Package ‘desire’

February 19, 2015

Version 1.0.7
Title Desirability functions in R
Description Harrington and Derringer-Suich type desirability functions
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Depends R (>= 2.9.0), loglognorm
License GPL-2
LazyData yes
NeedsCompilation yes
Repository CRAN
Date/Publication 2013-07-12 13:40:21

R topics documented:

Chocolate .............................................................. 2
compositeDF .......................................................... 2
ddesire ................................................................. 3
derringerSuich ....................................................... 5
dsplot ................................................................. 6
geometricDI ........................................................... 7
harrington1 ........................................................... 9
harrington2 ........................................................... 11
Internal functions .................................................... 13
meanDI ................................................................. 14
minimumDI ........................................................... 15
normMax ............................................................... 16
plot.desire.function ................................................. 18
plot.harrington2 ..................................................... 18
realisticDF .......................................................... 19

Index 21
**compositeDF**

| Chocolate | Chocolate production and quality measures |

**Description**
...

**Usage**

Chocolate

**Format**

A data.frame containing 13 observations

**Source**

C....

**References**


---

**compositeDF**

*Construct composite desirability functions*

**Description**

Combines a desirability function with an inner function and returns a new function object which calculates $d(f(x))$.

**Usage**

`compositeDF(expr, d, ...)`

**Arguments**

- `expr`: any valid inner function
- `d`: desirability function
- `...`: additional arguments passed to function

**Details**

Currently specialized for expressions, functions and objects with class `lm`. 
Value

A function object of a composite desirability function.

Author(s)

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References


See Also

`harrington1` and `harrington2` for Harrington type desirability functions; `derringerSuich` for desirability functions of Derringer and Suich;

Examples

```r
h <- harrington2(-1, 1, 1)
## Calculate h(x^2):
ch1 <- compositeDF(x^2, h)
ch1(0.5)
ch1(c(0.2, 0.5, 0.7))

## Calculate h(f(x))
f <- function(x) 2*x + 3
ch2 <- compositeDF(f, h)
ch2(0.3)
ch2(c(0.3, 0.35, 0.9))
```

**ddesire**

*Generic Distribution functions for desirabilities*

Description

Generic density, distribution, quantile and random number generation functions for desirability functions.
Usage

## Default S3 method:
ddesire(x, f, mean = 0, sd = 1)
## Default S3 method:
pdesire(q, f, mean = 0, sd = 1)
## Default S3 method:
qdesire(p, f, mean = 0, sd = 1)
## Default S3 method:
rdesire(n, f, mean = 0, sd = 1)
## Default S3 method:
edesire(f, mean, sd)
## Default S3 method:
vdesire(f, mean, sd)

Arguments

- **x, q** Vector of quantiles.
- **p** vector of probabilities.
- **n** number of observations.
- **f** desirability function
- **mean** vector of means.
- **sd** vector of standard deviations.

Value

'ddesire' gives the density, 'pdesire' gives the distribution function, 'qdesire' gives the quantile function, and 'rdesire' generates random deviates.

'edesire' and 'vdesire' return the expectation and variance of the function.

Note

The default implementations for pdesire, qdesire, edesire and vdesire are only approximations obtained by estimating the desired property from a random sample.

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See Also

For desirability functions: harrington1 and harrington2
Examples

```r
data(Chocolate)

## Fit linear model to data:
m.d90 <- lm(d90 ~ rt + as + I(rt^2) + I(as^2) + rt:as, Chocolate)
m.Fe <- lm(Fe ~ rt + as + I(rt^2) + I(as^2) + rt:as, Chocolate)

## Define desirability functions:
d.d90 <- harrington2(21, 22, 1)
d.Fe <- harrington1(22, 0.8, 28, 0.2)

## Plot density of desirability in rt=30, as=50:
df <- data.frame(rt=30, as=50)
y.Fe <- predict(m.Fe, df)
sigma.Fe <- summary(m.Fe)$sigma

y.d90 <- predict(m.d90, df)
sigma.d90 <- summary(m.d90)$sigma

## Plot curve of density function:
opar <- par(mfrow=c(2,1))
curve(ddesire(x, d.d90, y.d90, sigma.d90), 0, 1, main="d.90", n=202)
curve(ddesire(x, d.Fe, y.Fe, sigma.Fe), 0, 1, main="Fe", n=202)
par(opar)

## Integrate:
integrate(function(x) ddesire(x, d.d90, y.d90, sigma.d90), 0, 1)
integrate(function(x) ddesire(x, d.Fe, y.Fe, sigma.Fe), 0, 1)
```

