SDS 383D, Bayesian Inference in Simple Conjugate Families

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A: Beta prior with Bernoulli sampling distribution

$$p(w) = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} w^{a-1}(1-w)^{b-1} \tag{1}$$

$$p(D|w) = \binom{n}{y} w^{y}(1-w)^{n-y} \tag{2}$$

$$p(w|D) = p(w)\frac{p(D|w)}{p(D)} \propto p(w)p(D|w) \tag{3}$$

$$p(w|D) \propto w^{a-1}(1-w)^{b-1} w^{y}(1-w)^{n-y} \tag{4}$$

$$p(w|D) \propto w^{a+y-1}(1-w)^{n+b-y-1} \tag{5}$$

$$w|d \sim \text{Beta}(a+y, n+b-y) \tag{6}$$