

When does poor governance presage biosecurity risk?

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Outline

Motivations

- Border Protection Command
- Continuous Sampling Protocol

A Model for Governance

Example

- Data
- Statistical Modelling
- Profiling

Discussion

Motivations

Motivations

Border Protection Command

Continuous Sampling Protocol

Border Protection Command

International vessels: . . .

- ▶ Biosecurity
- ▶ Customs
- ▶ Immigration
- ▶ Police
- ▶ Safety
- ▶ Etc.

We might speculate that performance across these activities could be linked.

Continuous Sampling Plan; CSP-1

Risk-based inspection for pathways.

Pathway is in one of two modes: *enhanced*, or *monitoring*.

1. In **enhanced** mode, inspect all items. Switch to monitoring upon c consecutive passes.
2. In **monitoring** mode, inspect $f\%$ of the items, randomly selected. Switch to enhanced upon any fail.

Start in *enhanced* mode.

Equivalently,

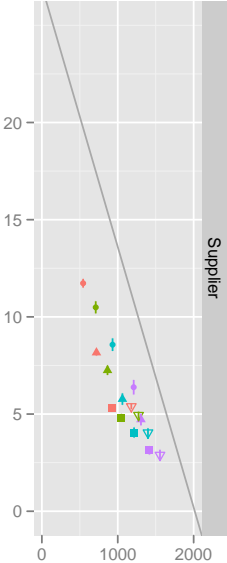
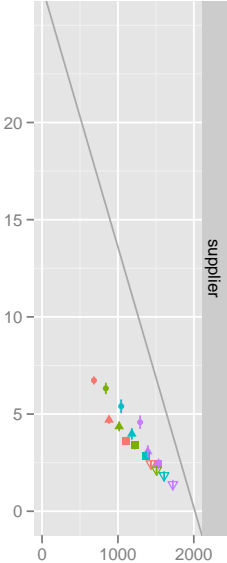
- ▶ if ≥ 1 fail in the previous c inspections, then inspect;
- ▶ if last c are all passes, then inspect with probability $f\%$.

Continuous Sampling Plan — General

But what kinds of fails?

Cashews: pathway predicted risk-based performance **improved**
using generic fails compared with biosecurity fails!

Predicted Biosecurity Leakage for Cashews under CSP



A Model for Governance

A Model for Governance

Governance as a Latent Variable

Not just reflecting history of targeted activity.

History in related activities:

- ▶ Other types of infractions in same pathway.
 - ▶ Non-regulated interceptions
 - ▶ Administrative failures
- ▶ Biosecurity history in other pathways.
 - ▶ Compliance in activities with other tariff codes

Example

Example

Data

Statistical Modelling

Profiling

Data

Fruit Inspection Data (Chapter 8)

- ▶ January 2007 – March 2012 (more than 5 years)
- ▶ 3150 importers
- ▶ 3655 suppliers
- ▶ 80 tariff codes
- ▶ 127 countries of origin
- ▶ Nearly 80,000 lines
- ▶ More than 50,000 inspections
- ▶ Four outcomes of interest
 - ▶ All clear
 - ▶ Administrative fail (e.g. paperwork) (~ 6000)
 - ▶ Quarantine fail — interception (~ 9000)
 - ▶ Biosecurity fail — regulated interception (~ 5000)

Process

For each year t in 2008 to 2011

- ▶ Compute fail rates for year $t - 1$ by: tariff, supplier, and year
 - ▶ Administrative fail
 - ▶ Interception fail
 - ▶ Biosecurity fail
 - ▶ Joint fail (B + A)

Generalized Linear Mixed-Effects Model

The i -th inspection in year y from supplier s in tariff t is

$$x_{isty} \stackrel{d}{=} \text{Bernoulli}(p_{sty})$$

and

$$\log\left(\frac{p_{sty}}{1 - p_{sty}}\right) = \beta_0 + b_3(y) + \beta_1 r_{sty-1} \dots + \gamma_s + \tau_t$$

where

β_0, β_1 are constants to be estimated;

$b_3(y)$ represents a cubic spline for year y ;

$r_{sty-1} \dots$ is $y - 1$ profiles (empirical logit);

γ_s is a supplier random effect, $\gamma_s \sim N(0, \sigma_\gamma^2)$; and

τ_t is a tariff random effect, $\tau_t \sim N(0, \sigma_\tau^2)$.

Outcomes: Model Comparison

Table: ANOVA-based comparison of GLMM models.

