Property Inspection Model and Real Time Decisions

Jenny Zhang

Allstate Insurance Company

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Contents

Inspection Model → Real Time Decisions → Group Activity

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Background of Property Inspection

- Property Inspections are conducted to catch potential issues

  - Condition Hazard (CH):   Physical and/or Liability issues
  - Insurance to value (ITV): Changes in Replacement Cost after inspections

- New business inspection and renewal inspection

- Cost of each inspection is about $22 - $40

Motivation for the Model –Based Inspection

50% vs. 100% NB Inspection?

Select Property Efficiently

The goal is to optimize the number of inspections and select the property to inspect in a more efficient way.
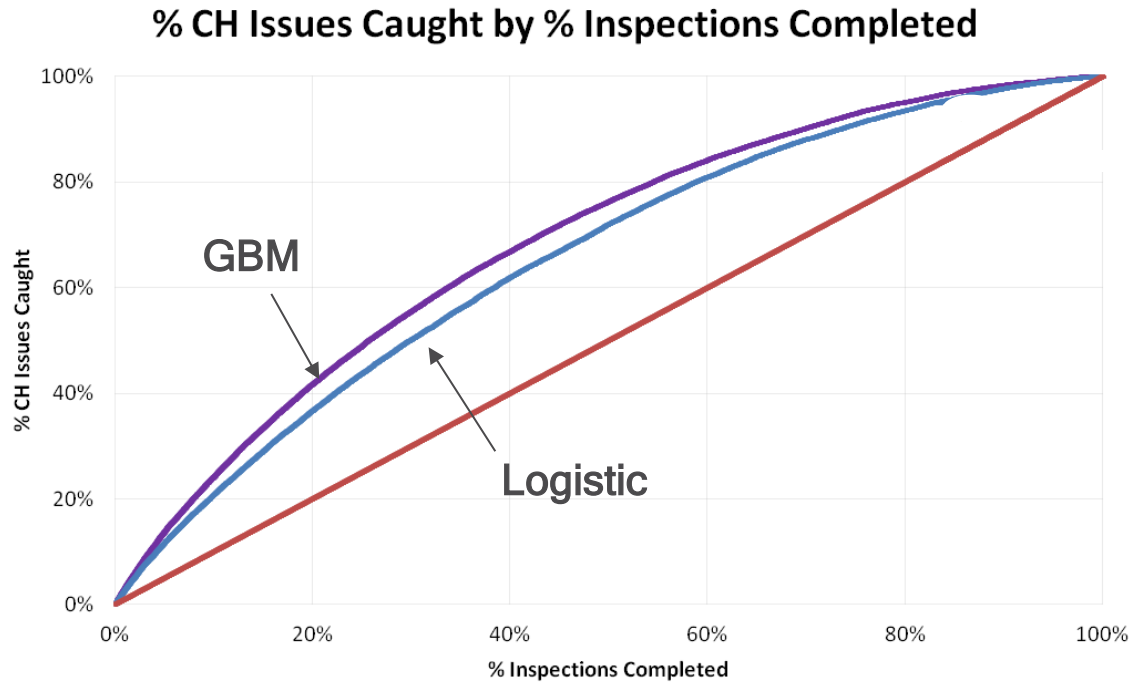
(Same method can be applied to solve other business problems.)

Logistic Regression vs. GBM

|	Logistic Regression	Gradient Boosting Machine (GBM)
Variable Selection	Traditional methods	Can handle more variables
Interpretation	Easy	Not so easy
Predictive Power	Good	Better

Condition Hazard Model

% CH Issues Caught by % Inspections Completed

	% CH Issues Caught	
% Inspecitons Completed	Logistic Regression	GBM
25%	44%	49%
50%	72%	76%
75%	91%	93%

GBM outperforms the Logistic model.

