

Fisher's Exact Test

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1 Example: Old vs New Treatment

We are researching a new medical treatment and wish to discover whether it is better than the old one.

```
M <- matrix(c(5,2,2,4),2,2)
dimnames(M) <- list(treatment=c("new","old"),cured=c(TRUE,FALSE))
M

##           cured
## treatment TRUE FALSE
##      new      5      2
##      old      2      4

# x: contingency table (2 by 2)
# alternative: Alternative hypothesis
# Testing if being in 'new' increases the odds of being in 'TRUE'

fisher.test(x = M, alternative = "greater")

##
## Fisher's Exact Test for Count Data
##
## data:  M
## p-value = 0.2086
## alternative hypothesis: true odds ratio is greater than 1
## 95 percent confidence interval:
##  0.4275931      Inf
## sample estimates:
## odds ratio
##  4.354273
```

2 How to use 'alternative'

```
M <- matrix(c('a','c','b','d'),2,2)
dimnames(M) <- list(c("Row 1","Row 2"),c("Col 1","Col 2"))
knitr::kable(M)
```

	Col 1	Col 2
Row 1	a	b
Row 2	c	d

The **Odds Ratio (OR)** is estimated roughly as:

$$OR \approx \frac{a \times d}{b \times c}$$

The test compares:

- the odds of an event in **Row 1** falling into **Column 1** versus
- the odds of an event in **Row 2** falling into **Column 1**.

2.1 alternative = “greater”

- **Row 1 is more associated with Column 1** than Row 2 is.
- Testing if the **Odds Ratio > 1**.
- In English: “Being in Row 1 increases the odds of being in Column 1.”

2.2 alternative = “less”

- **Row 1 is less associated with Column 1** than Row 2 is.
- Testing if the **Odds Ratio < 1**.
- In English: “Being in Row 1 decreases the odds of being in Column 1.”

2.3 alternative = “two.sided”

- Testing if the **Odds Ratio $\neq 1$** .
- In English: “Row 1 and Row 2 have different distributions across the columns, but I don’t assume a specific direction beforehand.”