

IMPLICATIONS OF (DESIRE OF) TEACHING BAYESIAN STATISTICS TO UNDERGRADUATES

Bayesian statistics might help *Towards Improving Psychological Science*

→ Stop teaching only/mainly frequentist statistical techniques

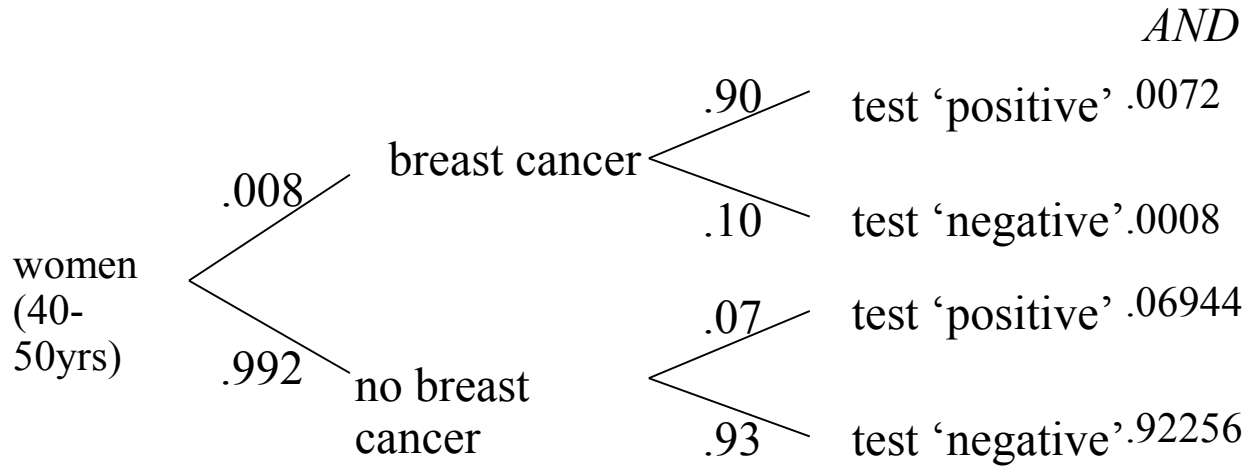
That'll be (y)our challenge.....

1. What to teach ?
2. What type of software?
3. How deal with frequentist statistics vs Bayesian statistics?
4. How to reach our nonstatistical colleagues?

1. What to teach? How deep should we go?

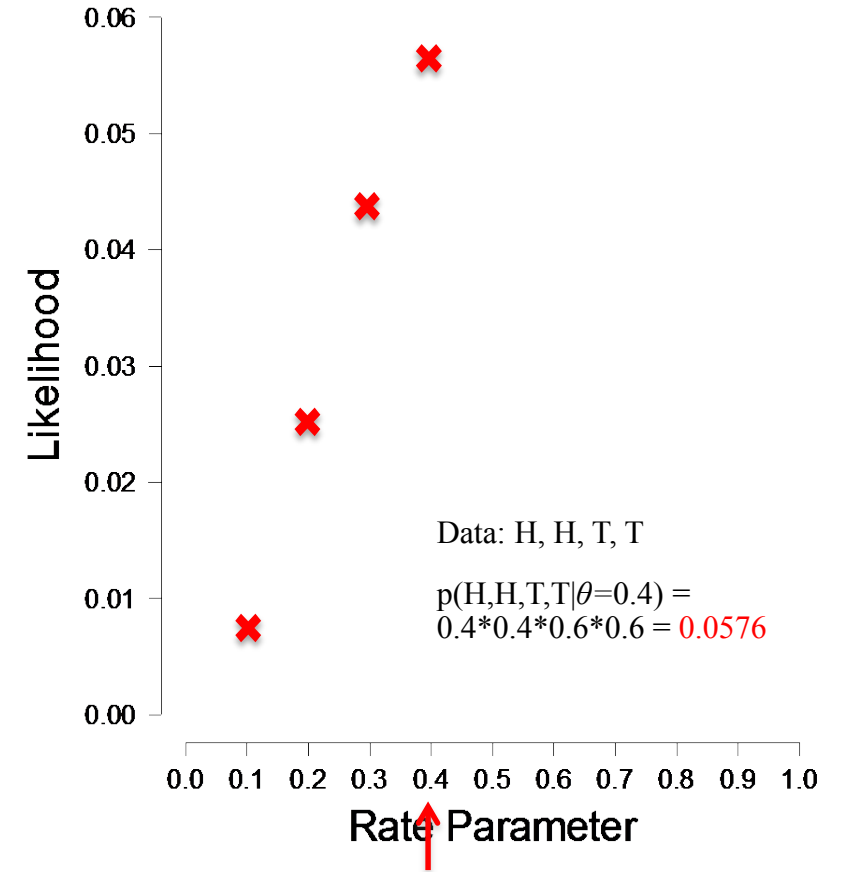
By hand? Dichotomous/Continuous data?