Insurance-to-Value Model
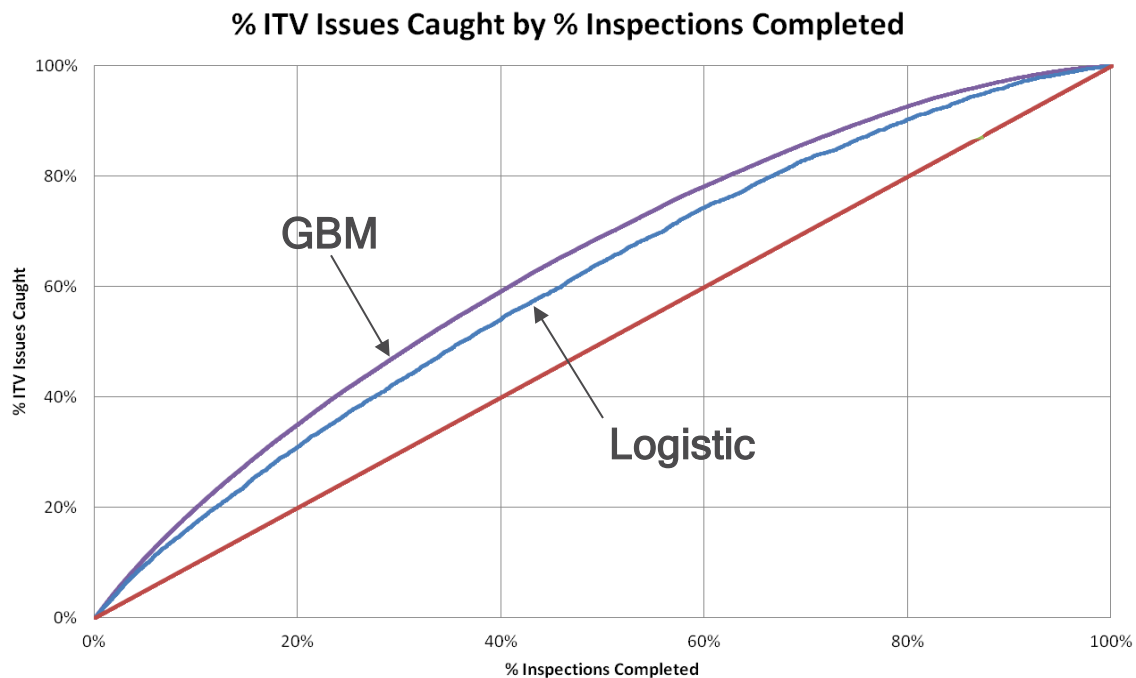
% ITV Issues Caught by % Inspections Completed

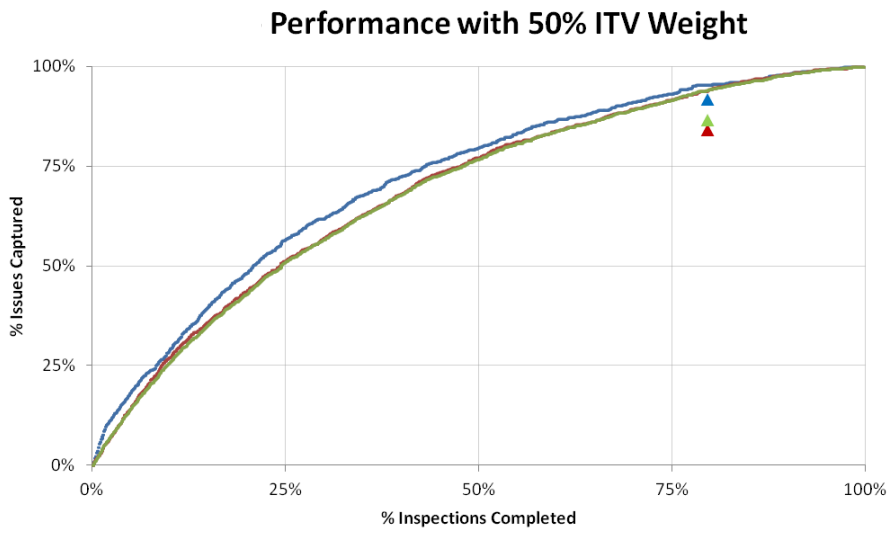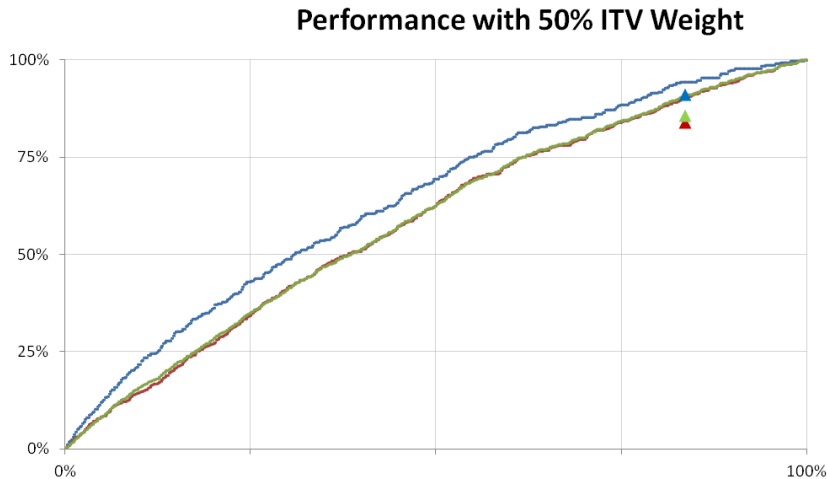|	% ITV Issues Caught	
% Inspecitons Completed	Logistic Regression	GBM
25%	37%	42%
50%	65%	69%
75%	95%	96%

