Sample sizes for different epidemiologic purposes

Topics for discussion

- Why calculate sample size?
- How large a sample should I take?
- Sample sizes for 3 common scenarios

Why calculate sample size?

- Practical considerations
  - Study planning
    - Budgeting
    - Resource needs
    - Assessment of study feasibility
    - Give yourself a reasonable chance of detecting significant risk factors for a disease
  - Grant/research proposals require them!

How large a sample to take?

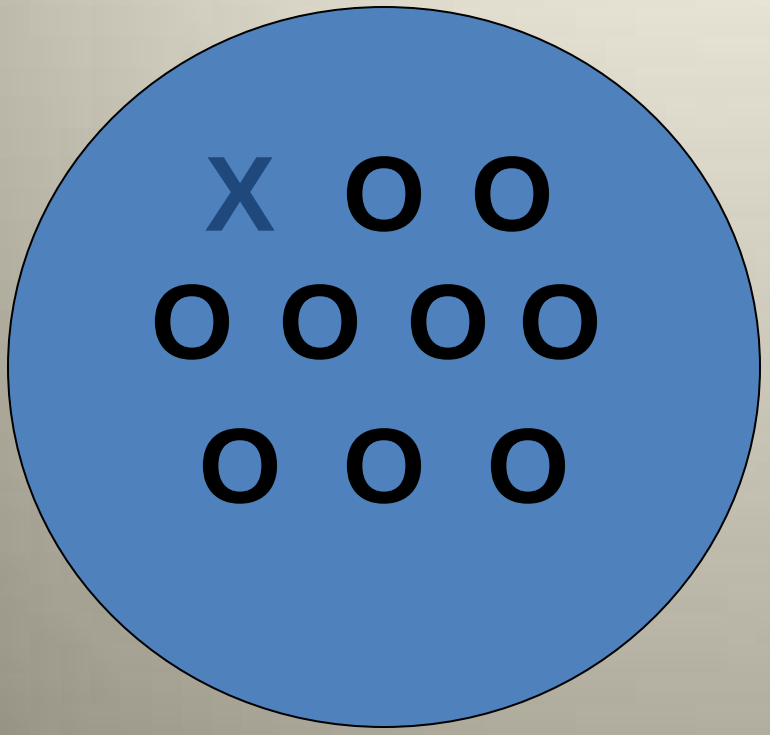
- Most important consideration is the objective of the study/diagnostic testing

  i.e. what question is being asked?
- Three common sampling situations:
  - to detect disease
    - outbreak investigations
    - flock diagnosis
    - disease freedom certification
  - to estimate prevalence
    - prevalence survey
  - to detect a difference in prevalence or incidence between groups
    - risk factor studies/clinical trials

Sample size to detect disease:

Logical reasoning

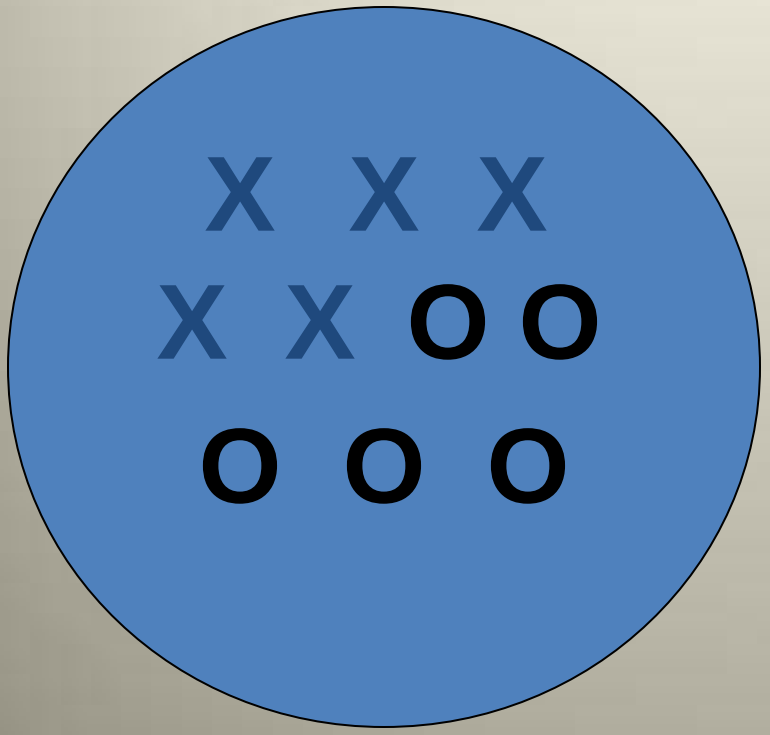
Prevalence of disease X = 10%



Confidence level	
100% (perfect)	95% (v. high)
n =	n =

How many (n) do I need to sample to detect disease (at least one X) with high confidence?

