

# Package ‘Trendtwosub’

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**Title** Two Sample Order Free Trend Nonparametric Inference

**Version** 0.0.2

**Description** Non-parametric trend comparison of two independent samples with sequential subsamples. For more details, please refer to Wang, Stapleton, and Chen (2018) <doi:10.1080/00949655.2018.1482492>.

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**License** GPL (>= 2)

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 chi.stat

*chi.stat function*


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### Description

This function calculates the  $M$  statistics value as defined in the reference paper.

### Usage

```
chi.stat(ftab)
```

### Arguments

ftab                    it is a matrix with dimension 2 by  $K$ .

### Details

The  $M$  statistics is defined as:

$$M = \sum_{l=1}^K \left( \frac{(O_{x,l} - E_{x,l})^2}{E_{x,l}} + \frac{(O_{x,l} - E_{x,l})^2}{(n_l n_{l+1} - E_{x,l})} \right) + \sum_{l=1}^K \left( \frac{(O_{y,l} - E_{y,l})^2}{E_{y,l}} + \frac{(O_{y,l} - E_{y,l})^2}{(m_l m_{l+1} - E_{y,l})} \right).$$

### Value

chi.val, a chisqure type of statistics value

### References

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

### Examples

```
chi.stat(ftab=rbind(c(20,10,20),c(15,15,20)))
```

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freq.less	<i>List of functions freq.less function</i>
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**Description**

This function finds the sum of counts that the x-sample observations is greater than or less than the ones from the y-sample.

**Usage**

```
freq.less(x, y)
```

**Arguments**

x, y	x and y are numerical vectors of different subsamples. The length of the two vectors can vary.
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**Details**

When there is a tie between any pair of observations, 0.5 is added to the count. Missing value is allowed. Missing value is only added to the calculation when it is compared with another missing value from the other subsample.

**Value**

Two values are returned: less.count and more.count. The first one is the total count that the observations in x-sample is less than the ones from the y-sample, and the second output is the total count that the observations in x-sample is more than the ones from the y-sample. When there is a tie, 0.5 is added to the count, instead of 1 or 0.

**Examples**

```
freq.less(x=c(1,2,4,9,0,0,NA),y=c(1,4,9,NA))
```

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gen.decision	<i>gen.decision function This function compares frequency comparison counts of subsamples from two independent samples, and calculates a simulated p-value with a novel bootstrap method proposed in the reference paper.</i>
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**Description**

gen.decision function This function compares frequency comparison counts of subsamples from two independent samples, and calculates a simulated p-value with a novel bootstrap method proposed in the reference paper.

**Usage**

```
gen.decision(est.prob, effn.subsam1, effn.subsam2, fn.rep = 10^3,
            alpha = 0.05)
```

**Arguments**

<code>est.prob</code>	a matrix of two rows, with each row represents the the sequential comparison results of subsamples from a sample.
<code>effn.subsam1</code>	the subsample sizes from sample 1.
<code>effn.subsam2</code>	the subsample sizes from sample 2.
<code>fn.rep</code>	the total number of replications.
<code>alpha</code>	the size of type I error.

**Details**

The dimensions of `est.prob`, `effn.subsam1` and `effn.subsam2` need to match. For example, the first two entries of the first two rows from `est.prob` are pf comparison results from `subsample1` and `subsample2` of sample 1. Thus the sum of the two entries is the product of the two subsample sizes.

**Value**

`critical.value` the critical value of the test based on the alpha level provided  
`chi-stat` the chisquare type test statistics value from the sample provided.  
`pvalue` the simulated p-value.

**References**

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

**Examples**

```
freq.mat<-rbind(c(20,5,10,15,20,5),c(15,10,15,10,20,5));
n.sam1<-rep(5,4);n.sam2<-rep(5,4); n.rep=1000;
gen.decision(freq.mat,n.sam1,n.sam2,n.rep);
### This command will replicate the first p-value in Table 4 of the reference paper.
freq.mat<-rbind(c(40,10,20,30,40,10),c(30,20,30,20,40,10));
n.sam1<-c(5,10,5,10);n.sam2<-c(10,5,10,5); n.rep=1000;
gen.decision(freq.mat,n.sam1,n.sam2,n.rep)
### This command will replicate the second p-value in Table 4 of the reference paper.
```

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multi.freq	<i>multi.freq function</i>
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### Description

This function find trend in a sample by comparing neighboring subsamples. The subsamples are stored in a list in R.

### Usage

```
multi.freq(fsam)
```

### Arguments

`fsam` a list in R. The order of the vectors in the list follows the order of the subsamples.

### Details

The first vector of data in the list will be compared with the second vector in the list by using function `freq.less`. Then the second vector will be compared with the 3rd vector if there is one. The statistics collected are based on computing:

$$\frac{1}{n_l n_{l+1}} \sum_{i=1}^{n_l} \sum_{j=1}^{n_{l+1}} 1(x_{li} < x_{(l+1)j})$$

### Value

`count.vec` it is a collection of a sequence `less.count`, `more.count` based on `freq.less` function.

### References

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

### Examples

```
x1=c(1,2,4,9,0,0,NA);x2=c(1,4,9,NA);x3=c(2,5,10);
sam=list(x1,x2,x3); #
multi.freq(sam);
```

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pow.ana.gen.decision    *pow.ana.gen.decision function*

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### Description

This function evaluates the type I error of the proposed test.