GBM outperforms the Logistic model.

GBM Outperforms Rule-Based Decision

State 1

	% Inspections Completed	% CH Issues Captured	% ITV Issues Captured	% Total Issues Captured
GBM	80%	95%	94%	94%
Rules	80%	92%	84%	87%

Performance with 50% ITV Weight

Blue – CH　　**Red – ITV**　　**Green - Total**

GBM Outperforms Rule-Based Decision

State 2

	% Inspections Completed	% CH Issues Captured	% ITV Issues Captured	% Total Issues Captured
GBM	85%	94%	90%	91%
Rules	85%	91%	84%	86%

Performance with 50% ITV Weight

Blue – CH   **Red – ITV**   **Green - Total**

Impact to the Inspection Process

The action rate is expected to increase.

–   Action rate = # issues caught / # inspections

–   Control group (10%) vs. Non-control group

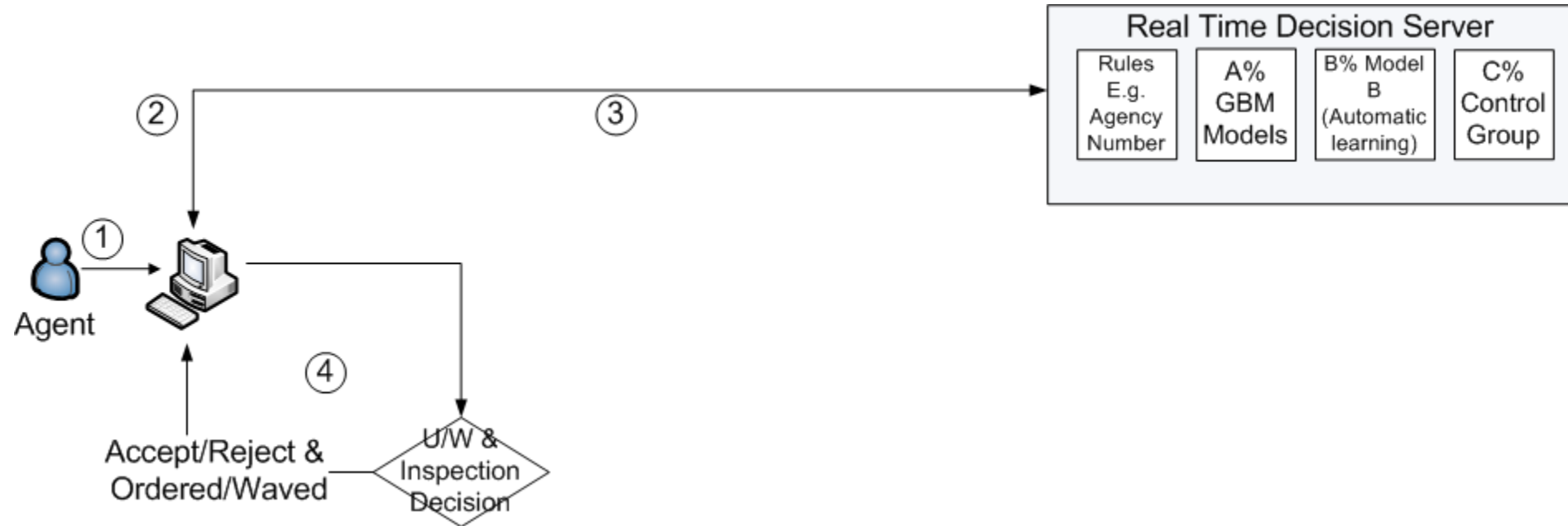The volume of inspections conducted can be set by state.
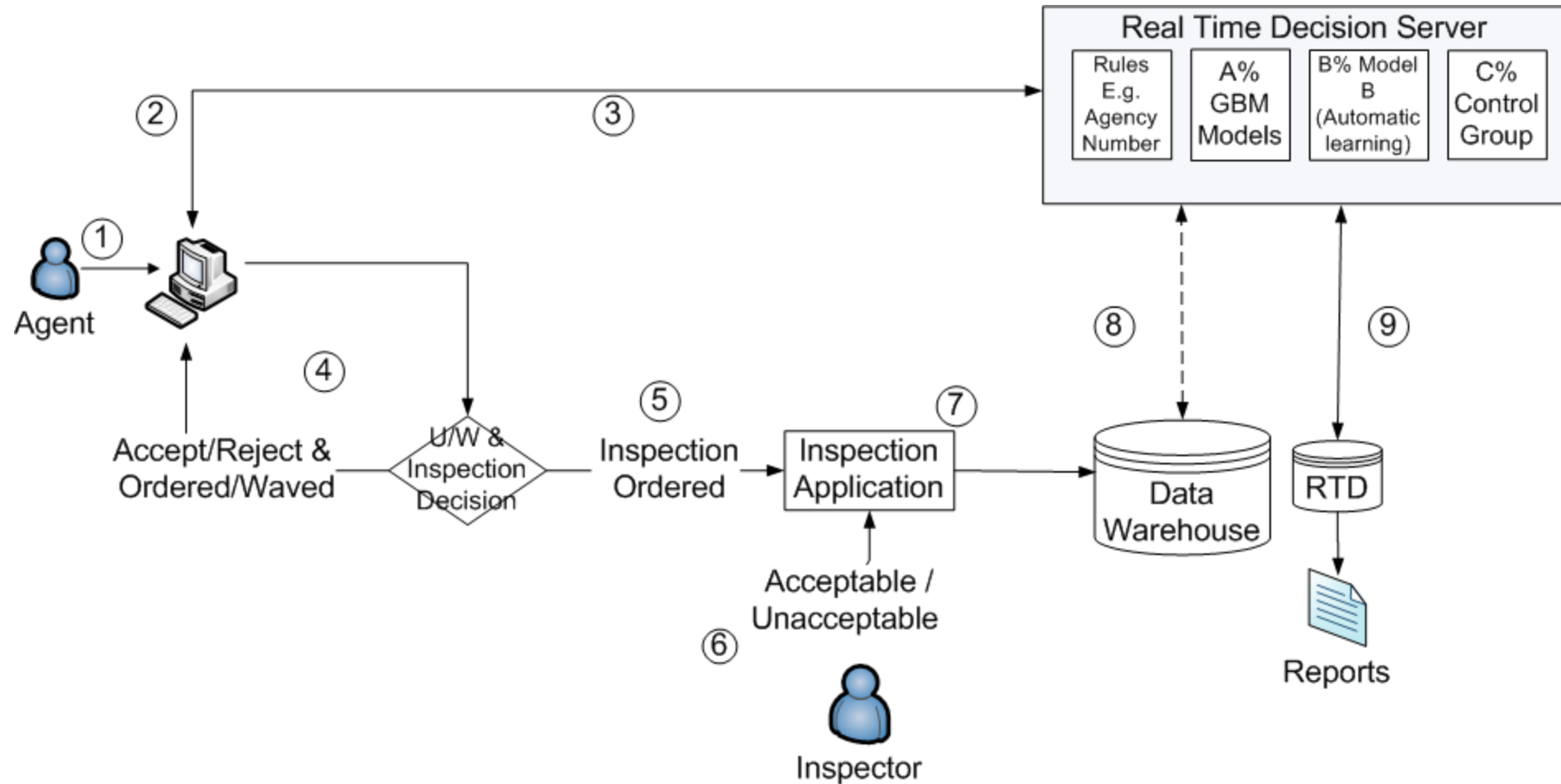
State	Target New Business Inspection%
State 1	80%
State 2	75%

