# Package: LARisk (via r-universe)

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**Type** Package

**Title** Estimation of Lifetime Attributable Risk of Cancer from Radiation Exposure

**Version** 1.0.0

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**Description** Compute lifetime attributable risk of radiation-induced cancer reveals that it can be helpful with enhancement of the flexibility in research with fast calculation and various options. Important reference papers include Berrington de Gonzalez et al. (2012) <doi:10.1088/0952-4746/32/3/205>, National Research Council (2006, ISBN:978-0-309-09156-5).

**License** LGPL-3

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`incid2010` *Cancer incidence table of Korea 2010*

---

## Description

A dataset containing the crude incidence rate of death by age, cancer site and gender.

## Usage

```
incid2010
```

## Format

A data frame with 1919 rows and 4 variables:

`Site` cancer site

`Age` age

`Rate_m` crude incidence rate for male

`Rate_f` crude incidence rate for female

## Source

KOSIS(Ministry of Health and Welfare, Cancer Registration Statistics) https://kosis.kr/

## incid2018 *Cancer incidence table of Korea 2018*

### Description

A dataset containing the crude incidence rate of death by age, cancer site and gender.

### Usage

```
incid2018
```

### Format

A data frame with 1919 rows and 4 variables:

`Site` cancer site

`Age` age

`Rate_m` crude incidence rate for male

`Rate_f` crude incidence rate for female

### Source

KOSIS(Ministry of Health and Welfare, Cancer Registration Statistics) https://kosis.kr/

## LAR *Estimate Lifetime Attributable Risk for one person*

### Description

`LAR` is used to estimate lifetime attributable radiation-related cancer risk for data with one person.

### Usage

```
LAR(
  data,
  basedata,
  sim = 300,
  seed = 99,
  current = as.numeric(substr(Sys.Date(), 1, 4)),
  ci = 0.9,
  weight = NULL,
  DDREF = TRUE,
  basepy = 1e+05
)
```

## Arguments

| | |
|---|---|
| data | data frame containing demographic information and exposure information. See 'Details'. |
| basedata | a list of the data of lifetime table and incidence rate table. The first element is lifetime table and the second is incidence rate table. |
| sim | number of iteration of simulation. |
| seed | a random seed number. |
| current | a current year. default is year of the system time. |
| ci | confidence level of the confidence interval. |
| weight | a list containing the value between 0 and 1 which is a weight on ERR model. See 'Details'. |
| DDREF | logical. Whether to apply the dose and dose-rate effectiveness factor. |
| basepy | number of base person-years |

## Details

The maximum age in LAR is set as 100. If the data contains birth which makes attained age (=current - birth) exceed 100, the result has no useful value.

data should include information which includes gender, year of birth, year of exposure, sites where exposed, exposure rate, distribution of dose and dose parameters of exosed radiation. The name of each variables must be sex, birth, exposure, site, exposure_rate, dosedist, dose1, dose2, dose3.

For some variables, there is a fixed format. sex can have the component 'male' or 'female'. site can have the component 'stomach', 'colon', 'liver', 'lung', 'breast', 'ovary', 'uterus', 'prostate', 'bladder', 'brain/cns', 'thyroid', 'remainder', 'oral', 'oesophagus', 'rectum', 'gallbladder', 'pancreas', 'kidney', 'leukemia'. exposure_rate can have the component 'acute' or 'chronic'. dosedist can have the component 'fixedvalue', 'lognormal', 'normal', 'triangular', 'logtriangular', 'uniform', 'loguniform'.

dose1, dose2, dose3 are parameters of dose distribution. The parameters for each distribution are that:

**fixedvalue** dose value (dose1)

**lognormal** median (dose1), geometric standard deviation (dose2)

**normal** mean (dose1), standard deviation (dose2)

**triangular or logtriangular** minimum (dose1), mode (dose2), maximum (dose3)

**uniform or loguniform** minimum (dose1), maximum (dose2)

weight

## Value

LAR returns an object of "LAR" class.

An object of class "LAR" is a list containing the following components:

LAR Lifetime attributable risk (LAR) from the time of exposure to the end of the expected lifetime.

`F_LAR` Future attributable risk from current to the expected lifetime.

`LBR` Lifetime baseline risk.

`BFR` Baseline future risk.

`LFR` Lifetime fractional risk.

`TFR` Total future risk.

`current` Current year.

`ci` Confidence level.

`pinfo` Information of the person.

## References

Berrington de Gonzalez, A., Iulian Apostoaei, A., Veiga, L., Rajaraman, P., Thomas, B., Owen Hoffman, F., Gilbert, E. and Land, C. (2012). RadRAT: a radiation risk assessment tool for lifetime cancer risk projection. *Journal of Radiological Protection*, **32(3)**, pp.205-222.

