

# Package ‘ceRtainty’

June 14, 2019

**Type** Package

**Title** Certainty Equivalent

**Version** 1.0.0

**Description** Compute the certainty equivalents and premium risks as tools for risk-efficiency analysis. For more technical information, please refer to: Hardaker, Richardson, Lien, & Schumann (2004) <doi:10.1111/j.1467-8489.2004.00239.x>, and Richardson, & Outlaw (2008) <doi:10.2495/RISK080231>.

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**Encoding** UTF-8

**LazyData** true

**Imports** dplyr, tidyr, RColorBrewer, stats, base

**RoxygenNote** 6.1.1

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**NeedsCompilation** no

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|            |   |
|------------|---|
| add_legend | <i>Customized Legend for CE and RP plots.</i> |
|------------|---|

---

### Description

Customized Legend for CE and RP plots.

### Usage

```
add_legend(...)
```

### Arguments

```
...          free
```

---

|           |   |
|-----------|---|
| certainty | <i>Certainty equivalent computation</i> |
|-----------|---|

---

### Description

Certainty equivalent computation

### Usage

```
certainty(data, ival, fval, utility, wealth = 0)
```

### Arguments

|         |   |
|---------|---|
| data    | data.set with profit for each treatment/project. Each column is a treatment and each row a different profit observation.  |
| ival    | The initial value for the RAC vector to employ (scalar).  |
| fval    | The final value for the RAC vector to employ (scalar).  |
| utility | Indicator of utility function: "ExpNeg" for the Exponential Negative utility, and "Power" for the Power utility function. |
| wealth  | The initial agent wealth. By default is zero.   |

## Details

This function computes the certainty equivalent values using profit as inputs. Works with `data.frames` with 3 or more observations. Consider each column as a different treatment or project.

## Value

This function produces three objects: `CE_values` is a table with treatment by columns and certainty values by row; `RAC` is a vector with the absolute risk aversion coefficients (ARAC) if the Power utility function was implemented, or the relative risk aversion coefficient (RRAC) if the Exponential Negative utility function was implemented. The length of this vector is the same as the number of profit observations in the original dataset; and, `CE_plot` is a graph using `plot` function, to compare the different CEs computed.

## References

Hardaker, J.B., Richardson, J.W., Lien, G., & Schumann, K.D. (2004). Stochastic efficiency analysis with risk aversion bounds: a simplified approach. *Australian Journal of Agricultural and Resource Economics*, 48(2), 253-270.

## Examples

```
## Example 1. Using profit data from ceRtainty package
data(profitSWG)

# Storing CE values using Power utility function
c1 <- certainty(data = profitSWG,
               ival = .5,
               fval = 4,
               utility = "Power")
c1$CE_values # Table with CE values
c1$RAC      # RAC vector used in CE computation
c1$CE_plot() # Invoking the CE plot

# To use the ExpNeg function, it is required the RRAC (ARAC/wealth)
# so we can compute the mean value among all profit in the dataset.

# Mean value among all profit value
mean(sapply(profitSWG,mean)) # 5081.844

# Storing CE values using Power utility function
c1 <- certainty(data = profitSWG,
               ival = .5/5082,
               fval = 4/5082,
               utility = "ExpNeg")

c1$CE_values # Table with CE values
c1$RAC      # RAC vector used in CE computation
c1$CE_plot() # Invoking the CE plot

## Example 2. Using the example values of Hardaker et al. (2004)
dt <- data.frame(treatment=c(100,125,135,142,147,150,153,158,163,175,195))
```

```

# Storing CE values using Power utility function. Hardaker use an
# unique RAC value (0.005)
c2 <- certainty(data = dt,
               ival = .005,
               fval = .005,
               utility = "Power")

# or
c2 <- certainty(data = dt,
               ival = .005,
               fval = .005,
               utility = "ExpNeg")

c2$CE_values
c2$RAC
c2$CE_plot()

```

---

ce\_en

*Certainty Equivalent Function for Negative Exponential Function*


---

### Description

Certainty Equivalent Function for Negative Exponential Function

### Usage

```
ce_en(profit, rac, weight = 0)
```

### Arguments

|        |                               |
|--------|-------------------------------|
| profit | data.frame with profit values |
| rac    | scalar of RAC value           |
| weight | original wealth               |

### Value

Scalar with the CE value

---

ce\_epnegative

*Certainty Equivalent Computation using Power Utility Function*


---

### Description

Certainty Equivalent Computation using Power Utility Function

### Usage

```
ce_epnegative(data, rac_ini, rac_fin, weight = 0)
```

**Arguments**

|         |                                    |
|---------|------------------------------------|
| data    | data.frame with profit values      |
| rac_ini | Initial value for the RAC sequence |
| rac_fin | Final value for the RAC sequence   |
| weight  | Original wealth                    |

**Value**

Generate three objects: A table with the CEs, a vector of risk aversion coefficients RAC, and a plot to compare the CEs.

