Exploring False Data

Accounting for False Negatives and False Positives

What are they anyway?

A Rose by Any Other Name

False Positive - Rejecting a true null hypothesis, Type I error, α, false alarm:

Convicting an innocent person, diagnosing a disease which is not present

False Negative - Accepting a false null hypothesis, Type II error, β:

Acquitting someone who is guilty, clean bill of health to a sick person

Sensitivity and Specificity

Sensitivity (aka. Recall, Probability of Detection, True Positive Rate (TPR)) -

True Positives / (Number of true positives + Number of false negatives)

Specificity (aka. True Negative Rate (TNR)) -

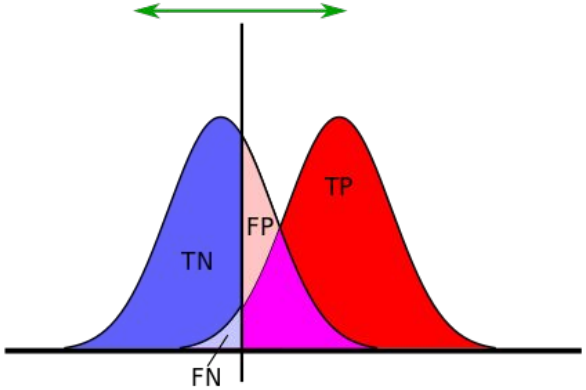
True Negatives / (Number of true negatives + number of false positives)

How are they determined?

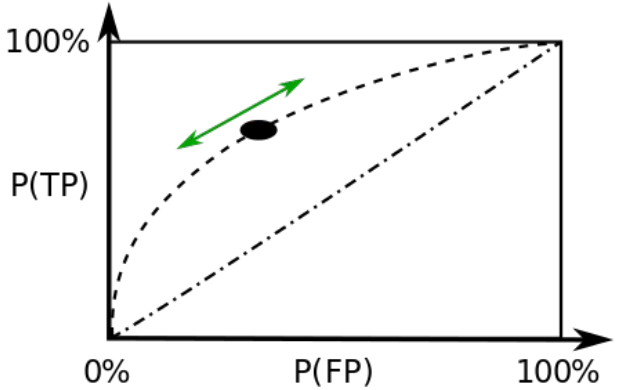
Determining the Sensitivity and Specificity

By using samples of known disease status (or training and testing data), values such as sensitivity and specificity can be easily calculated.

Decrease One, Increase the Other



TP	FP
FN	TN



Screen then Test

Screening Tests:

- High sensitivity, low specificity
- Generally cheaper and easier to widely deploy
- High rate of False Positives, but ideally no False Negatives

Confirmation Testing:

- Higher accuracy
- More expensive or difficult
- Weed out False Positives

What about less clear cut cases?

P-Values

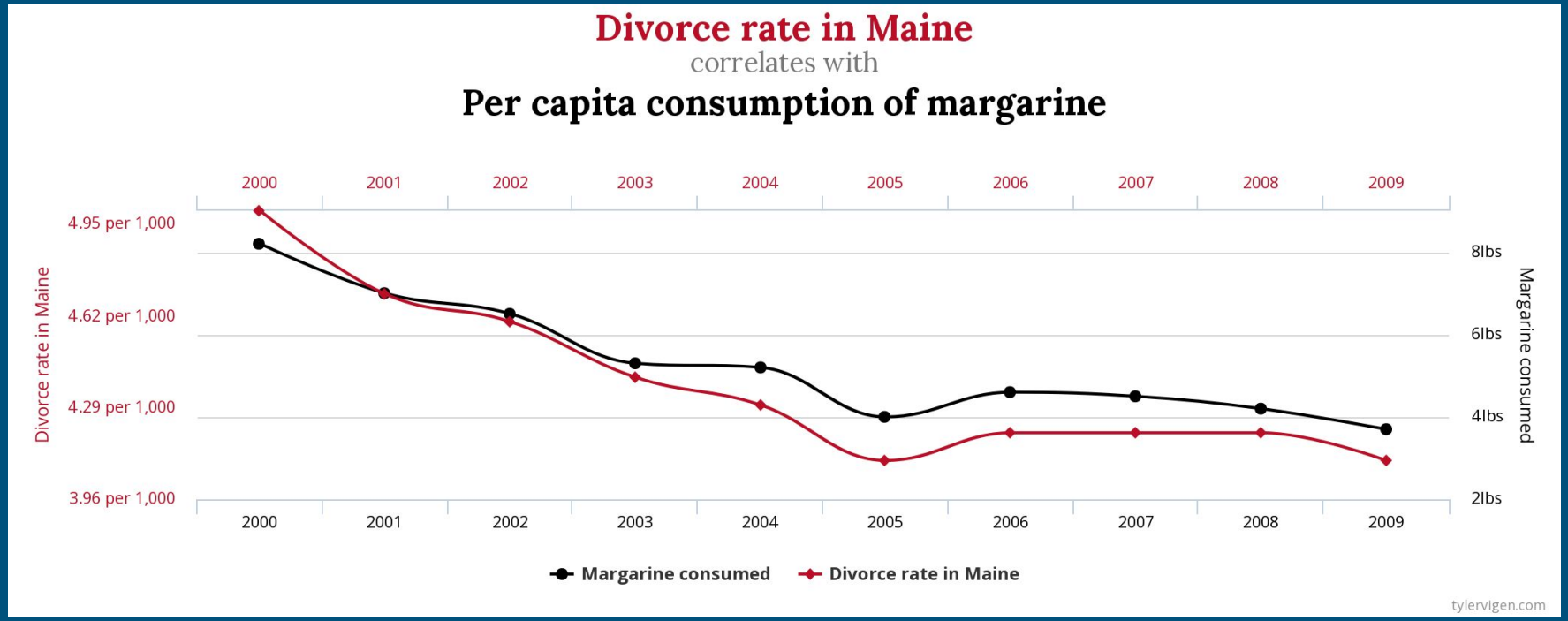
Probability of the observed (or more extreme) data when the null hypothesis is true

Indicate the degree of compatibility between a dataset and the null hypothesis

Generally, < 0.05 fail to reject the null hypothesis

Not the probability that the null hypothesis is true

Issues with P-Values



What’s to be done?

Bayes Factors

Likelihood ratio of the marginal likelihood of two competing hypotheses, usually a null and an alternative.

Bayes Factors vs P-Values

Bayes Factors:

- More reliable
- Better accuracy in noisy data
- Better estimation for small samples
- Less prone to type I errors
- Give probability hypothesis is true, given some data

P-Values:

- Give probability of data, given the null hypothesis
- Can only be used to reject the null hypothesis
- Widely misunderstood
- Liable to misuse (p-hacking)

Resources

https://365datascience.com/explainer-video/type-i-error-vs-type-ii-error/
https://www.technologynetworks.com/analysis/articles/sensitivity-vs-specificity-318222
https://en.wikipedia.org/wiki/Sensitivity_and_specificity
https://en.wikipedia.org/wiki/Type_I_and_type_II_errors
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4534731/
https://www.dummies.com/education/math/statistics/what-a-p-value-tells-you-about-statistical-data/
https://en.wikipedia.org/wiki/Misuse_of_p-values
http://www.tylervigen.com/spurious-correlations
https://en.wikipedia.org/wiki/Bayes_factor
https://www.researchgate.net/publication/335911462_Indices_of_Effect_Existence_and_Significance_in_the_Bayesian_Framework
https://daniellakens.blogspot.com/2014/09/bayes-factors-and-p-values-for.html