Practical Rates and Rates Ratio

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1.0 Load packages

```
library(foreign)
library(epiDisplay)
library(epitools)
library(epiR)
library(fmsb)
```

2.0 Load the child deaths data

```
childdeaths <- read.table("child.deaths.csv", header = TRUE,
    sep = ",")
str(childdeaths)
```

```
## 'data.frame':    500 obs. of  7 variables:
##  $ pid       : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ date_birth: chr  "1/1/07" "1/1/07" "1/1/07" "1/1/07" ...
##  $ date_exit : chr  "1/1/12" "1/2/07" "1/1/12" "1/1/12" ...
##  $ sex       : chr  "f" "f" "f" "f" ...
##  $ locn_birth: chr  "Home" "Hospital" "Home" "Home" ...
##  $ status    : int  1 2 1 1 1 1 1 1 1 1 ...
##  $ mom_educ  : chr  "some education" "some education" "some e
```

2.1 label the values of the variable “status”

```
childdeaths$status <- as.numeric(childdeaths$status)
childdeaths$status <- factor(childdeaths$status, levels = c(1,
    2), labels = c("alive", "dead"))
table(childdeaths$status)
```

```
##
## alive  dead
##   459    41
```

3.0 generate person-years

```
childdeaths$date_exit <- as.Date(childdeaths$date_exit, "%m/%d/%
childdeaths$date_birth <- as.Date(childdeaths$date_birth, "%m/%d
person_yrs <- difftime(childdeaths$date_exit, childdeaths$date_b
person_yrs <- (as.numeric(person_yrs))/365.25
childdeaths <- data.frame(childdeaths, person_yrs)
```

```
head(childdeaths)
```

```
##   pid date_birth  date_exit sex locn_birth status       mom_e
## 1   1 2007-01-01 2012-01-01   f       Home  alive some educat
## 2   2 2007-01-01 2007-01-02   f   Hospital   dead some educat
## 3   3 2007-01-01 2012-01-01   f       Home  alive some educat
## 4   4 2007-01-01 2012-01-01   f       Home  alive some educat
## 5   5 2007-01-01 2012-01-01   f       Home  alive some educat
## 6   6 2007-01-01 2012-01-01   f       Home  alive some educat
```

4.0 Calculate rates

```
total_deaths <- length(childdeaths$status[childdeaths$status ==
    "dead"])
total_deaths
```

```
## [1] 41
```

```
total_pyrs <- sum(childdeaths$person_yrs)
total_pyrs
```

```
## [1] 2311.543
```

```
mort_rate <- (as.numeric(total_deaths)/total_pyrs)
mort_rate
```

```
## [1] 0.01773707
```

5.0 calculate standard error of the rate

```
s.e.Rate <- sqrt(total_deaths)/total_pyrs * 1000  #
s.e.Rate
```

```
## [1] 2.770065
```

```
s.e.log.Rate <- 1/sqrt(total_deaths)
s.e.log.Rate
```

```
## [1] 0.1561738
```

6.0 Compute 95% CI for rate

```
log.rate = log(mort_rate)
lower.bound = exp(log.rate - 1.96 * s.e.log.Rate)
lower.bound
```

```
## [1] 0.01306003
```

```
upper.bound = exp(log.rate + 1.96 * s.e.log.Rate)
upper.bound
```

```
## [1] 0.02408905
```

COMPARING TWO RATES

7.0 Rate difference: Males vs. Females

- Calculate number of deaths for each gender: female

```
f.deaths <- length(childdeaths$status[childdeaths$status == "dea
    childdeaths$sex == "f"])
f.deaths
```

```
## [1] 21
```

- Calculate number of deaths for each gender: male

```
m.deaths <- length(childdeaths$status[childdeaths$status == "dea
    childdeaths$sex == "m"])
m.deaths
```

```
## [1] 20
```