National Research Council (NRC) and Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation (2005) *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (Washington, DC: National Academy of Sciences)

## See Also

`LAR_batch`, `LAR_group`

## Examples

```
## example with lifetime and incidence rate table in 2010 Korea.
organ2 <- split(organ, organ$ID)[[1]]   ## data of one person.

## defualt
lar1 <- LAR(organ2, basedata = list(life2010, incid2010))
summary(lar1)

## change the weight for ERR and EAR models
weight_list <- list("rectum" = 0.5)
lar2 <- LAR(organ2, basedata = list(life2010, incid2010), weight = weight_list)
summary(lar2)

## change the DDREF option (DDREF=FALSE)
lar3 <- LAR(organ2, basedata = list(life2010, incid2010), DDREF = FALSE)
summary(lar3)
```

LAR_batch *Estimate Lifetime Attributable Risk for several people*

## Description

LAR_batch is used to estimate lifetime attributable radiation-related cancer risk for data with several people.

## Usage

```
LAR_batch(
  data,
  pid,
  basedata,
  sim = 300,
  seed = 99,
  current = as.numeric(substr(Sys.Date(), 1, 4)),
  ci = 0.9,
  weight = NULL,
  DDREF = TRUE,
  basepy = 1e+05
)
```

## Arguments

| | |
|---|---|
| data | data frame containing demographic information and exposure information. See 'Details'. |
| pid | a vector which distinguish each person. |
| basedata | a list of the data of lifetime table and incidence rate table. The first element is lifetime table and the second is incidence rate table. |
| sim | number of iteration of simulation. |
| seed | a random seed number. |
| current | a current year. default is year of the system time. |
| ci | confidence level of the confidence interval. |
| weight | a list containing the value between 0 and 1 which is a weight on ERR model. See 'Details'. |
| DDREF | logical. Whether to apply the dose and dose-rate effectiveness factor. |
| basepy | number of base person-years |

## Value

LAR_batch returns an object of multiple classes "LAR_batch", "LAR". An object of class LAR_batch is a list of LAR class objects which names of elements are ID of each person.

## References

Berrington de Gonzalez, A., Iulian Apostoaei, A., Veiga, L., Rajaraman, P., Thomas, B., Owen Hoffman, F., Gilbert, E. and Land, C. (2012). RadRAT: a radiation risk assessment tool for lifetime cancer risk projection. *Journal of Radiological Protection*, **32(3)**, pp.205-222.

National Research Council (NRC) and Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation (2005) *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (Washington, DC: National Academy of Sciences)

## See Also

LAR, LAR_group

## Examples

```
## example with lifetime and incidence rate table in 2010 Korea.
lar1 <- LAR_batch(nuclear, pid=nuclear$ID, basedata = list(life2010, incid2010))
summary(lar1)
```

---

LAR_group *Average Estimated Lifetime Attributable Risk by Group*

---

## Description

LAR_group is used to estimate lifetime attributable radiation-related cancer risk by group.

## Usage

```
LAR_group(
  data,
  pid,
  group,
  basedata,
  sim = 300,
  seed = 99,
  current = as.numeric(substr(Sys.Date(), 1, 4)),
  ci = 0.9,
  weight = NULL,
  DDREF = TRUE,
  basepy = 1e+05
)
```

## Arguments

| | |
|---|---|
| data | data frame containing demographic information and exposure information. See 'Details'. |
| pid | a vector which distinguish each person. |
| group | a vector or list of vectors which distinguish each group. |
| basedata | a list of the data of lifetime table and incidence rate table. The first element is lifetime table and the second is incidence rate table. |
| sim | number of iteration of simulation. |
| seed | a random seed number. |
| current | a current year. default is year of the system time. |
| ci | confidence level of the confidence interval. |
| weight | a list containing the value between 0 and 1 which is a weight on ERR model. See 'Details'. |
| DDREF | logical. Whether to apply the dose and dose-rate effectiveness factor. |
| basepy | number of base person-years |

## Value

LAR_group returns an object of multiple classes "LAR_group", "LAR". An object of class LAR_group is a list of LAR class objects which names of elements are group of each groups.

## References

Berrington de Gonzalez, A., Iulian Apostoaei, A., Veiga, L., Rajaraman, P., Thomas, B., Owen Hoffman, F., Gilbert, E. and Land, C. (2012). RadRAT: a radiation risk assessment tool for lifetime cancer risk projection. *Journal of Radiological Protection*, **32(3)**, pp.205-222.