What is the probability that a woman has breast cancer when the mammogram result is positive? (Hint: Use Bayes' theorem)

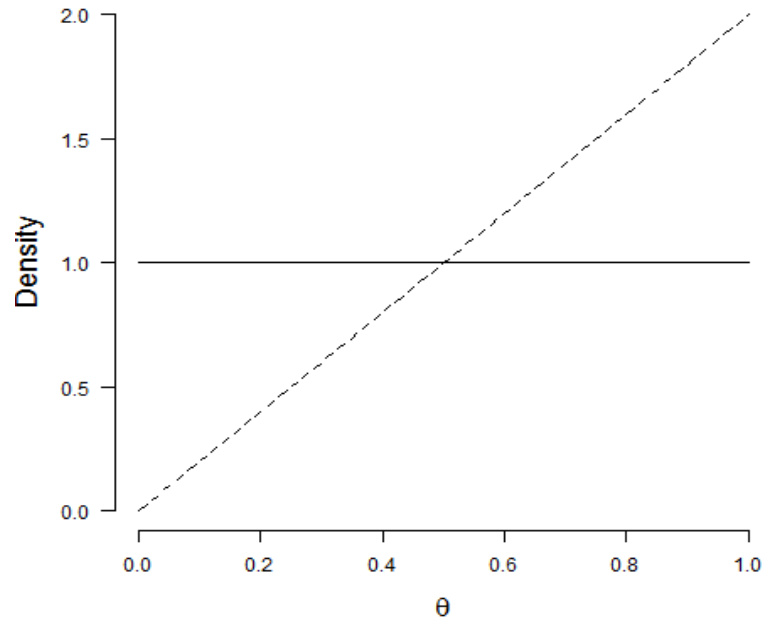


$$p(C|+) = \frac{p(+|C) \times p(C)}{p(+|C) \times p(C) + p(+|no C) \times p(no C)} = \frac{.0072}{.0072 + .06944} = .094 \text{ (or 9.4\%)}$$

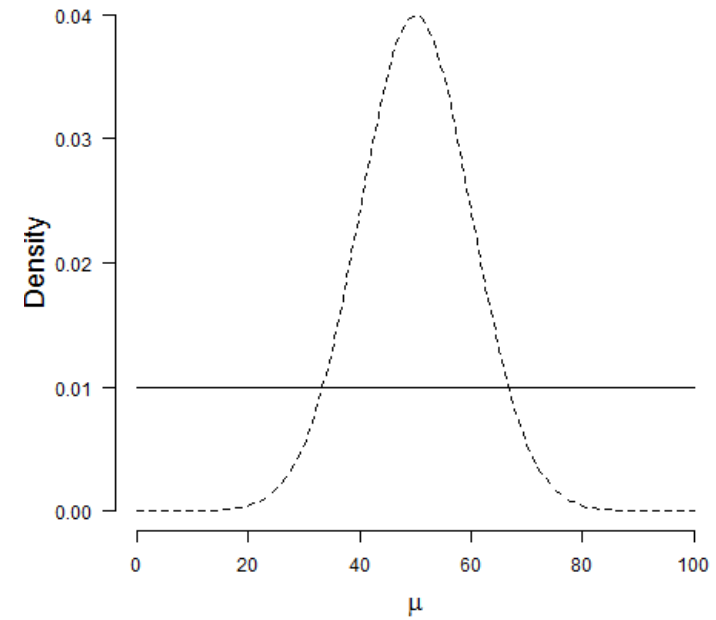
Based on this, what percentage of positive results are 'false positives'?



