# Package 'darts'

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**Type** Package

**Title** Statistical Tools to Analyze Your Darts Game

**Version** 1.0

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**Description** Are you aiming at the right spot in darts? Maybe not! Use this package to find your optimal aiming location. For a better explanation, go to http://www-stat.stanford.edu/~ryantibs/darts/ or see the paper ``A Statistician Plays Darts".

**License** GPL

**LazyLoad** yes

**Repository** CRAN

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**NeedsCompilation** yes

## R topics documented:

darts-package *Statistical Tools to Analyze Your Darts Game*

## Description

Are you aiming at the right spot on the dartboard? Maybe not! Use this package to compute your optimal aiming location. For a better explanation, go to http://stat.stanford.edu/~ryantibs/darts/ or read the paper "A Statistician Plays Darts".

## Details

| | |
|---|---|
| Package: | darts |
| Type: | Package |
| Version: | 1.0 |
| Date: | 2011-01-17 |
| License: | GPL |
| LazyLoad: | yes |

## Author(s)

Ryan Tibshirani <ryantibs@gmail.com>

## References

Ryan Tibshirani, Andrew Price, and Jonathan Taylor. "A Statistician Plays Darts". Journal of the Royal Statistical Society: Series A, Vol. 174, No. 1, 213-226, 2011.

http://stat.stanford.edu/~ryantibs/darts/

## Examples

```
# An example of how to use this package to calculate my variance, and
# then generate a personalized heatmap instructing me where to aim

# Start with 100 scores from throws aimed at the center of the board
x = c(12,16,19,3,17,1,25,19,17,50,18,1,3,17,2,2,13,18,16,2,25,5,5,
1,5,4,17,25,25,50,3,7,17,17,3,3,3,7,11,10,25,1,19,15,4,1,5,12,17,16,
50,20,20,20,25,50,2,17,3,20,20,20,5,1,18,15,2,3,25,12,9,3,3,19,16,20,
5,5,1,4,15,16,5,20,16,2,25,6,12,25,11,25,7,2,5,19,17,17,2,12)

####################
# Simple model
####################

## Step 1: EM algorithm
```

```
# Get my variance in the simple Gaussian model
a = simpleEM(x,niter=100)

# Check the log likelihood
plot(1:a$niter,a$loglik,type="l",xlab="Iteration",ylab="Log likelihood")

# The EM estimate of my variance
s = a$s.final

## Step 2: Generate a heatmap

# Build the matrix of expected scores
e = simpleExpScores(s)

# Plot it
par(mfrow=c(1,2))
drawHeatmap(e)
drawBoard(new=TRUE)
drawAimSpot(e)

####################
# General model
####################

## Step 1: EM algorithm

# Get my variance in the general Gaussian model
aa = generalEM(x,niter=100,seed=0)

# The EM estimate of my covariance matrix
Sig = aa$Sig.final

## Step 2: Generate a heatmap

# Build the matrix of expected scores
ee = generalExpScores(Sig)

# Plot it
par(mfrow=c(1,2))
drawHeatmap(ee)
drawBoard(new=TRUE)
drawAimSpot(ee)
```

---

drawAimSpot *Optimal Aiming Spot*

---

## Description

Draws the optimal aiming location, i.e. the spot with the highest expected score, on top of an existing plot.

### Usage

```
drawAimSpot(e, col = "blue", pch = 19, ...)
```

### Arguments

| | |
|---|---|
| e | A matrix of the expected scores, created by the function simpleExpScores or generalExpScores. |
| col | The color of the dot. |
| pch | The plotting "character" for the dot. |
| ... | More arguments for drawing the dot. |

### Author(s)

Ryan Tibshirani

### Examples

```
# This will take a couple of seconds
e = simpleExpScores(s=0)

# This is what your heatmap would look like if you had perfect accuracy
par(mfrow=c(1,2))
drawHeatmap(e)
drawBoard(new=TRUE)
drawAimSpot(e)
```

---

## drawBoard *Dartboard*

---

### Description

Draws the dartboard, either as a new plot or on top of an existing one.

### Usage

```
drawBoard(new = FALSE, lines = TRUE, numbers = TRUE, outside = TRUE,
          col = "black", ...)
```

### Arguments

| | |
|---|---|
| new | Make a new plot? |
| lines | Draw the lines separating the regions? |
| numbers | Draw the numbers? |
| outside | Draw the numbers outside (or inside) the dartboard? |
| col | The color for the lines. |
| ... | More arguments for drawing the numbers (text). |

### Author(s)

Ryan Tibshirani

### Examples

```
# Draw a new dartboard
drawBoard(new=TRUE)
```

---

## drawHeatmap *Heatmap of Expected Scores*

---

### Description

Draws a heatmap of the expected score as the aiming location varies across the dartboard, as a new plot.