derringerSuich

Derringer-Suich type desirability function

Description

Returns a function evaluating a (generalized) Derringer-Suich desirability.

Usage

derringerSuich(y, d, beta)

Arguments

- `y`
- `d`
- `beta`

Details

If only `y` is provided and it is a vector of length 5, a normal \((l, t, u, \beta_1, \beta_2)\) Derringer Suich desirability is constructed. Otherwise `y`, `d` and `beta` specify a generalized Derringer Suich type desirability.
dsplot

Value
derringerSuich returns a function.

Author(s)

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References


See Also

harrington1 for one sided Harrington type desirabilities and harrington2 for two sided Harrington type desirabilities.

Examples

```r
## Simple (l, t, u, b0, b1) Derringer-Suich desirabilities:
d1 <- derringerSuich(c(0, 1, 2, 1, 1))
d2 <- derringerSuich(c(0, 1, 2, 2, 2))
d3 <- derringerSuich(c(0, 1, 2, .5, .5))

## Comparison of their shape:
opar <- par(mfrow=c(3, 1))
plot(d1)
plot(d2)
plot(d3)
par(opar)

## d/p/q/r examples:
ddesign(.2, d1, 0, 1)
pdesign(.5, d1, 0, 1)
qdesign(.8, d1, 0, 1)
```

---

**dsplot**

*Desirability Plot*

Description

Plot a desirability function and its relation to an arbitrary expression.
**Usage**

dspot(expr, f, from = NULL, to = NULL, n = 101,
   show.zero = TRUE, interest = NULL,
   main = "Desirability Plot", sub = NULL, ...)

**Arguments**

- **expr**: an expression written as a function of 'x', or alternatively the name of a function which will be plotted.
- **f**: desirability function
- **from, to**: the range over which the function will be plotted.
- **n**: integer; the number of x values at which to evaluate.
- **show.zero**: add dotted line to visualize the origin
- **interest**: vector of interesting points
- **main**: an overall title for the plot
- **sub**: a subtitle for the plot
- **...**: parameters passed to low level plot functions

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**Examples**

d1 <- harrington2(2, 4, 2)
dspot(x*log(x), d1,
   from=0, to=6, n=507,
   interest=c(2, 3, 4))

---

**geometricDI**  
*Geometric Mean Desirability Index*

**Description**

Computes the weighted geometric mean of a number of desirability functions.

**Usage**

geometricDI(f, ..., weights)

**Arguments**

- **f, ...**: desirability functions
- **weights**: vector of weights
Details

The Desirability Index was introduced by Harrington (1965), and the concept was extended by Derringer and Suich (1980). It is a means for multicriteria (quality) optimization in industrial quality management. All desirability functions of the quality criteria are combined into a univariate global quality criterion in [0,1] which has to be optimized.

The function can be used for Harrington as well as Derringer and Suich desirability functions.

Value

geometricDI(f, ..., weights) returns a function object of the Geometric Mean Desirability Index.

Author(s)

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References


See Also

harrington1 and harrington2 for Harrington type desirability functions; derringersuich for desirability functions of Derringer and Suich; minimumDI,meanDI for other types of Desirability indices.

Examples

h1 <- harrington1(-2, .9, 2, .1)
h2 <- harrington2(0, 2, 2)

di <- geometricDI(h1, h2, weights=c(1/3, 2/3))
di(c(0, 1))

## Desirability Index of vector input:
h <- harrington2(c(3, 7, 1)
g <- harrington1(-2, .1, 2, .9)
d <- geometricDI(h, g, weights=c(0.5, 0.5))
m <- matrix(c(seq(2, 8, 0.1), seq(-2, 4, 0.1)), ncol=2, byrow=FALSE)
apply(m, 1, d)
Description

Returns a one-sided desirability function of the Harrington type. Density, distribution function, quantile function and random number generation for the distribution of the one-sided Harrington desirability function are computed given a normally distributed variable $Y$ with expected value equal to $\text{mean}$ and standard deviation equal to $\text{sd}$.