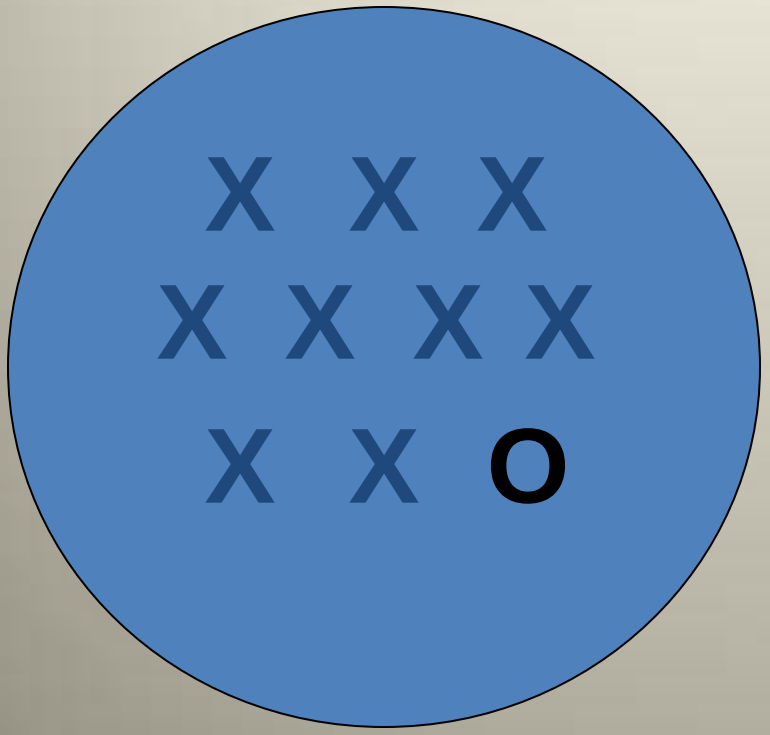
Prevalence of disease X = 50%



Confidence level	
100%	95%
n =	n =

How many (n) do I need to sample to detect disease (at least one X) with high confidence?

Prevalence of disease X = 90%



Confidence level	
100%	95%
n =	n =

How many (n) do I need to sample to detect disease (at least one X) with high confidence?

Sample size to detect disease

- Important in outbreak investigations and disease surveillance– laboratory sample submission
- Don’t have to use random sampling if a prevalence estimate is not necessary
- We assume small sample from population (binomial sampling) – formulas more complicated for hypergeometric sampling (entire population or a large part thereof is sampled)

Sample size to detect AI

- Goal is to detect ≥ 1 positive bird (in an infected flock) when we sample "n" birds from flock with unknown prevalence (P)

Probability that all "n" are disease free = $(1-P)^n$

Probability of ≥ 1 positive = $1 - (1-P)^n$

Set C (confidence) = $1 - (1-P)^n$ and solve for n

$$n = \log (1-C) / \log (1-P)$$

Sample size to detect AI

- The choice of P for an infected flock (or population) is a critical factor for this calculation, can be
  - Minimum expected prevalence
  - Prevalence that > 95% flocks would exceed
  - Typical (average) prevalence

Sample size calculations for disease detection

- Published tables
- Excel worksheet that performs calculations readily for you
- Your friendly statistician!!!

Sample size to detect disease

Confidence level (C)

Est. P	0.9	0.95	0.99
0.05	45	59	90
0.1	22	29	44
0.15	15	19	29
0.2	11	14	21
0.25	9	11	17
0.3	7	9	13
0.4	5	6	10
0.5	4	5	7
0.6	3	4	6
0.7	2	3	4
0.8	2	2	3
0.9	1	1	2

“Samp size detect” worksheet

POPULATION SIZE	**1,000**
CONFIDENCE LEVEL	**95%**
SENSITIVITY	**99%**
EXPECTED PREVALENCE	**60%**
SAMPLE SIZE (n)	**4**

$$n \cong \frac{(1-(1-\alpha)^{1/D})(N-\frac{1}{2}(SeD-1))}{Se}$$

Sample size to detect disease

- Sample size increases
  - As prevalence tends to zero
  - Desired confidence increases
  - Sensitivity of detection decreases (not shown)

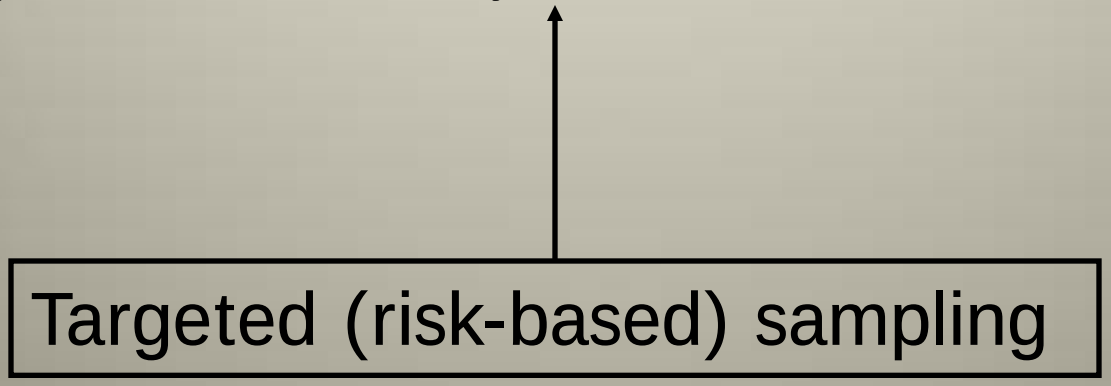
- Remember that it is sensible to focus on high-risk groups (e.g. clinically affected individuals or groups where prevalence is likely to be greater) to reduce sample sizes

Sample size to detect disease

- If infection clusters in some flocks/age groups but not in others,
  - then sampling a single unit or building may no longer be adequate,
  - and thus the sample size represents the *numbers for each flock*.

Sample size to detect disease

- If the goal is detection of infection and not estimation of prevalence, then animals with clinical signs consistent with disease can be sampled selectively



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Interpretation of 0 positive in the number of selected samples

- The table can also be used once results are obtained

- Assume 6 samples were selected and the results are all negative, what can we conclude assuming that our testing procedure (test and sample collection and handling) were perfect?

Interpretation of 0 positive in the number of selected samples

- Prevalence is zero?

  or

- Prevalence is <0.6 (60%) with 99% confidence