Package 'AnglerCreelSurveySimulation'

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Title Simulate a Bus Route Creel Survey of Anglers

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Depends R (>= 3.0.2)

Imports dplyr, ggplot2, stats, grid

Description Simulate an angler population, sample the simulated population with a user-specified survey times, and calculate metrics from a bus route-type creel survey.

License GPL-3

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VignetteBuilder knitr

RoxygenNote 6.0.1

NeedsCompilation no

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R topics documented:

`calculate_rse` *Calculate the Relative Standard Error of a numeric vector*

Description

Calculates relative standard error of a vector of numbers.

Usage

```
calculate_rse(x)
```

Arguments

`x`	The numeric vector of numbers from which relative standard error should be calculated.

Details

Relative standard error is returned as a proportion. It is sometimes also referred to as "proportional standard error."

Relative standard error is the standard error divided by the mean:

$$RelativeStandardError = \frac{\frac{s}{\sqrt{n}}}{\bar{x}}$$

Value

This function returns a single value that is the relative standard error of a vector of numbers.

Author(s)

Steven H. Ranney

References

Malvestuto, S. P. 1996. Sampling the recreational creel. Pages 591-623 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Examples

```
calculate_rse(rnorm(100, 10, 3))
```

`conduct_multiple_surveys` *Conduct multiple simulations of a survey*

Description

This function uses `make_anglers` and `get_total_values` to conduct multiple bus-route or traditional access point creel surveys (from the number provided to the `n_sims` argument) of a population of anglers.

Usage

```
conduct_multiple_surveys(n_sims, ...)
```

Arguments

`n_sims`	The number of simulations to be conducted in the simulation of interest.
`...`	Arguments to be passed to other subfunctions

Details

Because this function is merely a wrapper for the `simulate_bus_route` code, the user still needs to set `start_time`, `wait_time`, `n_anglers`, `n_sites`, and `sampling_prob` as objects. These can be passed through the `...` argument or through setting `wait_time` and others outside of the function call itself.

Value

Estimate catch (Ehat), the catch rate calculated by the ratio of means, the true, observed catch, and the actual catch rate (mean_lambda).

Author(s)

Steven H. Ranney

See Also

`make_anglers`

`get_total_values`

`simulate_bus_route`

Examples

```
#Simulation 1
start_time <- c(1, 3.5, 6.5)
wait_time <- c(2, 2, 3)
n_anglers <- c(10,10,50)
n_sites <- 3
sampling_prob <- sum(wait_time)/12
mean_catch_rate <- 3

n_sims <- 10

set.seed(256)

conduct_multiple_surveys(n_sims = n_sims, start_time = start_time, wait_time = wait_time,
                         n_anglers = n_anglers, n_sites = n_sites,
                        sampling_prob = sampling_prob, mean_catch_rate = mean_catch_rate)

#Simulation 2
start_time <- 0
wait_time <- 8
n_anglers <- 100
n_sites <- 1
sampling_prob <- 8/10
mean_catch_rate <- 2.5

#One survey/week for a year
conduct_multiple_surveys(n_sims = 52, start_time, wait_time, n_anglers, n_sites, sampling_prob,
                         mean_catch_rate, fishing_day_length = 10)
```

---

create_plot_from_simulation

Create a plot from a creel survey simulation

Description

Generates a plot of either `Ehat` or `Ehat*catch_rate_ROM` as a function of `true_effort` or `true_catch`, respectively. Adds `link{lm()}` to the plot and returns the `link{summary()}` of the fitted model.

Usage

```
create_plot_from_simulation(data, value = "effort", color = "black")
```

Arguments

`data`	The data frame from which to draw the `Ehat` and `true_effort` values
`value`	The value of interest from the simulation. Other values include `"catch"`
`color`	The color of the points in the plot, passed to `ggplot`.

Author(s)

Steven H. Ranney

Examples

```
start_time <- 0
wait_time <- 8
n_anglers <- 50
n_sites <- 1
sampling_prob <- wait_time/12
mean_catch_rate <- 10

tmp <- conduct_multiple_surveys(91, start_time, wait_time, n_anglers, n_sites, sampling_prob,
                          mean_catch_rate, fishing_day_length = 12, mean_trip_length = 4)

create_plot_from_simulation(tmp, "catch")
```

---

get_total_values *Conduct a creel survey of a population of anglers at an access site.*

Description

This function uses the output from `make_anglers` to conduct a bus-route or traditional access point creel survey of the population of anglers from `make_anglers` and provide clerk-observed counts of anglers and their effort.