Usage

```r
harrington1(y1, d1, y2, d2)
## S3 method for class 'harrington1'
ddesire(x, f, mean, sd)
## S3 method for class 'harrington1'
pdesire(q, f, mean, sd)
## S3 method for class 'harrington1'
qdesire(p, f, mean, sd)
## S3 method for class 'harrington1'
edesire(f, mean, sd)
## S3 method for class 'harrington1'
vdesire(f, mean, sd)
dharrington1(x, y1, d1, y2, d2, mean, sd)
pharrington1(q, y1, d1, y2, d2, mean, sd)
qharrington1(p, y1, d1, y2, d2, mean, sd)
rharrington1(n, y1, d1, y2, d2, mean, sd)
eharrington1(y1, d1, y2, d2, mean, sd)
vharrington1(y1, d1, y2, d2, mean, sd)
```

Arguments

- $x, q$: vector of quantiles.
- $p$: vector of probabilities.
- $n$: number of observations.
- $f$: one-sided Harrington type desirability function.
- $y1, d1, y2, d2$: Two values $y1$ and $y2$ of variable $Y$ with respective desirability values $d1$ and $d2$ determine the shape of the desirability function.
- $\text{mean}$: vector of expected values of normal distributions.
- $\text{sd}$: vector of standard deviations of normal distributions.

Details

$harrington1(y1, d1, y2, d2)$ is the one-sided desirability function of Harrington type (Harrington (1965)). It aims at the specification of desired values of a variable $Y$ which has to be minimized or maximized. $Y$ is transformed onto a unitless scale to the interval $[0,1]$. 
Harrington's one-sided desirability function \( d \) given a normally distributed variable \( Y \) with \( E(Y) = \text{mean} \) and \( sd(Y) = \text{sd} \) has the Double Lognormal Distribution (Holland and Ahsanullah (1989)).

**Value**

\( \text{harrington1}(y1, d1, y2, d2) \) returns a function object of the one-sided desirability function of the Harrington type (see example below). Values \( b_0 \) and \( b_1 \) of the desirability function formula are determined.

\( \text{ddesire}/\text{dharrington1} \) give the density, \( \text{pdesire}/\text{pharrington1} \) give the distribution function, \( \text{qdesire}/\text{qharrington1} \) give the quantile function, and \( \text{rdesire}/\text{rharrington1} \) generate random deviates. \( \text{edesire}/\text{eharrington1} \) and \( \text{vdesire}/\text{vharrington1} \) compute the expected value and the variance of the desirability function for a normally distributed random variable \( Y \) with \( E(Y) = \text{mean} \) and \( sd(Y) = \text{sd} \).

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**References**


**See Also**

\( \text{harrington2} \) for two sided Harrington type desirabilities

**Examples**

```R
# Assigning the function object to h:
h <- \text{harrington1}(-2, .1, 2, .9)

# Plot of desirability function:
plot(h)

# Desirability function of a vector:
h(seq(-2,2,0.1))

# d/p/q/r/e/v examples:
\text{ddesire}(0.8, h, 0, 1)
\text{dharrington1}(0.8, -2, .1, 2, .9, 0, 1)
\text{ddesire}(0.8, h, c(0,0.5), c(1,1.5))
\text{pdesire}(0.8, h, 0, 1)
\text{pharrington1}(0.8, -2, .1, 2, .9, 0, 1)
```
Two-sided Harrington type desirability function

Description

Returns a two sided desirability function of the Harrington type. Density, distribution function, quantile function and random number generation for the distribution of the two-sided Harrington desirability function are computed given a normally distributed variable \( Y \) with expected value equal to \( \text{mean} \) and standard deviation equal to \( \text{sd} \).