Inspection Model → Real Time Decisions → Group Activity

Real Time Decision – Flow
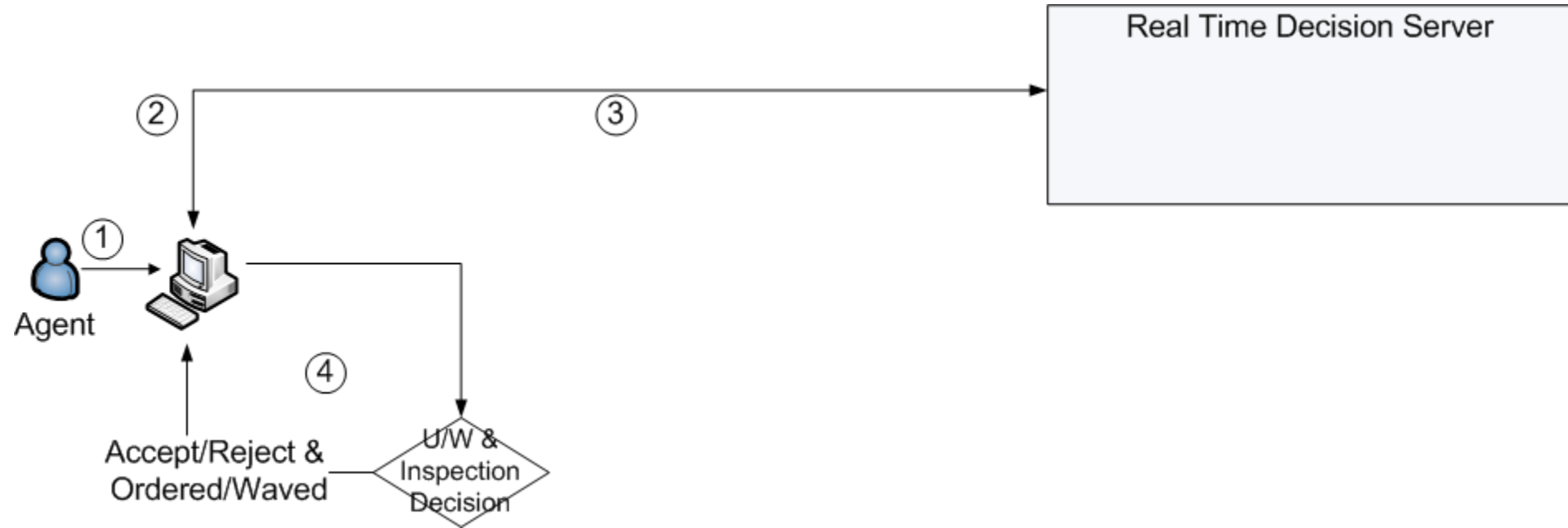
Real Time Decision – Components
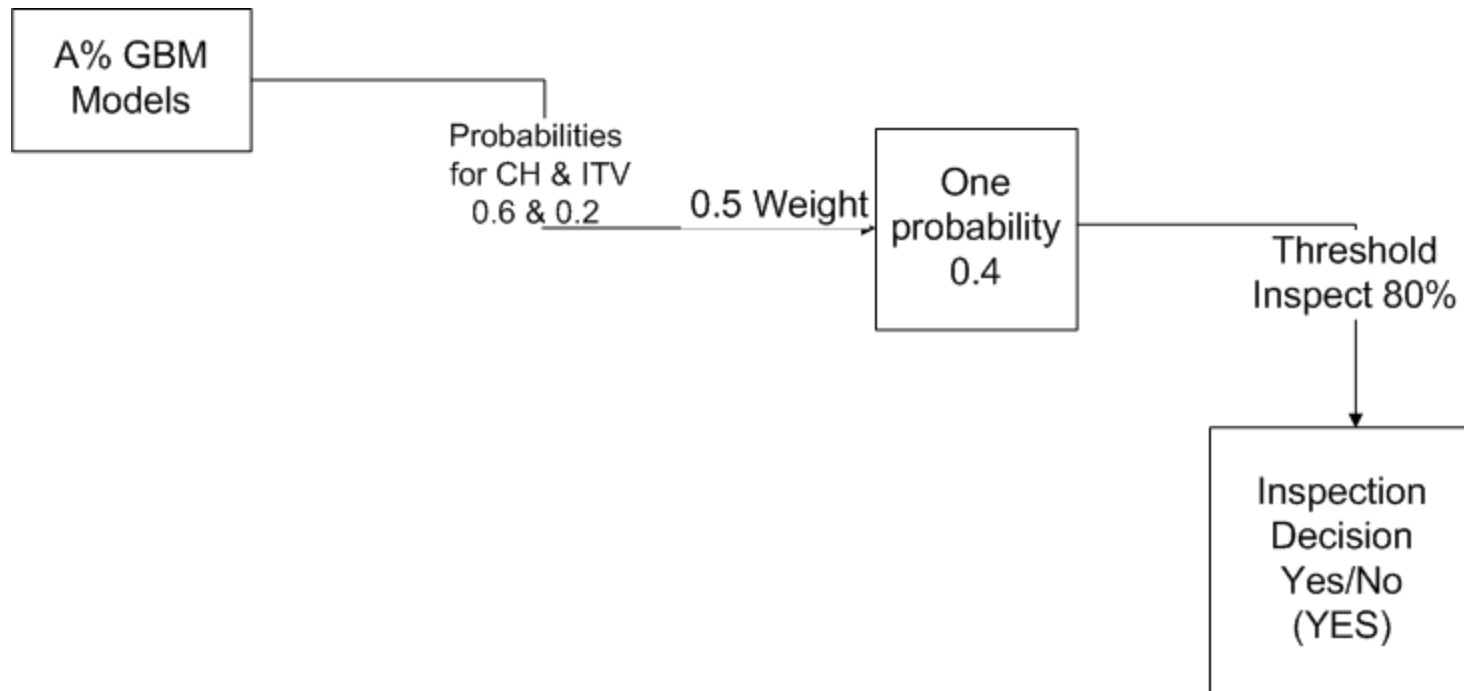
Real Time Decision – Data

