what to report

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zinc in drinking water

no difference

$$P(H_1 \mid \text{data}) = 0.0152$$

$$\mu_{\text{diff}} = 0 \mid \text{H}_1, \text{data}$$

means are different

$$P(H_2 \mid \text{data}) = 0.9848$$

$$\mu_{\text{diff}} \mid H_2, \text{data} \sim t_{n-1}\left(\frac{n}{n+n_0}\bar{D}, \frac{s_B^2}{n}\right)$$

$$s_B^2 = \frac{s^2(n-1) + (\bar{D}-0)^2 \frac{n\, n_0}{n+n_0}}{n-1}$$

Source: https://pixabay.com/en/wine-glass-clear-glass-739540/

point estimate μ_{diff}

posterior mean for μ_{diff} under H_2 is $\frac{n}{n+n_0}\bar{D}$

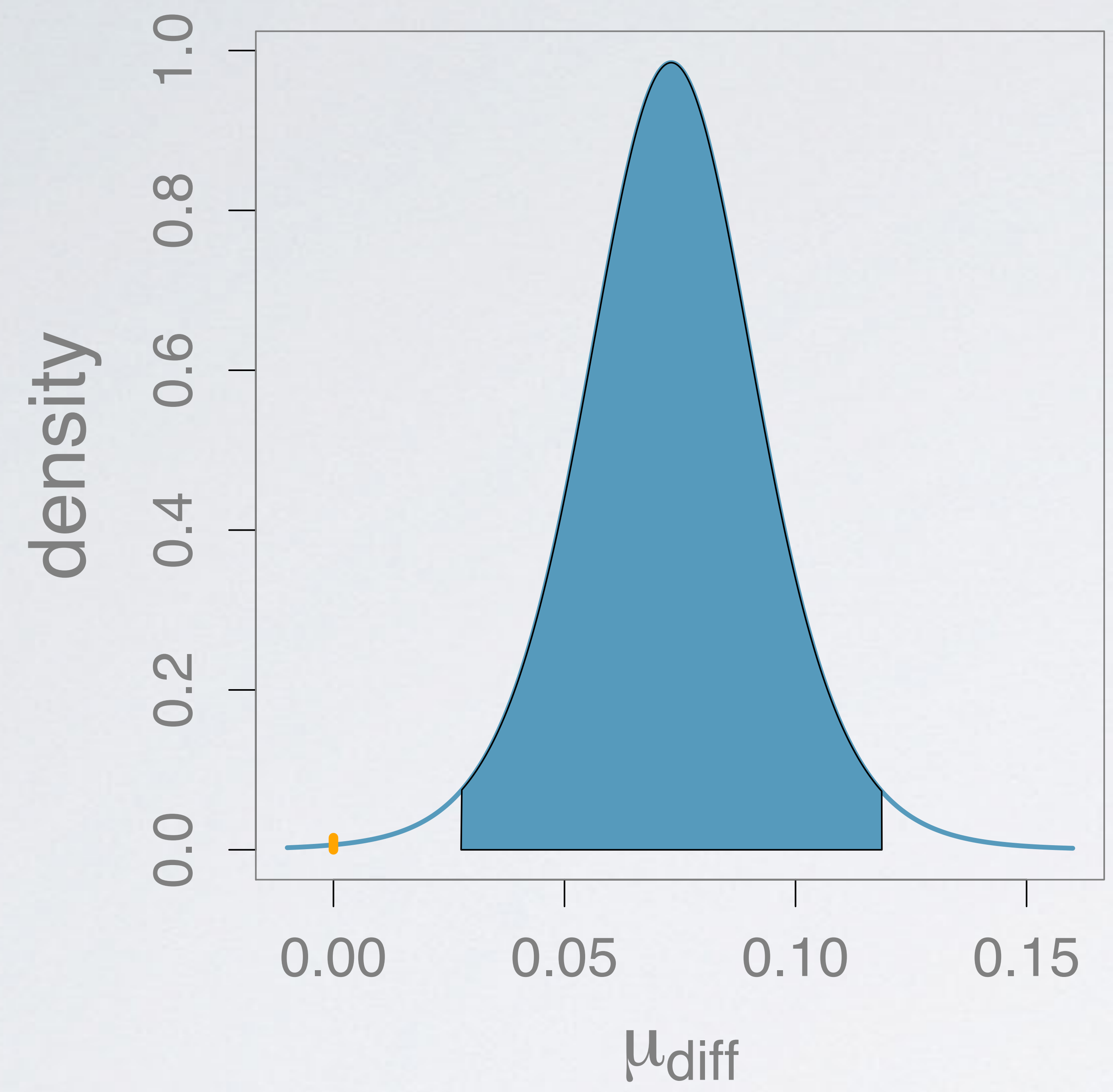
$$\frac{10}{10+1}0.0804 = 0.0731$$

unconditional posterior mean: weighted average

$$P(H_1 \mid \text{data}) \times 0 + P(H_2 \mid \text{data}) \times \frac{n}{n+n_0}\bar{D}$$

$$0.0152 \times 0 + 0.9848 \times \frac{10}{10+1}0.0804 = 0.072$$

posterior distribution for μ_{diff}



$$P(0.0276 < \mu_{\text{diff}} < 0.1187 \mid \text{data}) = 0.95$$

directional hypotheses

H3 $\mu_B > \mu_S \Leftrightarrow \mu_{\text{diff}} > 0$

$$P(\mu_{\text{diff}} > 0 \mid \text{data, H}_2) = 0.9984$$

$$P(\text{H}_3 \mid \text{data}) = P(\text{H}_3 \mid \text{data,H}_2)P(\text{H}_2 \mid \text{data}) = 0.9832$$

H4 $\mu_B < \mu_S \Leftrightarrow \mu_{\text{diff}} < 0$

$$P(\text{H}_4 \mid \text{data,H}_2) = 0.001621$$

$$P(\text{H}_4 \mid \text{data}) = P(\text{H}_4 \mid \text{data,H}_2)\text{P}(\text{H}_2 \mid \text{data}) = 0.001597$$

summary

- posterior distribution for μ_{diff}
- point estimates and credible intervals that include **uncertainty** about the hypotheses
- statistical significance versus practical significance
- **nested** hypotheses