Usage

harrington2(LSL, USL, n)
## S3 method for class 'harrington2'
ddesire(x, f, mean, sd)
## S3 method for class 'harrington2'
pdesire(q, f, mean, sd)
## S3 method for class 'harrington2'
qdesire(p, f, mean, sd)
dharrington2(x, LSL, USL, n, mean, sd)
pharrington2(q, LSL, USL, n, mean, sd)
qharrington2(p, LSL, USL, n, mean, sd)
rharrington2(ns, LSL, USL, n, mean, sd)
eharrington2(LSL, USL, n, mean, sd)
vharrington2(LSL, USL, n, mean, sd)

Arguments

- \( x, q \) : vector of quantiles.
- \( p \) : vector of probabilities.
- \( ns \) : number of observations.
f  two-sided Harrington type desirability function.
LSL  Lower Specification Limit of Y.
USL  Upper Specification Limit of Y.
n  Kurtosis parameter of desirability function. Values > 1 result in smoother shapes around the target value \( T = (LSL+USL)/2 \). Values < 1 already penalize small target deviations.
mean  vector of means.
sd  vector of standard deviations.

Details

\texttt{harrington2(LSL, USL, n)} is the two-sided desirability function of Harrington type (Harrington (1965)). It aims at the specification of desired values of a variable \( Y \) which has to be optimized regarding a target value \( T \). \( Y \) is transformed onto a unitless scale to the interval \([0,1]\). \( LSL \) and \( USL \) are associated with a desirability of \( 1/e \approx 0.37 \). \( LSL \) and \( USL \) have to be chosen symmetrically around the target value \( T \).

The density and distribution functions of Harrington’s two-sided desirability function \( d \) given a normally distributed variable \( Y \) with \( E(Y) = \text{mean} \) and \( sd(Y) = \text{sd} \) can be determined analytically, see Trautmann and Weihs (2006).

Value

\texttt{harrington2(LSL, USL, n)} returns a function object of the two-sided desirability function of the Harrington type (see example below).

\texttt{d/harrington2} give the density, \texttt{p/harrington2} give the distribution function, \texttt{q/harrington2} give the quantile function, and \texttt{r/harrington2} generate random deviates. \texttt{ed/harrington2} and \texttt{vd/harrington2} compute the expected value and the variance of the desirability function for a normally distributed random variable \( Y \) with \( E(Y) = \text{mean} \) and \( sd(Y) = \text{sd} \).

Author(s)

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References


See Also

\texttt{harrington1} for one sided Harrington type desirabilities
**Examples**

```r
## Assigning the function object to h:
h <- harrington2(3, 7, 1)

## Plot of desirability function:
plot(h)

## Desirability function of a vector:
h(seq(2, 8, 0.1))

## d/p/q/r/e/v examples:
ddesire(4, h, 0, 1)
dharrington2(4, 3, 7, 1, 0, 1)
ddesire(4, h, c(0, 0.5), c(1, 1.5))
pdesire(4, h, 0, 1)
pharrington2(4, 3, 7, 1, 0, 1)
qdesire(0.8, h, 0, 1)
qharrington2(0.8, 3, 7, 1, 0, 1)
rdesire(1e6, h, 0, 1)
rharrington2(1e6, 3, 7, 1, 0, 1)
edesire(h, 3, 0.5)
vdesire(h, 3, 0.5)
```

---

**Description**

Functions not exported and not intended for general use.

**Usage**

```r
h1.solve.params(y1, d1, y2, d2)
```

**Arguments**

- `y1`
- `d1`
- `y2`
- `d2`
Description

Computes the weighted mean of a number of desirability functions.

Usage

\[ \text{meanDI}(f, \ldots, \text{weights} = 1) \]

Arguments

- \( f, \ldots \) : desirability functions.
- \( \text{weights} \) : vector of weights. Weights do not need to sum to one.

Details

The Desirability Index was introduced by Harrington (1965), and the concept was extended by Derringer and Suich (1980). It is a means for multicriteria (quality) optimization in industrial quality management. All desirability functions of the quality criteria are combined into a univariate global quality criterion which has to be optimized. The Weighted Mean Desirability Index is related to the concept of utility functions.