### Usage

```
pow.ana.gen.decision(mean.prob1, mean.prob2, effn.subsam1, effn.subsam2,
  N.rep = 10^1, boot.rep = 10^1, rseed = 1234, alpha.level = 0.05)
```

### Arguments

mean.prob1,	the probability that observations of a subsample is less than the ones from another subsample, in sample #1.
mean.prob2,	the probability that observations of a subsample is less than the ones from another subsample, in sample #2.
effn.subsam1	the subsample sizes from sample 1.
effn.subsam2	the subsample sizes from sample 2.
N.rep	the total number of bootstrap repetitions needed for calculating type I errors.
boot.rep	the number of repetitions needed to calculate simulated p-value,
rseed	a random seed.
alpha.level	the type I error level that will be assessed.

### Value

the simulated type I error.

### References

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

### Examples

```
prob.vec<-c(.4,.2,.3,.6);
sub.sizes1<-c(2,4,3,5,3);sub.sizes2<-c(6,3,2,4,2)
pow.ana.gen.decision(prob.vec,prob.vec,sub.sizes1, sub.sizes1)
pow.ana.gen.decision(prob.vec,prob.vec,sub.sizes1, sub.sizes1,alpha.level=0.1)
```

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`seedwt.multi.subsample`*seedwt.multi.subsample dataset*

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**Description**`seedwt.multi.subsample dataset`**Usage**`seedwt.multi.subsample`**Format**

An object of class `data.frame` with 2916 rows and 10 columns.

**Details**

multiple maize inbreds were exposed to all combinations of the following stressors: drought, nitrogen, and density stress. Plants were grown in an experimental plot divided into eight sections, and each of the sections received a combination of between zero and three of the stresses previously mentioned, so that all possible stress combinations were included. More details about the experiment can be found in the references

**References**

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

Stutts, L., Wang, Y., & Stapleton, A. E. (2018). Plant growth regulators ameliorate or exacerbate abiotic, biotic and combined stress interaction effects on *Zea mays* kernel weight with inbred-specific patterns. *Environmental and experimental botany*, 147, 179-188.

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`simu.ustat.pattern`*simu.ustat.pattern function*

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**Description**

This function create two independent subsamples of various subsample sizes, with a given probability vector.

**Usage**`simu.ustat.pattern(mean.prob.vec, effn.subs, n.rep = 10^2)`

**Arguments**

mean.prob.vec a vector of length 2. Its first element represents the probability that a random observation from one subsample is less than the the one from another subsample..

effn.subs a vector contains two subsample sizes.

n.rep the total number of repetition.

**Details**

each subsample is generated from a normal distribution, with an average generated from the mean.prob.vec.

**Value**

simu.tab a list of length n.rep. Each element of the list is a 2 by 2 matrix, showing the comparison results from function multi.freq.

**References**

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

**Examples**

```
simu.ustat.pattern(c(0.8,0.2),c(5,8),n.rep=100)
```

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sub.test	<i>sub.test function This function calculates the simulated p-value of comparing the trend in subsamples from two independent samples.</i>
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**Description**

sub.test function This function calculates the simulated p-value of comparing the trend in subsamples from two independent samples.

**Usage**

```
sub.test(sam1, sam2, fn.rep2)
```

**Arguments**

sam1, the first sample.

sam2, the second sample

fn.rep2 the total number of bootstrap repetitions needed for calculating the simulated p-value.



**Value**

critical.value the critical value of the test based on the alpha level provided

chi-stat the chisquare type test statistics value from the sample provided.

pvalue the simulated p-value.

**References**

Wang, Y., Stapleton, A. E., & Chen, C. (2018). Two-sample nonparametric stochastic order inference with an application in plant physiology. *Journal of Statistical Computation and Simulation*, 88(14), 2668-2683.

**Examples**

```
attach(seedwt.multi.subsample)
Lev.TN<-levels(TreatmentName);
Lev.Line<-levels(Line);
n<-dim(seedwt.multi.subsample)[1];
level.show=c(1:8);fn.rep3=10^2;
line.name<-Lev.Line[1]; t1.name<-Lev.TN[1];t2.name<-Lev.TN[3];
### To compare the GA treatment and the PACGA treatment from line B73
par(mfrow=c(1,2))
idx<-subset((TreatmentName==t1.name)*(Line==line.name)*(1:n),Env %in% level.show)
idx2<-subset((TreatmentName==t2.name)*(Line==line.name)*(1:n),Env %in% level.show)
boxplot(seedwt[idx]~Env[idx],xlab="ENV levels",ylab=paste('seedwt from',t1.name),
        ylim=c(0,12),cex.lab=1.5,cex.axis=1.8);
boxplot(seedwt[idx2]~Env[idx2], xlab="ENV levels",ylab=paste('seedwt from',t2.name),
        cex.lab=1.5,cex.axis=1.8);
mtext( paste ("Line Name:",line.name), side = 3,outer = TRUE, cex = 2.2,line = -3)
temp.sw1<-seedwt[idx];lab<-Env[idx]; uni.lab<-unique(lab)
sam.1<-lapply(1:length(uni.lab), function(x) temp.sw1[lab==uni.lab[x]])
temp.sw2<-seedwt[idx2];lab2<-Env[idx2]; uni.lab2<-unique(lab2)
sam.2<-lapply(1:length(uni.lab2), function(x) temp.sw2[lab2==uni.lab2[x]])
print(paste("working with line ",line.name,'and treatment',t1.name ,'vs',t2.name ))
resu<-sub.test(sam.1,sam.2,fn.rep2=fn.rep3);
dev.off()
## This will show a similar result as the first experiment of section 5 in the paper.
```

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