CRC PLANT biosecurity

QUT

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Maximising the probability of detection in heterogeneous grain bulks

Sampling basis for management

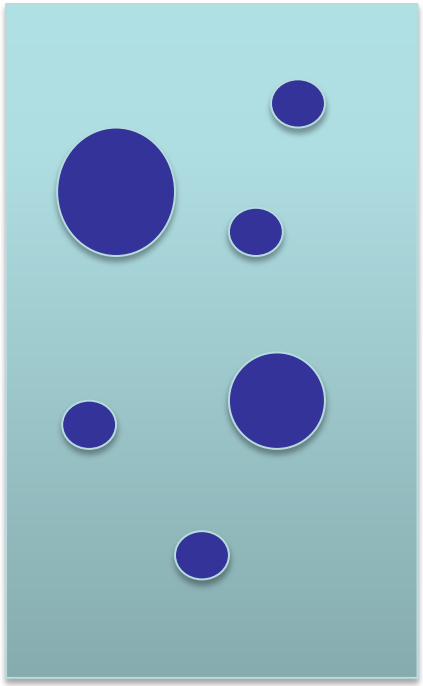
Aim: detect insects in grain bulk with known probability

Much (very good work) already done

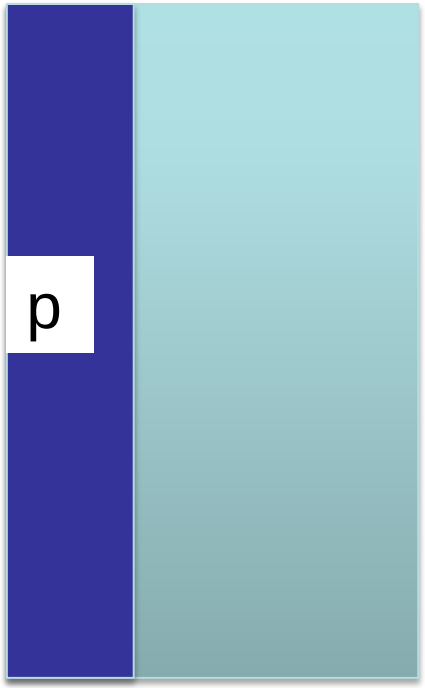
- Estimate number of samples to take based on a sampling model
- All models are wrong, some are useful
  - Fit for the purpose-incorporate along supply chain
  - Model complexity (number of parameters)

- Need meaningful aspects of organism's ecology
- Most currently in use based on a Binomial
- Assumption- homogeneous distribution of critters