The function can be used for Harrington as well as Derringer and Suich desirability functions.

Value

\[ \text{meanDI}(f, \ldots, \text{weights}) \] returns a function object of the Weighted Mean Desirability Index.

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References


See Also

\text{harrington1} and \text{harrington2} for Harrington type desirability functions; \text{derringerSuich} for desirability functions of Derringer and Suich; \text{geometricDI}, \text{minimumDI} for other types of Desirability indices.
**Examples**

```r
h1 <- harrington1(-2, .9, 2, .1)
h2 <- harrington2(0, 2, 2)

di <- meanDI(h1, h2, weights=c(0.2, 0.8))
di(c(0, 1))

## Desirability Index of vector input:
h <- harrington2(3, 7, 1)
g <- harrington1(-2, .1, 2, .9)
d <- meanDI(h, g, weights=c(0.3, 0.7))
m <- matrix(c(seq(2, 8, 0.1), seq(-2, 4, 0.1)), ncol=2, byrow=FALSE)
apply(m, 1, d)
```

---

**minimumDI**

*Minimum Desirability Index*

**Description**

Computes the minimum of a number of desirability functions.

**Usage**

`minimumDI(f, ...)`

**Arguments**

- `f, ...`: desirability functions

**Details**

The Desirability Index was introduced by Harrington (1965), and the concept was extended by Derringer and Suich (1980). It is a means for multicriteria (quality) optimization in industrial quality management. All desirability functions of the quality criteria are combined into a univariate global quality criterion in [0,1] which has to be optimized.

The function can be used for Harrington as well as Derringer and Suich desirability functions.

**Value**

`minimumDI(f, ...)` returns a function object of the Minimum Desirability Index.
Author(s)

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References


See Also

harrington1 and harrington2 for Harrington type desirability functions; derringerSuich for desirability functions of Derringer and Suich; geometricDI,meanDI for other types of Desirability indices.

Examples

h1 <- harrington1(-2,.9,2,.1)
h2 <- harrington2(0,2,2)
di <- minimumDI(h1,h2)
di(c(0,1))

## Desirability Index of vector input:
h <- harrington2(3,7,1)
g <- harrington1(-2,.1,2,.9)
d <- minimumDI(h,g)
m <- matrix(c(seq(2,8,.1), seq(-2,4,.1)), ncol=2, byrow=FALSE)
apply(m,1,d)

normMax

Normal Distribution based desirability functions.

Description

Desirability functions based on the normal distribution. These where developed by XXX in order to improve YYY.
Usage

\[
normMax(LSL, USL) \\
normMin(LSL, USL) \\
normTarget(LSL, T, USL)
\]

Arguments

- **LSL**: Lower specification limit
- **T**: Target value
- **USL**: Upper specification limit

Value

\[
normMin \text{ and } \normMax \text{ return functions implementing the specified minimization or maximizing desirability. } \normTarget \text{ returns a function implementing the specified target desirability.}
\]

Author(s)

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References

XXX Technical Report ZZZ

See Also

- `harrington1` for one sided Harrington type desirabilities, `harrington2` for two sided Harrington type desirabilities and `derringerSuich` for Derringer-Suich type desirabilities.

Examples

```r
## Create desirability functions:
d1 <- normMin(-1, 1)
d2 <- normMax(-1, 1)
d3 <- normTarget(-1, 0, 1)

## Show shape of desirability function:
opar <- par(mfrow=c(3,1))
plot(d1)
plot(d2)
plot(d3)
par(opar)

## Show
dsplot(log(x), d1, .5, 2)
dsplot(sin(x), d2, -pi, pi)
dsplot(cos(x), d3, 0, 2*pi)
```
plot.desire.function  

Plot a desirability function.