Adaptability

Machine learning algorithm

The model will learn over time based on the recent results of actual inspections
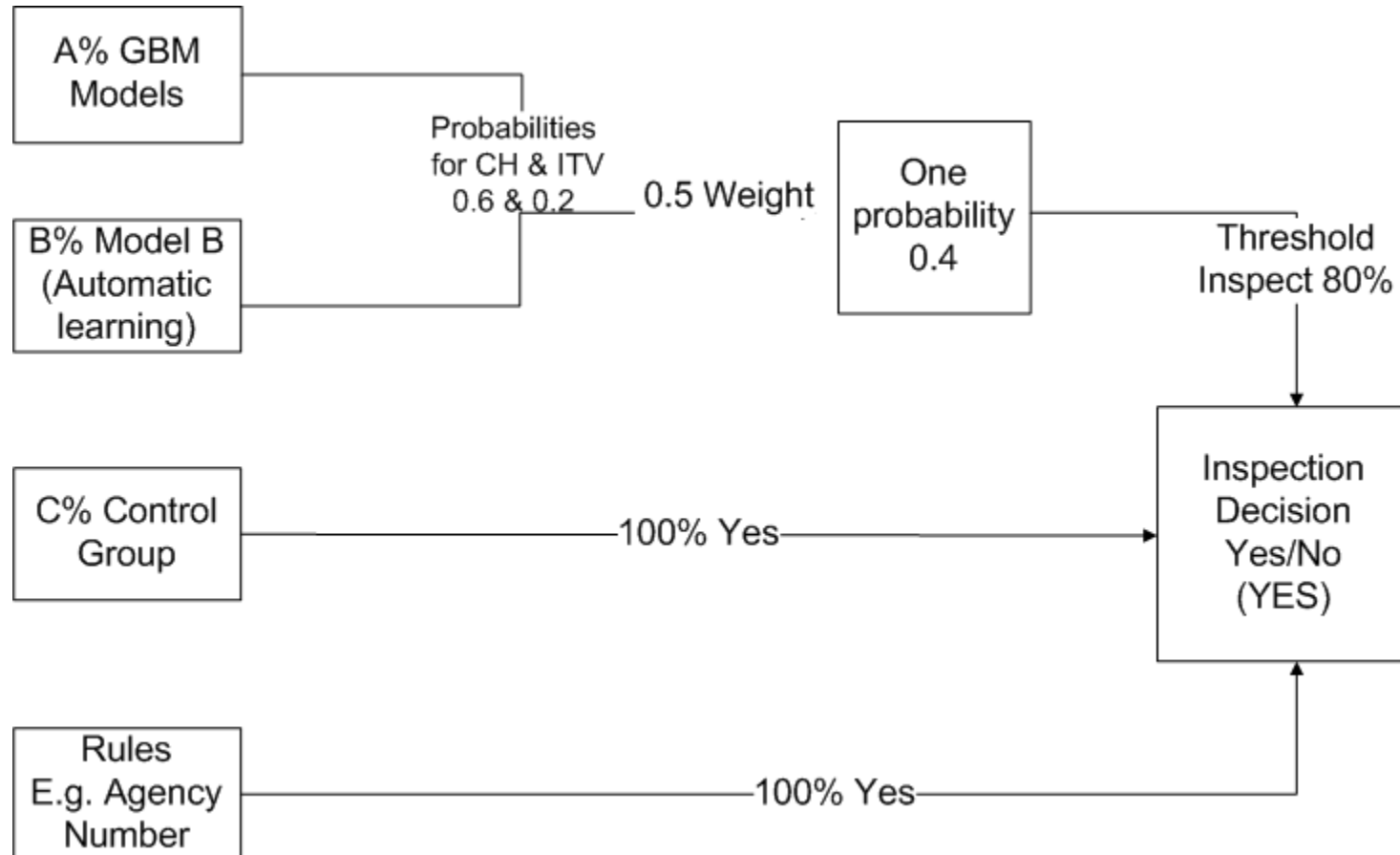
From Probability to Yes/No - Example

