(x,u)` where `x` is a vector of directions, and `u` is a vector of directions upon which correlations is to be calculated.

Examples

Algorithm

See Also

`raymod, vmod, raymodp, vmodp,`

References

Purpose

Random numbers from the unit circle uniform distribution.

Synopsis

```
[r]=rands2(M)
[r]=rands2(M,N)
```

Description

`[r]=rands2(M)` generates generates a column vector of size M of random numbers from the uniform distribution on the unit circle.

`[r]=rands2(M,N)` generates generates a matrix of size M by N of random numbers from the uniform distribution on the unit circle.

Examples

```
[u]=rands2(10); plot(u(:,1),u(:,2),'o')
```

Purpose

Random numbers from the unit sphere uniform distribution.

Synopsis

```
[r]=rands3(M)
[r]=rands3(M,N)
```

Description

`[r]=rands3(M)` generates generates a column vector of size M of random numbers from the uniform distribution on the unit sphere.

`[r]=rands3(M,N)` generates generates a matrix of size M by N of random numbers from the uniform distribution on the unit sphere.

Purpose

Generate random number from a von Mises distribution.

Synopsis

```
[r]=randvm(kappa,theta)
[r]=randvm(kappa,theta,n)
[r]=randvm(kappa,theta,n,'deg')
[x,y]=randvm(kappa,theta,n,'deg')
```

Description

If `kappa` and `theta` are vector or matrix valued they must be of the same size.

`randvm(0.5*ones(m,n),10*ones(m,n))` generates a `m` by `n` matrix of random number from a von Mises distribution $\kappa = 0.5$ and $\theta = 10^\circ$.

`[r]=randvm(kappa,theta,n,'deg')` generates a vector on length n of samples from a von Mises distribution $M(\kappa, \theta)$.

Purpose

Generate random number from a von Mises distribution.

Synopsis

```
[r]=randvm(kappa,theta)
[r]=randvm(kappa,theta,n)
[r]=randvm(kappa,theta,n,'deg')
```

Description

If `kappa` and `theta` are vector or matrix valued they must be of the same size.

`randvm(0.5*onesm,n,10*ones(m,n))` generates a `m` by `n` matrix of random number from a von Mises distribution $\kappa = 0.5$ and $\theta = 10^\circ$.

`[r]=randvm(kappa,theta,n,'deg')` generates a vector on length n of samples from a von Mises distribution $M(\kappa, \theta)$.

Examples

Algorithm

See Also

References

Purpose

Generate random number from p-modal wrapped Cauchy distribution.

Synopsis

```
[r]=randwc(p,rho,theta)
[r]=randwc(p,rho,theta,n)
[r]=randwc(p,rho,theta,n,'deg')
```

Description

If `rho` and `theta` are vector or matrix valued they must be of the same size.

`randwc(1,0.5*onesm,n,10*ones(m,n))` generates a `m` by `n` matrix of random number from a von Mises distribution $\kappa = 0.5$ and $\theta = 10^\circ$.

`[r]=randwc(1,rho,theta,n,'deg')` generates a vector on length n of samples from a wrapped Cauchy distribution $WC(\rho, \theta)$.

Purpose

Calculate the cumulative distribution function of the Rayleigh distribution.

Synopsis

```
[P]=raycdf(x,a)
```

Description

`[P]=raycdf(x,a)` calculates the cumulative distribution function

$$1 - e^{-x^2/a^2}, x > 0.$$

For vector or matrix `x`, a vector or matrix of probability values are calculated.

Examples

Algorithm

See Also

References

.

Purpose

Calculate the upper percentile of the distribution for the rayleigh Rtatistic.

Synopsis

```
[xp]=raypct(p,n)
```

Description

`[xp]=raypct(p,n)` calculates x_p such that $\int_{x_p}^{\infty} f_R(x)dx = p$.

Algorithm

The function is a table lookup of Table 2.6 of Mardia for $p = 0.10, 0.05, 0.01, 0.001$ and $n = 5(1)30, \ldots$. For all other p values the quantile is interpolated in the table och approximated by $x_p \approx \sqrt{-\ln(p)/n}$.

References

Mardia, K.V. *Statistics of Directional Data.* Academic Press, London 1972.

Purpose

Calculate the probability density function of the Rayleigh distribution.