Usage

```r
## S3 method for class 'desire.function'
plot(x, n = 600, xlim = NULL, ylim = c(0, 1),
     xlab = "Value", ylab = "Desirability", ..., main)
```

Arguments

- `x`: desirability function
- `n`: the number of x values at which to evaluate.
- `xlim`: numeric of length 2; if specified, it serves as the default for the range of x values.
- `ylim`: numeric of length 2; if specified, it serves as the default for the range of y values.
- `xlab`: x axes label
- `ylab`: y axes label
- `...`: arguments passed to `lines`.
- `main`: main title of plot

Author(s)

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plot.harrington2  

Plot of two-sided Harrington type desirability function

Description

Plots a two-sided desirability function of the Harrington type.

Usage

```r
## S3 method for class 'harrington2'
plot(x, ...)
```
Arguments

- `x`: two-sided Harrington desirability function.
- `...`: additional parameters passed to `plot`.

Details

Lower Specification Limit (LSL) and Upper Specification Limit (USL) are visualized. The default range of the x-axis is selected automatically.

Value

R-graphics plot object of two-sided Harrington desirability function.

Author(s)

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References


See Also

- `harrington2` for two sided Harrington type desirabilities, `plot`.

Examples

```r
## Assigning a function object to h:
h <- harrington2(3, 7, 1)

## Plot of desirability function:
plot(h)
plot(harrington2(4, 8, 1.5))
```

Description

Convert a desirability into a realistic desirability.

Usage

```r
realisticDF(f, ...)  
## S3 method for class 'desire.function'
realisticDF(f, ...)
```
Arguments

\(f\) desirability function

Details

To construct a composite realistic desirability, first create a realistic desirability and then compose it. Doing the opposite is currently unsupported. This allows the composition to possibly pass a standard deviation which can be deduced from the inner function (e.g. if the inner function is an object of class \(lm\)).

Value

A function with the same arguments as \(x\) and \(sd\), which returns the realistic desirability.

Author(s)

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See Also

minimumDI
Index

*Topic datasets
Chocolate, 2

*Topic distribution
desire, 3

*Topic hplot
dsplot, 6
plot.desire.function, 18

*Topic multivariate
compositeDF, 2
derringerSuich, 5
gEometricDI, 7
harrington1, 9
harrington2, 11
meanDI, 14
minimumDI, 15
normMax, 16
realisticDF, 19

*Topic optimize
compositeDF, 2
derringerSuich, 5
gEometricDI, 7
harrington1, 9
harrington2, 11
meanDI, 14
minimumDI, 15
normMax, 16
realisticDF, 19

Chocolate, 2
compositeDF, 2

desire, 3
desire.harrington1 (harrington1), 9
desire.harrington2 (harrington2), 11
derringerSuich, 3, 5, 8, 14, 16, 17
dharrington1 (harrington1), 9
dharrington2 (harrington2), 11
dsplot, 6
edesire (desire), 3
edesire.harrington1 (harrington1), 9
edesire.harrington2 (harrington2), 11
eharrington1 (harrington1), 9
eharrington2 (harrington2), 11
gEometricDI, 7, 14, 16
h1.solve.params (Internal functions), 13
harrington1, 3, 4, 6, 8, 9, 12, 14, 16, 17
harrington2, 3, 4, 6, 8, 10, 11, 14, 16, 17, 19

Internal functions, 13
meanDI, 8, 14, 16
minimumDI, 8, 14, 15, 20

normMax, 16
normMin (normMax), 16
normTarget (normMax), 16

pdesire (desire), 3
pdesire.harrington1 (harrington1), 9
pdesire.harrington2 (harrington2), 11
pharrington1 (harrington1), 9
pharrington2 (harrington2), 11
plot, 19
plot.desire.function, 18
plot.harrington2, 18

qdesire (desire), 3
qdesire.harrington1 (harrington1), 9
qdesire.harrington2 (harrington2), 11
qharrington1 (harrington1), 9
qharrington2 (harrington2), 11

rdesire (desire), 3
realisticDF, 19
rharrington1 (harrington1), 9
rharrington2 (harrington2), 11

vdesire (desire), 3

21
vdesire.harrington1 (harrington1), 9
vdesire.harrington2 (harrington2), 11
vharrington1 (harrington1), 9
vharrington2 (harrington2), 11