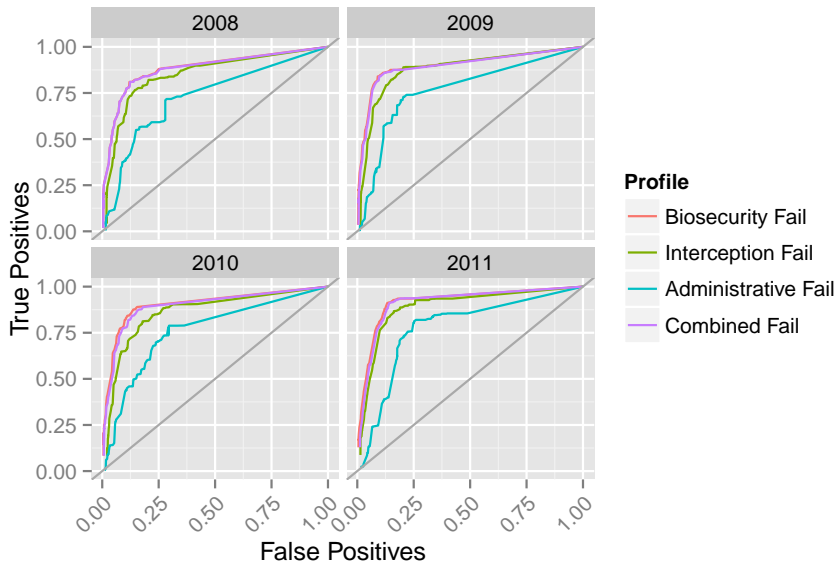
	Df	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
Base	6	-5150.5	10301			
+ Biosecurity	7	-5130.0	10260	40.945	1	1.565e-10
++ Interception	8	-5124.9	10250	10.140	1	0.001
++ Administration	8	-5129.8	10260	0.280	1	0.597
++ Combined	8	-5130.0	10260	0.046	1	0.830

Process

For each year t in 2008 to 2011

- ▶ Order tariff / supplier combinations by fail rates
- ▶ Compute ROC curves against year t inspections
- ▶ Report AUC

Supplier and Tariff-level Result: ROCs



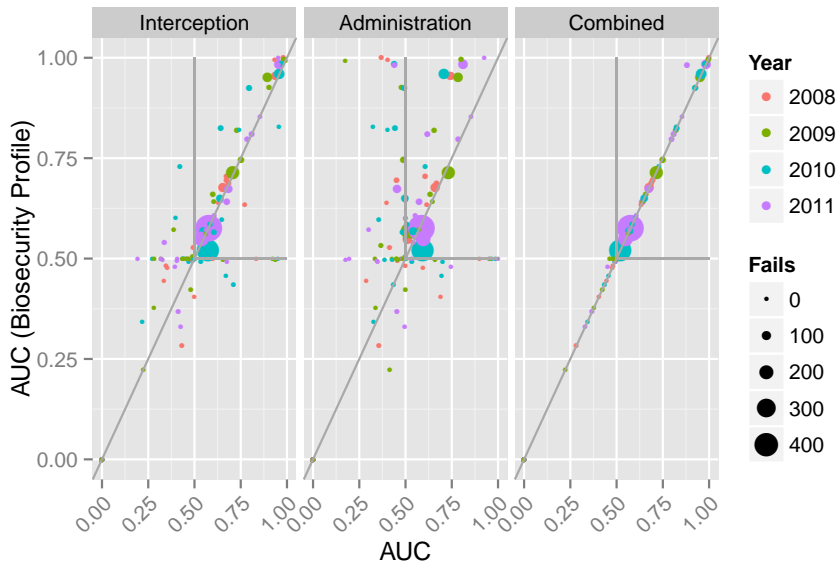
Supplier and Tariff-level Result

Table: AUC values for supplier- and tariff-level profiling.

Profile	2008	2009	2010	2011
Biosecurity Fail	0.88	0.90	0.90	0.92
Interception Fail	0.85	0.88	0.86	0.89
Administrative Fail	0.73	0.76	0.76	0.77
Combined (B + A)	0.88	0.89	0.89	0.91

Driven, in all likelihood, by tariff-level differences.

Within-Tariff Result



Discussion

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- ▶ Although conceptually attractive, governance is operationally slippery.
- ▶ Statistical significance does not necessarily translate into operational improvements.
- ▶ More thinking needs to be done.

Thanks! Questions?

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