Synopsis

```
[d]=rayleigh(x,a)
```

Description

`[d]=rayleigh(x,a)` calculates the probability density function

$$\frac{2x}{a^2}e^{-x/a^2}, x > 0.$$

For vector or matrix `x`, a vector or matrix of probability values are calculated.

Purpose

Calculate concentration to clustering direction and its location.

Synopsis

```
r(x)
raymod(x)
[r]=raymod(x)
[r,u]=raymod(x)
```

Description

`[r,u]=raymod(x)` where `x` is a vector of directions, calculates the concentration in `r`. The cosine and sine of the clustering direction is given in `u(1)` and `u(2)` of `u` respectively.

See Also

`circmean`

Purpose

Calculate concentrations to clustering directions, depending on a number of factors, and their locations.

Synopsis

```
raymodp(x,D)
[r]=raymodp(x,D)
[r,U]=raymodp(x,D)
```

Description

`raymodp(x,D)` where `x` is a vector of directions, and `D` is a matrix with the same number of rows as `x` and a column for each of a number of factors each column describing the level of the factor for each direction in `x`.

Examples

Algorithm

See Also

`raymod, vmod`

References

Purpose

Plot a circle function.

Synopsis

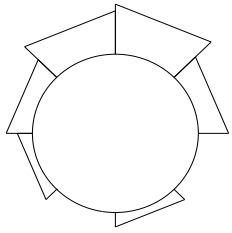
```
s2hist(x,e)
```

Description

`s2hist(x,e)` where `x` is a vector of directions, and `e` is a vector of sector limits (in degrees). plots vector `x` in a circular histogram.

Examples

```
e=[0:45:315]; x=randvm(2,0,20,'deg'); s2hist(x,e)
```



Algorithm

See Also

`circplot, sektplot,`
`rose` (in the main MATLAB User's Guide)

References

.

Purpose

Calculates mean direction and concentration of a circular sample.

Synopsis

```
[A,r]=circmean(x)
```

Description

`[A,r]=circmean(x)` calculates the circular mean and concentration of the angles given in degrees. The cosine and sine of mean direction are given in `A(1)` and `A(2)`, and the concentration is given in `r`.

See Also

`circmean, circaxis`

Purpose

Plot a circle function.

Synopsis

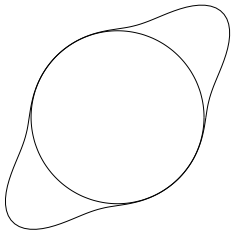
```
s2plot(y)
s2plot(x,y)
s2plot(x,y,':')
s2plot(x,y,'--')
s2plot(x,y,'-')
```

Description

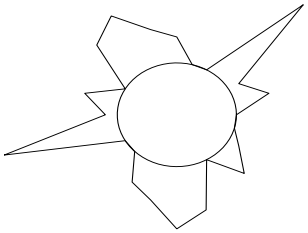
`s2plot(x,y)` where `x` is a vector of directions, plots vector `x` versus vector `y` in a circular plot.

Examples

```
x=[0:0.1:2*pi]; y=exp(3*cos(2*(x-pi/4)))/(2*pi*i0(3)); s2plot(x,y)
```



```
x=[0:pi/12:2*pi]; y=[0,3,35,12,0,0,...]; s2plot(x,y)
```



See Also

`circplot`, `sektplot`,
`rose` (in the main MATLAB User's Guide)

Purpose

Plot a circular case plot diagram.

Synopsis

```
s2cplot1(x,group)
s2cplot1(x,group,'deg',pos)
s2cplot1(x,group,'deg',pos,tot)
```

Description

`s2cplot(x,'deg',0)` or `circplot(x,'deg')` plots a circular diagram based on the angles given in `x`.

`circplot(x,'deg',2)` plots a circular diagram in position 2 (of a total 6) based on the angles given in `x`.

`circplot(x,'deg',2,tot)` plots a circular diagram in position 2 (of a total `tot`) based on the angles given in `x`.

See Also

`circplot`

Purpose

Calculate the number of theta points or samples within sector angle bins.

Synopsis

```
sector(theta,n)
sector(theta,x)
```

Description

`sector(theta,n)` where `n` is a scalar, uses `n` equally spaced sectors from 0 to 360. The default value of `n` is 4.

