Likelihood Function: Binomial/Bernoulli

- Samples $x(1),.. x(1000)$ where r purchase milk
- Assuming conditional independence, likelihood function is

$$L(\theta \mid x(1),..,x(1000)) = \prod_i \theta^{x(i)}(1-\theta)^{n-x(i)} = \theta^r(1-\theta)^{1000-r}$$

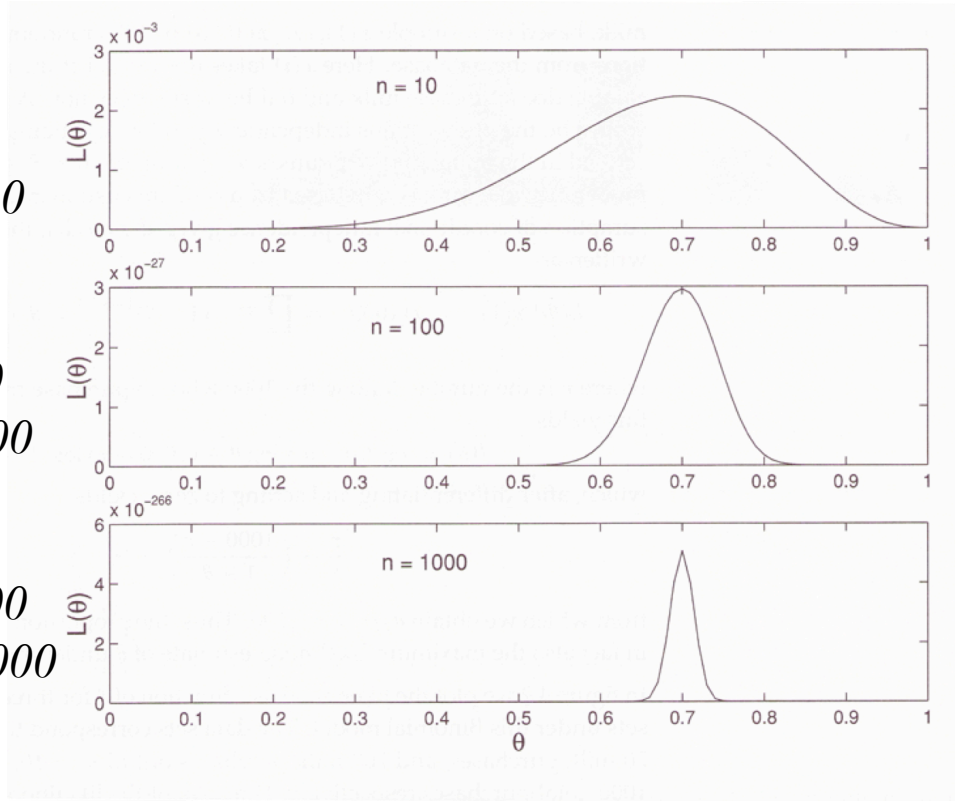
  - Binomial pdf includes every possible way of getting r successes so it has ${}^nC_r$ additive terms
- Log-likelihood Function

$$l(\theta) = \log L(\theta) = r\log\theta + (1000-r)\log(1-\theta)$$

- Differentiating and setting equal to zero

$$\hat{\theta}_{ML} = r/1000$$

Binomial: Likelihood Functions



Likelihood function for three data sets

Binomial distribution

r milk purchases out of n customers

θ is the probability that milk is purchased by random customer

Uncertainty becomes smaller as n increases