By software? Hard-code/custom made?

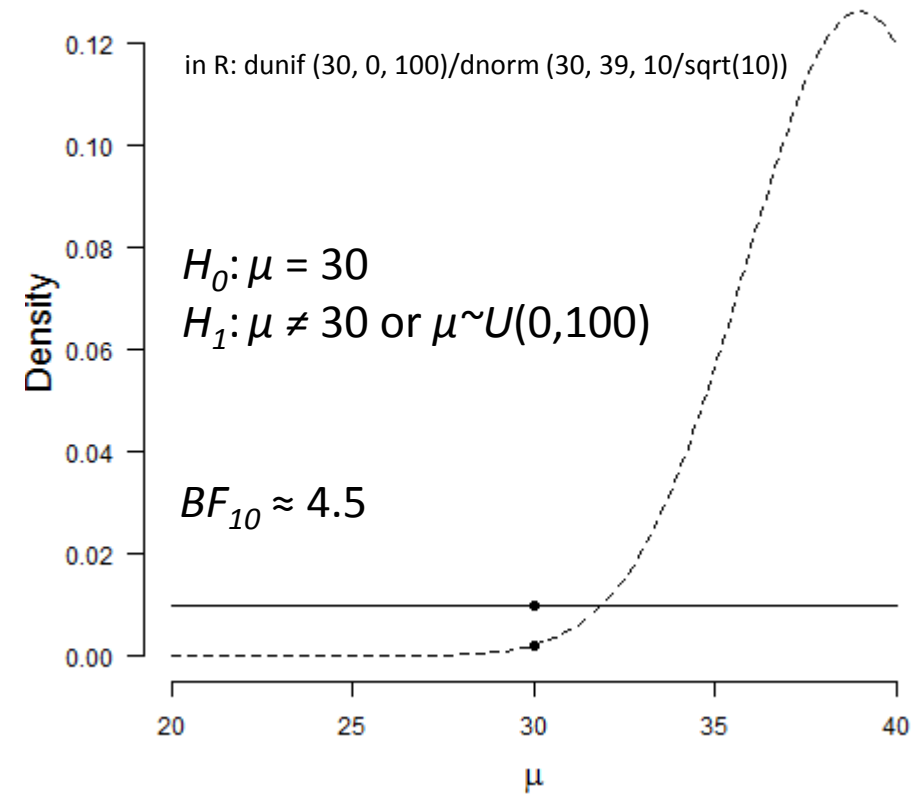
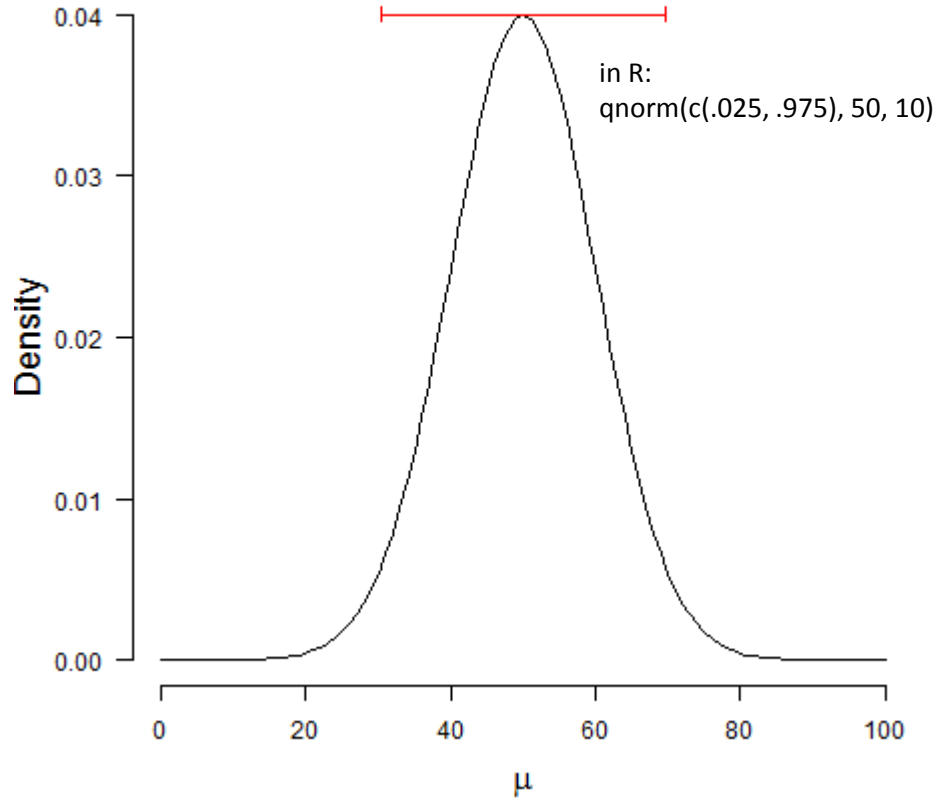