`sector(theta,x)` where `x` is a vector, uses the sectors specified in `x`. The values in `x` specifies the left hand angles (in degrees) of the sectors.

See Also

`circplot`, `sectplot`, `rose` (in the main MATLAB User's Guide)

Purpose

Plot a circle sector diagram.

Synopsis

```
sectplot(theta,n)
sectplot(theta,x)
```

Description

`sectplot(theta,n)` where `n` is a scalar, uses `n` equally spaced sectors from `0` to `360` and plots an angle sector diagram for the angles in `theta`. The default value of `n` is `4`.

`sectplot(theta,x)` where `x` is a vector, uses the sectors specified in `x`. The values in `x` specifies the left hand angles (in degrees) of the sectors.

See Also

`circplot, sektplot, rose` (in the main MATLAB User's Guide)

Purpose

Calculate the upper percentile of the gaussian distribution.

Synopsis

```
[R,N,A1,A2,A]=sect2rk(Z,D)
```

Description

`sect2rk(Z,D)` calculates the mode statistics of the m by s matrix Z containing sector counts in s sectors provided from m cases. The sector directions are given by the m by s matrix D.
The s mode-statistics are given in the m by s matrix R. The total number of counts in the s sector are gien in the m by 1 vector N.

Examples

Algorithm

See Also

References

Purpose

Synopsis

```
spin
```

Description

Examples

Algorithm

See Also

References

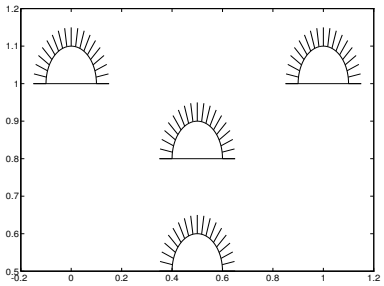
Purpose

Synopsis

```
sun(x)
sunrise
sunset
```

Description

Examples



Algorithm

See Also

References

Purpose

Plot a circle function.

Synopsis

```
[r]=vmod(x,u)
```

Description

`vmod(x,u)` where `x` is a vector of directions, and `u` is a vector of directions upon which correlations is to be calculated.

Examples

Algorithm

See Also

References

Purpose

Calculate circular correlations with given directions.

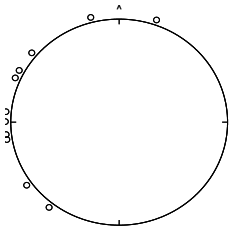
Synopsis

```
[r]=vmodp(x,U)
```

Description

`vmodp(x,U)` where `x` is a vector of directions, and `U` is a matrix of directions upon which correlations are to be calculated.

Examples



```
x=[276,309,218,234,261,294,270,345,379,263,300]';
U=[270,270,270,270,270,360,360,360,360,360,360;
180,180,180,180,180,210,210,210,210,210,210]'; vmodp(x,U)
```

gives the answer

```
0.8213
0.4168
```

Algorithm

See Also

References

Purpose

Calculate the upper percentile of the gaussian distribution.

Synopsis

```
[xp]=vpct(p,n)
```

Description

`[xp]=vpct(p,n)` calculates x_p such that $\int_{x_p}^{\infty} f_R(x)dx = p$.

Examples

Algorithm

The function is a table lookup of Table 2.4 of Mardia for $p = 0.10, 0.05, 0.010.001$ and $n = 5(1)30, ...$ Gor all other p values the quantile is interpolated in the table och approximated by $x_p \approx \sqrt{-n \ln(p)}$.

See Also

References

Purpose

Calculate the probability density function of the von Mises distribution.

Synopsis

```
[d]=vonmises(x,kappa,degmu)
```

Description

`[d]=vonmises(x,kappa,degmu)` calculates the probability density function

$$\frac{1}{2\pi I_0(\kappa)} e^{\kappa \cos(x-\mu)}.$$

For vector or matrix `x`, a vector or matrix of probability values are calculated.

Purpose

Synopsis

```
watsonu2(x,y)
```

Description

Examples

Algorithm

See Also

References

Purpose

Synopsis

```
watsonun(x)
```

Description

Examples

Algorithm

$$U_n^2 = \sum v_i^2 - \sum c_i v_i / n + n[\frac{1}{3} - (\bar{v} - \frac{1}{2})^2]$$

See Also

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