7.2 calculate person years for each gender

```
f.total_pyrs <- sum(childdeaths$person_yrs[childdeaths$sex ==
    "f"])
f.total_pyrs
```

```
## [1] 1148.698
```

```
m.total_pyrs <- sum(childdeaths$person_yrs[childdeaths$sex ==
    "m"])
m.total_pyrs
```

```
## [1] 1162.845
```

```
kableExtra::kable(table(childdeaths$status, childdeaths$sex))
```

	f	m
alive	228	231
dead	21	20

7.3 calculate rate difference

```
diff1 <- (f.deaths/f.total_pyrs) - (m.deaths/m.total_pyrs)
diff1
```

```
## [1] 0.001082363
```

```
gender_diff <- ratedifference(f.deaths, m.deaths, f.total_pyrs,
    m.total_pyrs, conf.level = 0.95)
```

```
##                      Cases  Person-time Incidence rates
## Exposed   2.100000e+01 1.148698e+03    1.828157e-02
## Unexposed 2.000000e+01 1.162845e+03    1.719920e-02
## Total     4.100000e+01 2.311543e+03    1.773707e-02
```

```
gender_diff
```

```
##
##  Incidence rate difference and its significance probability (
##  difference equals to zero)
##
## data:  f.deaths m.deaths f.total_pyrs m.total_pyrs
## p-value = 0.8451
## 95 percent confidence interval:
##  -0.009778324  0.011943050
## sample estimates:
## [1] 0.001082363
```

8.0 Rate Ratio: Home vs. Hospital delivery

8.1 Calculate number of deaths for each gender: male and female

```
home_deaths <- length(childdeaths$status[childdeaths$status ==
    "dead" & childdeaths$locn_birth == "Home"])
hosp_deaths <- length(childdeaths$status[childdeaths$status ==
    "dead" & childdeaths$locn_birth == "Hospital"])
table(childdeaths$status, childdeaths$locn_birth)
```

```
##
##          Home Hospital
##   alive   295      164
##   dead     32        9
```

8.2 calculate person years for both babies delivered in hospital and at home

```
home_pyrs <- sum(childdeaths$person_yrs[childdeaths$locn_birth ==
    "Home"])
hosp_pyrs <- sum(childdeaths$person_yrs[childdeaths$locn_birth ==
    "Hospital"])
home_vs_hosp <- ratetable(home_deaths, hosp_deaths, home_pyrs,
    hosp_pyrs)
dimnames(home_vs_hosp) <- list(Exposure = c("Home", "Hospital"),
    Outcome = c("Deaths", "PYears"))
home_vs_hosp
```

```
##           Outcome
## Exposure   Deaths    PYears
##   Home         32 1487.6632
##   Hospital      9  823.8795
```

8.3 calculate the rate ratio

```
rateratio.wald(home_vs_hosp, rev = "r")
```

```
## $data
##            Outcome
## Exposure    Deaths    PYears
##   Hospital       9  823.8795
##   Home          32 1487.6632
##   Total         41 2311.5428
##
## $measure
##            rate ratio with 95% C.I.
## Exposure    estimate     lower    upper
##   Hospital 1.000000        NA       NA
##   Home     1.969094 0.9399433 4.125071
##
## $p.value
##            two-sided
## Exposure    midp.exact        wald
```

8.4 Rate Ratio: mother's education (some education Vs. no education)

```
no_educ_deaths <- length(childdeaths$status[childdeaths$status =
    "dead" & childdeaths$mom_educ == "no education"])
some_educ_deaths <- length(childdeaths$status[childdeaths$status
    "dead" & childdeaths$mom_educ == "some education"])
table(childdeaths$status, childdeaths$mom_educ)
```

```
##
##          no education some education
##   alive           293            166
##   dead             32              9
```

```
no_educ_pyrs <- sum(childdeaths$person_yrs[childdeaths$mom_educ
    "no education"])
some_educ_pyrs <- sum(childdeaths$person_yrs[childdeaths$mom_edu
    "some education"])
some_educ_Vs_no_educ <- ratetable(no_educ_deaths, some_educ_deat
    no_educ_pyrs, some_educ_pyrs)
dimnames(some_educ_Vs_no_educ) <- list(Exposure = c("no educatio
    "some education"), Outcome = c("Deaths", "PYears"))
some_educ_Vs_no_educ
```

```
##                  Outcome
## Exposure          Deaths    PYears
##   no education        32 1477.7194
##   some education       9  833.8234
```

```
rateratio.wald(some_educ_Vs_no_educ, rev = "r")
```

```
## $data
##                   Outcome
## Exposure           Deaths    PYears
##   some education        9  833.8234
##   no education         32 1477.7194
##   Total                41 2311.5428
##
## $measure
##                   rate ratio with 95% C.I.
## Exposure           estimate     lower    upper
##   some education 1.000000        NA       NA
##   no education   2.006271 0.9576894 4.202953
##
## $p.value
##                   two-sided
## Exposure           midp.exact       wald
##   some education          NA          NA
##   no education   0.05630778 0.05971556
```