in R:
curve (dbeta (x, 2, 1), from = 0, to = 1)
curve (dbeta (x, 1, 1), add = T)



in R:
curve (dnorm (x, 50, 10), from = 0, to = 100)
curve (dunif (x, 0, 100), add = T)

Estimation? Testing?



2. What *software* should we teach?

Pre-writing Bayes Regression models

The image displays a workflow in RStudio for Bayesian regression analysis. It is divided into three main sections:

- Left Panel (Bayesian Paired Samples T-Test):** Shows the graphical interface for selecting variables (Erotic.Hits.PC vs Control.Hits.PC) and configuring the model, including the prior distribution (Cauchy with scale 0.707).
- Middle Panel (Code Editor):** Contains R code for data loading, model fitting with `stan_glm`, and diagnostic checks. A red box highlights the Bayesian regression code:

```
23 # Bayesian regression: rstanarm
24 regression1 <- stan_glm(diff ~ 1, data = data.frame(diff = diff, diff.std = diff / sd(diff)), prior = prior)
```
- Right Panel (Code Editor):** Shows the Stan model code for the regression, also highlighted with a red box:

```
32 stanModel <- "
33 data {
34   int<lower=1> N;
35   vector[N] diff;
36 }
37 parameters {
38   real delta;
39   real<lower=0> sigma_sqr;
40 }
41 model {
42   diff ~ normal(delta * sqrt(sigma_sqr), sqrt(sigma_sqr));
43   delta ~ cauchy(0, .707);
44   target += log(1 / sigma_sqr); // Jeffreys prior
45 }
46 "
```

Bottom Panels: The console shows the output of the regression analysis, including parameter estimates (mean, sd, 2.5%, 25%, 50%, 75% quantiles) and diagnostic statistics (mcse, Rhat, n_eff). A density plot on the far right visualizes the posterior distribution for the parameter `delta`, showing a unimodal, symmetric distribution centered around 0.2.

3. Teaching Bayesian Statistics fine, but what about Frequentist Statistics?

- Frequentist Statistics superfluous?
- At least teach what 'old school' people did (in the literature ...)

But how?

- Freqs first ('as default'), then Bayes as modern alternative approach
- Bayes first ('as default'), then Freqs as almost obsolete approach
- Freqs and Bayes side by side
(per type of research question, with pros and cons)
- Bayes as an extension of Freqs, justifying and/or correcting Freqs
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4. How to reach nonstatistical colleagues? Are we ready for Bayes?

- Nonstatistical staff probably has no idea how to deal with Bayes.
- How to school those? Do they want to be schooled?
- “Most students don’t even understand simple testing now: Why bother students with something even more complicated?”
 - Is Bayes more complicated?
 - How can we convince people that Bayes is needed?