Usage

```
get_total_values(data, start_time = NULL, end_time = NULL,
  wait_time = NULL, sampling_prob = 1, mean_catch_rate = NULL, ...)
```

Arguments

`data`	The dataframe returned from `make_anglers`
`start_time`	The start time of the clerk.
`end_time`	the end time of the clerk.
`wait_time`	the wait time of the clerk.
`sampling_prob`	The sampling probability of the survey. The default is `1` but will need to be changed if the survey is conducted during only half of the fishing day (i.e., `.5`) or over longer time periods (e.g., `9.5/12`, if the survey is 9.5 hours long and the fishing day length is 12 hours)
`mean_catch_rate`	The mean catch rate for the fishery.
`...`	Arguments to be passed to other functions.

Details

Total effort is the sum of the trip lengths from `data`

The total number of anglers is equal to the `nrow()` of the dataframe in `data`

Catch rates are assigned to anglers based upon the Gamma distribution with a mean of `mean_catch_rate`

If both `end_time=NULL` and `wait_time=NULL` then `wait_time` will be 0.5 (one-half hour). If a value is passed to `end_time`, then `wait_time` becomes `end_time - start_time`.

If `start_time=NULL`, then a `start_time` is generated from the uniform distribution between `0` and `11.5` hours into the fishing day.

If `end_time=NULL`, then `end_time = start_time+wait_time`

Incomplete trip effort is observed two ways: 1) by counting anglers that were at the site for the entire time that the surveyor was at the site and 2) counting anglers that arrived after the surveyor arrived at the site but remained at the site after the surveyor left. These anglers are counted and their effort calculated based upon surveyor `start_time` and `end_time`.

Completed trip effort is observed two ways: 1) by interviewing anglers that left while the surveyor was at the site. The surveyor can determine effort and catch. 2) by interviewing anglers that both arrived and departed while the surveyor was on site. When `wait_time` is short, these cases are are rare; however, when `wait_time` is long (e.g., all day), then these cases are much more likely.

Trip lengths of observed trips (both incomplete and complete) are scaled by the `sampling_prob` value. The `sampling_prob` is used to estimate effort and catch.

Author(s)

Steven H. Ranney

References

Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Special Publication 25, Bethesda, Maryland.

Examples

```
library(dplyr)
set.seed(256)

start_time = .001 #start of fishing day
end_time = 12 #end of fishing day
mean_catch_rate = 0.1 #this will cause VERY few fish to be caught!

make_anglers(100) %>%
  get_total_values(start_time = start_time,
                   end_time = end_time, mean_catch_rate = mean_catch_rate)

start_time = .001 #start of fishing day
end_time = 6 #halfway through the fishing day
sampling_prob = .5 #this needs to be .5 because we are sampling only 50% of the fishing day
mean_catch_rate = 0.1 #this will cause VERY few fish to be caught!
```

```
make_anglers(100) %>%
  get_total_values(start_time = start_time, end_time = end_time,
                   sampling_prob = sampling_prob, mean_catch_rate = mean_catch_rate)
```

`make_anglers` *Create a population of anglers.*

Description

Creates a population of `n_anglers` with trip length and fishing day length provided by the user.

Usage

```
make_anglers(n_anglers = 100, mean_trip_length = 3.88,
  fishing_day_length = 12)
```

Arguments

`n_anglers`	The number of anglers in the population
`mean_trip_length`	The mean trip length to be used in the function. `3.88` is the default. The default is from data from the 2008 Lake Roosevelt Fishing Evaluation Program.
`fishing_day_length`	The fishing day length to be used in the function. Anglers are not be allowed to be fishing past this day length. The default here is set to 12 hours, which may not be a suitable day length for fisheries at higher latitudes (i.e., sunrise-sunset is > 12 hours) or during shorter seasons.

Details

All trip lengths will be limited so that anglers have finished their fishing trip by the end of the fishing day. The function uses a `while` loop to ensure that the number of anglers = `n_anglers` provided in the function argument. `fishing_day_length` is passed to the argument. The default is set to 12 hours.

`starttimes` are assigned by the uniform distribution

`triplengths` are assigned by the gamma distribution where the default mean value comes from the 2008 Lake Roosevelt Fisheries Evaluation Program data.

Value

A data frame called that includes variables `start_time`, `trip_length`, and `departure_time`. Summing the `trip_length` field returns the true fishing effort.

Author(s)

Steven H. Ranney

Examples

```
make_anglers(100, mean_trip_length = 4, fishing_day_length = 10)
#make_anglers(10000)
```

`plot_multiple_objects` *Plot multiple ggplots in one window*

Description

This function takes multiple `ggplot` objects and puts them in one plot window.

Usage

```
plot_multiple_objects(..., plotlist = NULL, file, cols = 1, layout = NULL)
```

Arguments

`...`	The plots to include in the window
`plotlist`	If a `plotlist` exists, it should be included here
`file`	A plot file
`cols`	How many columns should the window have?
`layout`	A matrix specifying the layout. If present, `cols` is ignored.

Details

If the layout is something like `matrix(c(1,2,3,3), nrow=2, byrow=TRUE)`, then plot 1 will go in the upper left, 2 will go in the upper right, and 3 will go all the way across the bottom.