---

|      |  |
|------|--|
| ce_p | <i>Certainty Equivalent Function with Power Utility Function</i> |
|------|--|

---

**Description**

Certainty Equivalent Function with Power Utility Function

**Usage**

```
ce_p(profit, rac, weight = 0)
```

**Arguments**

|        |                               |
|--------|-------------------------------|
| profit | data.frame with profit values |
| rac    | scalar of RAC value           |
| weight | original wealth               |

**Value**

Scalar with the CE value

---

|          |  |
|----------|--|
| ce_power | <i>Certainty Equivalent Computation using Power Utility Function</i> |
|----------|--|

---

**Description**

Certainty Equivalent Computation using Power Utility Function

**Usage**

```
ce_power(data, rac_ini, rac_fin, weight = 0)
```

**Arguments**

|         |                                    |
|---------|------------------------------------|
| data    | data.frame with profit values      |
| rac_ini | Initial value for the RAC sequence |
| rac_fin | Final value for the RAC sequence   |
| weight  | Original wealth                    |

**Value**

Generate three objects: A table with the CEs, a vector of risk aversion coefficients RAC, and a plot to compare the CEs.

---

|            |  |
|------------|--|
| plot_ce_en | <i>Plot for CE using Exponential Negative Utility Function</i> |
|------------|--|

---

**Description**

Plot for CE using Exponential Negative Utility Function

**Usage**

```
plot_ce_en(data, rac = 0, rac_ini = 0, rac_fin = 1, rac_len = 10)
```

**Arguments**

|         |   |
|---------|---|
| data    | Data set with CE already computed   |
| rac     | Scalar with the RAC to use in the CE computation. When the analysis consider only one value of RAC  |
| rac_ini | Vector of the RAC to use in the CE computation. When the analysis consider a sequence of RAC values |
| rac_fin | Final value for the RAC vector  |
| rac_len | RAC vector length   |

**Value**

Plot of CE to compare treatments/projects

---

|               |   |
|---------------|---|
| plot_ce_power | <i>Plot for CE using Power Utility Function</i> |
|---------------|---|

---

**Description**

Plot for CE using Power Utility Function

**Usage**

```
plot_ce_power(data, rac = 0, rac_ini = 0, rac_fin = 1,
              rac_len = 10)
```

**Arguments**

|         |   |
|---------|---|
| data    | Data set with CE already computed   |
| rac     | Scalar with the RAC to use in the CE computation. When the analysis consider only one value of RAC  |
| rac_ini | Vector of the RAC to use in the CE computation. When the analysis consider a sequence of RAC values |
| rac_fin | Final value for the RAC vector  |
| rac_len | RAC vector length   |

**Value**

Plot of CE to compare treatments/projects

---

|                      |  |
|----------------------|--|
| plot_risk_premium_en | <i>Plot of the Risk Premium values using Exponential Negative Utility Function</i> |
|----------------------|--|

---

**Description**

Plot of the Risk Premium values using Exponential Negative Utility Function

**Usage**

```
plot_risk_premium_en(data, rac_ini, rac_fin, rac_len)
```

**Arguments**

|         |  |
|---------|--|
| data    | data.frame of CE computed by Exponential Negative function |
| rac_ini | Initial RAC values used in the CE computation              |
| rac_fin | Final RAC values used in the CE computation                |
| rac_len | Length of the RAC vector used in the CE computation        |

**Value**

Plot object

---

|                     |  |
|---------------------|--|
| plot_risk_premium_p | <i>Plot of the Risk Premium values using Exponential Negative Utility Function</i> |
|---------------------|--|

---

**Description**

Plot of the Risk Premium values using Exponential Negative Utility Function

**Usage**

```
plot_risk_premium_p(data, rac_ini, rac_fin, rac_len)
```

**Arguments**

|         |   |
|---------|---|
| data    | data.frame of CE computed by Power Utility function |
| rac_ini | Initial RAC values used in the CE computation       |
| rac_fin | Final RAC values used in the CE computation         |
| rac_len | Length of the RAC vector used in the CE computation |

**Value**

plot object

---

|         |                                 |
|---------|---------------------------------|
| premium | <i>Risk Premium computation</i> |
|---------|---------------------------------|

---

**Description**

Risk Premium computation

**Usage**

```
premium(tbase, ce_data, rac, utility)
```

**Arguments**

|         |   |
|---------|---|
| tbase   | Name of the base treatment/project  |
| ce_data | data.frame with CE values previously computed   |
| rac     | Vector with RAC sequence used in the CE computation   |
| utility | The utility function: "ExpNeg" if CE it was computed using Exponential Negative utility function. "Power" if the utility function was Power |



**Details**

This function computes the risk premium values, regarding a project or treatment arbitrarily chosen by the user, using a CEs dataset (a ‘certainty’ object) already computed.