Alternative



λ number/kg
infested portion



$$P\,(\text{detection}) = 1 - (1 - p + pe^{-w\lambda})^{n}$$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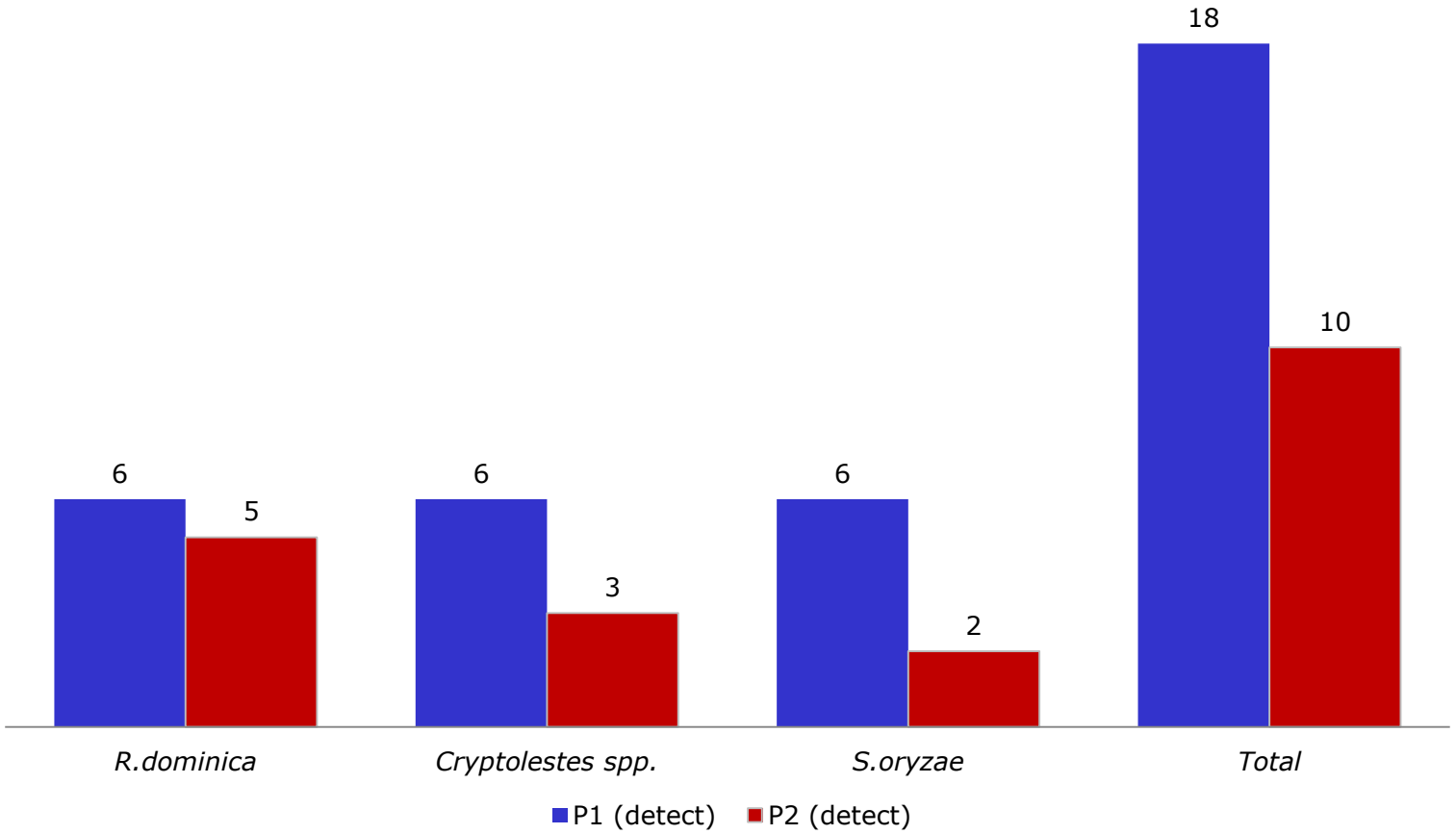
	Probability of Detection (%)	Prediction *P(A>0)*	Silo 1 Successes	Silo 2 Successes	Prediction *P(ψ)*	Silo 1 Successes	Silo 2 Successes
R. dominica	95	3	3	3	1	2	3
	85	2	3	3	1	2	3
	75	1	3	3	1	2	3
Cryptolestes Spp.	95	5	3	3	1	1	2
	85	3	3	3	1	1	2
	75	2	3	3	1	1	2
S. oryzae	95	13	3	3	1	2	0
	85	9	2	2	1	2	0
	75	6	2	1	1	2	0


18
10
6
5
6
3
6
2
R.dominica
Cryptolestes spp.
S.oryzae
Total
P1 (detect)
P2 (detect)

- Homogeneity - efficiency of sampling programs relate to proportion of grain bulk sampled

- Heterogeneity – number of subsamples very important
  - probability of intersecting infested portion

- NOT the first time heterogeneity been considered
- Simple, generic model
  - applied at farm level, trucks, bulk storages
  - minimum number of parameters to estimate
  - Integration along supply chain?

- Improving detection probabilities for pests in stored grains. (in press) Elmouttie, Kiermeier, Hamilton. Pest Management Science

- Omniscience=collaboration?
- Ecology, simulation modelling, statistics (no physics, sorry…)

$$P(A = a \mid X = x) = \frac{e^{-xw\lambda}(xw\lambda)^a}{a!}$$