Author(s)

Steven H. Ranney

simulate_bus_route *Simulate a bus route survey*

Description

This function uses the output from make_anglers and get_total_values to conduct a bus-route or traditional access point creel survey of the population of anglers from make_anglers and provide clerk-observed counts of anglers and their effort.

Usage

```
simulate_bus_route(start_time, wait_time, n_anglers, n_sites,
  sampling_prob = 1, mean_catch_rate, ...)
```

Arguments

start_time	The start time of the surveyor at each site. This can be a vector of start times to simulate a bus route or one startTime to simulate a traditional access survey.
wait_time	The wait time of the surveyor at each site. This can be a vector of wait times to simulate a bus route or one waitTime to simulate a traditional access survey.
n_anglers	the number of anglers at each site, either a vector or a single number for single sites
n_sites	The number of sites being visited.
sampling_prob	What is the sampling probability for the survey? If all sites will be visited during the first or second half of the fishing day, samplingProb=0.5. If the survey will take the entire fishing day, then samplingProb=1.
mean_catch_rate	The mean catch rate for the fishery
...	Arguments to be passed to other subfunctions, specifically to the make_anglers function, including mean_trip_length and fishing_day_length.

Details

Effort and catch are estimated from the the Bus Route Estimator equation in Robson and Jones (1989), Jones and Robson (1991; eqn. 1) and Pollock et al. 1994.

Catch rate is calculated from the Ratio of Means equation (see Malvestuto (1996) and Jones and Pollock (2012) for discussions).

The Ratio of means is calculated by

$$\widehat{R_1} = \frac{\sum_{i=1}^{n} c_i/n}{\sum_{i=1}^{n} L_i/n}$$

where c_i is the catch for the i^{th} sampling unit and L_i is thelength of the fishing trip at the time of the interview. For incomplete surveys, L_i represents in incomplete trip.

The bus route estimator is

$$\widehat{E} = T \sum_{i=1}^{n} \frac{1}{w_i} \sum_{j=1}^{m} \frac{e_{ij}}{\pi_j}$$

where *E* = estimated total party-hours of effort; *T* = total time to complete a full circuit of the route, including travelling and waiting; w_i = waiting time at the i^{th} site (where *i* = 1, ..., *n* sites); e_{ij} = total time that the j^{th} car is parked at the i^{th} site while the agent is at that site (where *j* = 1, ..., *n* sites).

Value

Estimate catch (`Ehat`), the catch rate calculated by the ratio of means, the true, observed catch, and the actual catch rate (mean_lambda).

Author(s)

Steven H. Ranney

References

Jones, C. M., and D. Robson. 1991. Improving precision in angler surveys: traditional access design versus bus route design. American Fisheries Society Symposium 12:177-188.

Jones, C. M., and K. H. Pollock. 2012. Recreational survey methods: estimation of effort, harvest, and released catch. Pages 883-919 in A. V. Zale, D. L. Parrish, and T. M. Sutton, editors. Fisheries Techniques, 3rd edition. American Fisheries Society, Bethesda, Maryland.

Malvestuto, S. P. 1996. Sampling the recreational creel. Pages 591-623 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Special Publication 25, Bethesda, Maryland.

Robson, D., and C. M. Jones. 1989. The theoretical basis of an access site angler survey design. Biometrics 45:83-98.

See Also

`make_anglers`

`get_total_values`

Examples

```
# To simulate one bus route survey that takes place in the morning, these values are used
#start time at access sites
startTimeAM <- c(1, 2,3,4,5)
#wait time at access sites
waitTimeAM <- c(.5, .5, .5, .5, 2)
#the number of anglers that will visit access site throughout the day
nanglersAM <- c(10,10,10,10,50)
# the number of sites to be visited
nsitesAM <- 5
# the sampling probability.  Here it is .5 because we are only conducting this
```

```
# survey during the first 50% of the fishing day
sampling_prob <- .5
# the mean catch rate.  Here it is 2.5 which equals 2.5 fish/hour
mean_catch_rate <- 2.5

simulate_bus_route(start_time = startTimeAM, wait_time = waitTimeAM, n_anglers = nanglersAM,
n_sites = nsitesAM, sampling_prob = sampling_prob, mean_catch_rate = mean_catch_rate)

# To simulate one traditional access point survey where the creel clerk arrives,
# counts anglers, and interviews anglers that have completed their trips
start_time = 0.001
wait_time = 8
#nanglers can be informed by previously-collected data
n_anglers = 1000
n_sites = 1
# sampling probability here is 8/12 because we are staying at the access site
# for 8 hours of a 12-hour fishing day.  To adjust the fishing day length, an
# additional 'fishing_day_length' argument needs to be passed to this function.
sampling_prob <- (8/12)
# the mean catch rate.
mean_catch_rate <- 5

simulate_bus_route(start_time, wait_time, n_anglers, n_sites, sampling_prob, mean_catch_rate)
```

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