**Value**

Generates three objects: A data.frame with the total values of the premium risks; a data.frame with the percentage of difference with respect the base treatment; and a plot with the treatments’ premium risk.

**Examples**

```
## Example using profit dataset
data(profitSWG)

# First, compute the CE values
c1 <- certainty(data = profitSWG,ival = .5,fval = 4,utility = "Power")

ce_values <- c1$CE_values # CE table
ce_rac <- c1$RAC          # RAC vector

# The Risk premium values respect to Serenade treatment
rp <- premium(tbase = "serenade", ce_data = ce_values,rac = ce_rac, utility = "Power")

rp$PremiumRisk          # absolute values
rp$PremiumRiskPer100    # values in percentage
rp$RP_plot()           # plot
```

---

profitSWG

*Profit SWG*


---

**Description**

The data come from strawberry trials experiments in Florida, USA, performed by the Gulf Coast Research and Education Center, University of Florida.

**Usage**

```
data(profitSWG)
```

**Format**

A data frame with 8 rows of profit and 4 pesticide treatments:

**control** Control (non-treated case), in US dollars

**fracture** Fracture treatment, in US dollars

**milstop** Milstop treatment, in US dollars

**serenade** Serenade Optimum treatment, in US dollars

**Details**

Correspond to the profit for three pesticide treatments plus the case without treatment. Four observations for each season, 2014-15 and 2015-16.

**Source**

Soto-Caro, Wu, Guan (2019). "Evaluating Pest Management Strategies: A Robust Method and Its Application to Strawberry Disease Management". AAEA 2019 Conference.

**References**

Soto-Caro, Wu, Guan (2019). "Evaluating Pest Management Strategies: A Robust Method and Its Application to Strawberry Disease Management". AAEA 2019 Conference.

**Examples**

```
data(profitSWG)
summary(profitSWG)
```

---

RACa

*Adjusted Risk Aversion Coefficient (RACa)*

---

**Description**

Adjusted Risk Aversion Coefficient (RACa)

**Usage**

```
RACa(rac, data)
```

**Arguments**

|      |  |
|------|--|
| rac  | An scalar with the value of the relative RAC |
| data | Dataset to weight the RAC                    |

**Value**

This function create an adjustment to the relative risk aversion coefficient, following Hardaker et al (2004).

---

|               |                      |
|---------------|----------------------|
| rac_generator | <i>RAC Generator</i> |
|---------------|----------------------|

---

**Description**

RAC Generator

**Usage**

```
rac_generator(data, ini, fin)
```

**Arguments**

|      |   |
|------|---|
| data | data.frame object to weight the RAC                               |
| ini  | The initial value of the risk aversion coefficient (RAC) sequence |
| fin  | The final value of the risk aversion coefficient (RAC) sequence   |

**Details**

Create a vector with the adjusted relative risk aversion coefficients to be used in the CE computation, under Power utility function.

**Value**

Produce a single vector of adjusted RACs.

**Examples**

```
# Example
data("profitSWG")
rac_generator(data = profitSWG$control, ini = 0.5, fin = 4.0)
```

---

|         |   |
|---------|---|
| rac_len | <i>Define the length of the Risk Aversion Coefficient, RAC.</i> |
|---------|---|

---

**Description**

Define the length of the Risk Aversion Coefficient, RAC.

**Usage**

```
rac_len(ini, fin, data)
```

**Arguments**

|      |  |
|------|--|
| ini  | The initial value of the RAC sequence        |
| fin  | The final value of the RAC sequence          |
| data | Original data, could be a vector or a matrix |

**Value**

Two elements are generated: "r" is the RAC vector, and "length" is a scalar with the number of elements on RAC vector.

---

|         |                               |
|---------|-------------------------------|
| rac_seq | <i>RAC Sequence generator</i> |
|---------|-------------------------------|

---

**Description**

RAC Sequence generator

**Usage**

```
rac_seq(ini, fin, len)
```

**Arguments**

|     |                                     |
|-----|-------------------------------------|
| ini | The initial value for the RAC       |
| fin | The final value for the RAC         |
| len | The Length of the vector to creates |

**Value**

Vector of RACs

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