### Usage

```
drawHeatmap(e, col = heat.colors(30))
```

### Arguments

| | |
|---|---|
| e | A matrix of the expected scores, created by the function simpleExpScores or generalExpScores. |
| col | The colors to use for the heatmap. |

### Author(s)

Ryan Tibshirani

### Examples

```
# This will take a couple of seconds
e = simpleExpScores(s=0)

# This is what your heatmap would look like if you had
# perfect accuracy
drawHeatmap(e)
```

generalEM *EM Algorithm for the General Model*

## Description

EM algorithm to estimate your variance based on your scores, in the general model.

## Usage

```
generalEM(x, Sig.init = c(10^2, 10^2, 0.1 * 10 * 10), niter = 100,
          seed = NULL)
```

## Arguments

| | |
|---|---|
| x | Scores of throws aimed at the center of the dartboard. |
| Sig.init | The initial guess for the covariance matrix, represented as a vector: x marginal variance, then y marginal variance, then x-y covariance. |
| niter | The number of iterations. |
| seed | The seed for the random number generator (the E-step is done by importance sampling). |

## Value

| | |
|---|---|
| Sig.final | The final estimate of the covariance matrix. |
| Sig.init | The initial estimate of the covariance matrix. |
| Sig | The estimate of the covariance at each iteration. |
| loglik | The log likelihood at each iteration—currently not implemented (this is just an array of 0s). |
| niter | The number of iterations. |

## Author(s)

Ryan Tibshirani

## Examples

```
# Scores of 100 of my dart throws, aimed at the center of the board
x = c(12,16,19,3,17,1,25,19,17,50,18,1,3,17,2,2,13,18,16,2,25,5,5,
1,5,4,17,25,25,50,3,7,17,17,3,3,3,7,11,10,25,1,19,15,4,1,5,12,17,16,
50,20,20,20,25,50,2,17,3,20,20,20,5,1,18,15,2,3,25,12,9,3,3,19,16,20,
5,5,1,4,15,16,5,20,16,2,25,6,12,25,11,25,7,2,5,19,17,17,2,12)

# Get my variance in the general Gaussian model
a = generalEM(x,niter=100,seed=0)

# The EM estimate of my covariance matrix
Sig = a$Sig.final
```

## generalExpScores *Expected Scores for the General Model*

### Description

Computes the expected score as the aiming location varies across the board, using the specified covariance matrix and the general model for dart throws.

### Usage

```
generalExpScores(Sig)
```

### Arguments

| | |
|---|---|
| Sig | The covariance matrix. |

### Value

| | |
|---|---|
| e | The matrix of expected scores. |

### Author(s)

Ryan Tibshirani

### Examples

```
# Generate the matrix of expected scores if my covariance is
# Sig=c(15^2,30^2,0), in the general model. This will take a
# couple of seconds.
e = generalExpScores(Sig=(c(15^2,30^2,0)))

# Draw a heatmap!
drawHeatmap(e)
```

## simpleEM *EM Algorithm for the Simple Model*

### Description

EM algorithm to estimate your variance based on your scores, in the simple model.

### Usage

```
simpleEM(x, s.init = 100, niter = 100)
```

### Arguments

| | |
|---|---|
| x | Scores of throws aimed at the center of the dartboard. |
| s.init | The initial guess for the marginal variance. |
| niter | The number of iterations. |

### Value

| | |
|---|---|
| s.final | The final estimate of the variance. |
| s.init | The initial estimate of the variance. |
| s | The estimate of the variance at each iteration of the EM algorithm. |
| loglik | The (observed) log likelihood at each iteration of the EM algorithm. |
| niter | The number of iterations. |

### Author(s)

Ryan Tibshirani

### Examples

```
# Scores of 100 of my dart throws, aimed at the center of the board
x = c(12,16,19,3,17,1,25,19,17,50,18,1,3,17,2,2,13,18,16,2,25,5,5,
1,5,4,17,25,25,50,3,7,17,17,3,3,3,7,11,10,25,1,19,15,4,1,5,12,17,16,
50,20,20,20,25,50,2,17,3,20,20,20,5,1,18,15,2,3,25,12,9,3,3,19,16,20,
5,5,1,4,15,16,5,20,16,2,25,6,12,25,11,25,7,2,5,19,17,17,2,12)

# Get my variance in the simple Gaussian model
a = simpleEM(x,niter=100)

# Check the log likelihood
plot(1:a$niter,a$loglik,type="l",xlab="Iteration",ylab="Log likelihood")

# The EM estimate of my variance
s = a$s.final
```

---

## simpleExpScores *Expected Scores for the Simple Model*

---

### Description

Computes the expected score as the aiming location varies across the board, using the specified variance and the simple model for dart throws.

### Usage

```
simpleExpScores(s)
```

## Arguments

| | |
|---|---|
| s | The marginal variance. |

## Value

| | |
|---|---|
| e | The matrix of expected scores. |

## Author(s)

Ryan Tibshirani

## Examples

```
# Generate the matrix of expected scores if my variance is 25^2,
# in the simple model. This will take a couple of seconds.
e = simpleExpScores(s=25^2)

# Draw a heatmap!
drawHeatmap(e)
```

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