National Research Council (NRC) and Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation (2005) *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (Washington, DC: National Academy of Sciences)

## Examples

```
## example with lifetime and incidence rate table in 2010 Korea.
lar1 <- LAR_group(nuclear, pid=nuclear$ID, group=nuclear$distance,
                  basedata = list(life2010, incid2010))
summary(lar1)

lar2 <- LAR_group(nuclear, pid=nuclear$ID, group=list(nuclear$sex, nuclear$distance),
                  basedata = list(life2010, incid2010))
summary(lar2)
```

## life2010 *Lifetime table of Korea 2010*

### Description

A dataset containing the probability of death by age and gender.

### Usage

```
life2010
```

### Format

A data frame with 101 rows and 3 variables:

`Age` age

`Prob_d_m` probability of death for male

`Prob_d_f` probability of death for female

### Source

KOSIS(Statistics Korea, Life Tables By Province) https://kosis.kr/

## life2018 *Lifetime table of Korea 2018*

### Description

A dataset containing the probability of death by age and gender.

### Usage

```
life2018
```

### Format

A data frame with 101 rows and 3 variables:

`Age` age

`Prob_d_m` probability of death for male

`Prob_d_f` probability of death for female

### Source

KOSIS(Statistics Korea, Life Tables By Province) https://kosis.kr/

## nuclear *Simulated data of organ radiation exposure dose*

### Description

nuclear is simulated dataset for acute exposure event. The scenario assumes that the people exposure the radiation at 2011.

### Usage

```
nuclear
```

### Format

A data frame with 100 observation of 11 variables:

ID person ID.

sex gender

birth birth-year

exposure exposed year to radiation

site organ where exposed to radiation

exposure_rate expsoure rate

dosedist distribution of dose

dose1 dose parameter

dose2 dose parameter

dose3 dose parameter

distance distance from the hyper

## organ *Simulated data of organ radiation exposure dose*

### Description

organ is simulated dataset from the data of workers at interventional radiology departments.

### Usage

```
organ
```

## Format

A data frame with 971 observation of 11 variables:

`ID` person ID.

`sex` gender

`birth` birth-year

`exposure` exposed year to radiation

`site` organ where exposed to radiation

`exposure_rate` expsoure rate

`dosedist` distribution of dose

`dose1` dose parameter

`dose2` dose parameter

`dose3` dose parameter

`occup` occupation

## References

Lee, W. J., Bang, Y. J., Cha, E. S., Kim, Y. M., & Cho, S. B. (2021). Lifetime cancer risks from occupational radiation exposure among workers at interventional radiology departments. *International Archives of Occupational and Environmental Health*, **94(1)**, 139-145.

---

# print.LAR *Print estimated Lifetime Attributable Risk for one person*

---

## Description

`print.LAR` is the basic function for printing class "LAR".

## Usage

```
## S3 method for class 'LAR'
print(x, digits = 4, ...)

## S3 method for class 'LAR_batch'
print(x, digits = 4, max.id = 50, ...)

## S3 method for class 'LAR_group'
print(x, digits = 4, max.id = 50, ...)
```

## Arguments

| | |
|---|---|
| `x` | 'LAR', 'LAR_batch' or 'LAR_group' object. |
| `digits` | the number of decimal points to print. |
| `...` | further arguments to be passed from or to other methods. |
| `max.id` | the number of maximum of printing LAR results. |

summary.LAR *Summarize estimated Lifetime Attributable Risk for one person*

## Description

summary.LAR is the function for printing class "LAR".

## Usage

```
## S3 method for class 'LAR'
summary(object, digits = 4, ...)

## S3 method for class 'LAR_batch'
summary(object, digits = 4, max.id = 50, ...)

## S3 method for class 'LAR_group'
summary(object, digits = 4, max.id = 50, ...)
```

## Arguments

| | |
|---|---|
| object | object of class 'LAR_batch' or LAR'. |
| digits | the number of decimal points to print. |
| ... | further arguments to be passed from or to other methods. |
| max.id | the number of maximum of printing LAR results. |

write_LAR *Write a LAR object*

## Description

Write 'LAR' object to CSV file

## Usage

```
write_LAR(x, filename)

## S3 method for class 'LAR'
write_LAR(x, filename)

## S3 method for class 'LAR_batch'
write_LAR(x, filename)

## S3 method for class 'LAR_group'
write_LAR(x, filename)
```

### Arguments

| | |
|---|---|
| x | a 'LAR' object. |
| filename | a string naming the file to save (.csv file) |

### Methods (by class)

- LAR: write an 'LAR' class object
- LAR_batch: write an 'LAR_batch' class object
- LAR_group: write an 'LAR_group' class object

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