

$$\mu \sim \text{Beta}(2.3, 4.1)$$

$$y|\mu \sim \text{BINOMIAL}(17, \mu)$$

$$y_{\text{new}}|\mu \sim \text{BINOMIAL}(3, \mu)$$

$$P_{\mu}(y_{\text{new}} = 1 | y = 4)$$

$$\mu | y = 4 \sim \text{Beta}(2.3 + 4, 4.1 + 17 - 4) = \text{Beta}(6.3, 17.1)$$

$$P_{\mu}(y_{\text{new}} = 1 | y = 4) = \frac{\text{Beta}(6.3 + 1, 17.1)}{\text{Beta}(6.3, 17.1)} \binom{3}{1}$$