- **Select CH, ITV weights based on state specific situation**

  0.6*0.5+0.2*(1-0.5) = 0.4

- **Determine the threshold based on the inspection volume**

Inspection Decision Process

Real Time Decisions

Conclusion

Gradient Boosting Machine would be a good option when

- Interpretability is not indispensable
- No specific filing is required
- Obvious predictive advantage

Logistic model would be a good option when

- Interpretability is important
- Specific filing is required
- Obvious predictive advantage

Trade-off

Inspection Model → Real Time Decisions → **Group Activity**

Group Activity

Given

- Predicted CH/ITV issues caught

- State detailed status

To determine

- Weight between CH and ITV

- New Business Inspection Volume

For example:

	Target New Business Inspection%	Weight for CH	Weight for ITV
State 1	80%	50%	50%
State 2	75%	70%	30%

State Detailed Status

|	State A	State B	State C
Size	Big	Medium	Small
Combined ratio	92%	110%	88%
Growth	0%	-2%	3%
Inspection cost	$40	$35	$40
Details	Was shrinking for a while	Tough Regulatory Environment	Has been growing

Four Scenarios Available

	Inspection%	CH Weight%	ITV Weight%
1	100	50	50
2	75	50	50
3	85	25	75
4	95	75	25

State A - 1: Decide Weight btw CH and ITV; and NB Inspection%
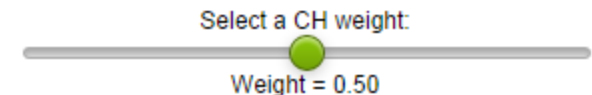
	State A
Size	Big
Combined ratio	92%
Growth	0%
Inspection cost	$40
Details	Was shrinking for a while
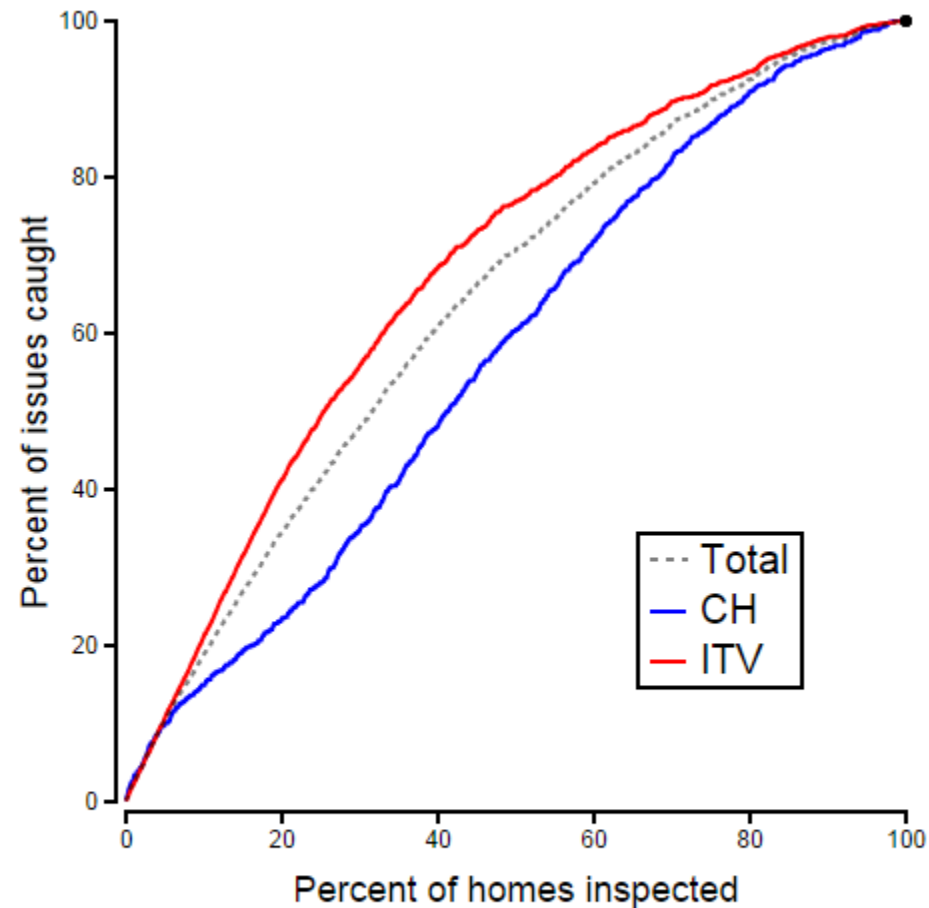
When inspect 100% NB:
- Action rate is 24% for CH and 40% for ITV.
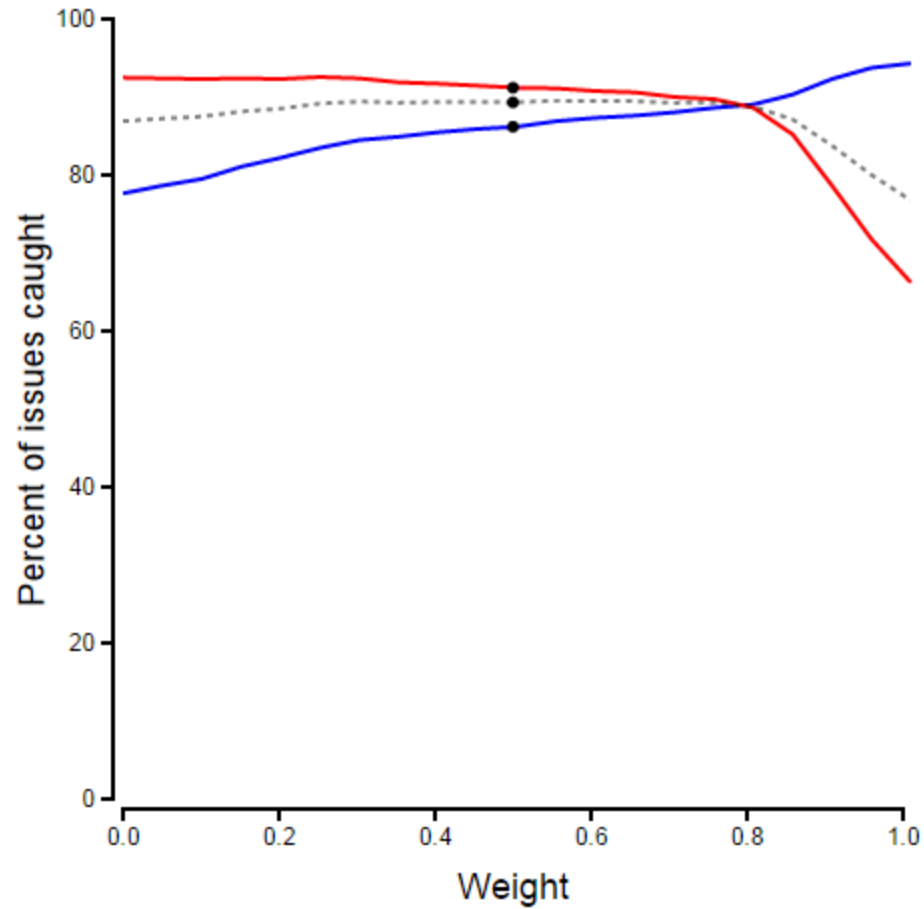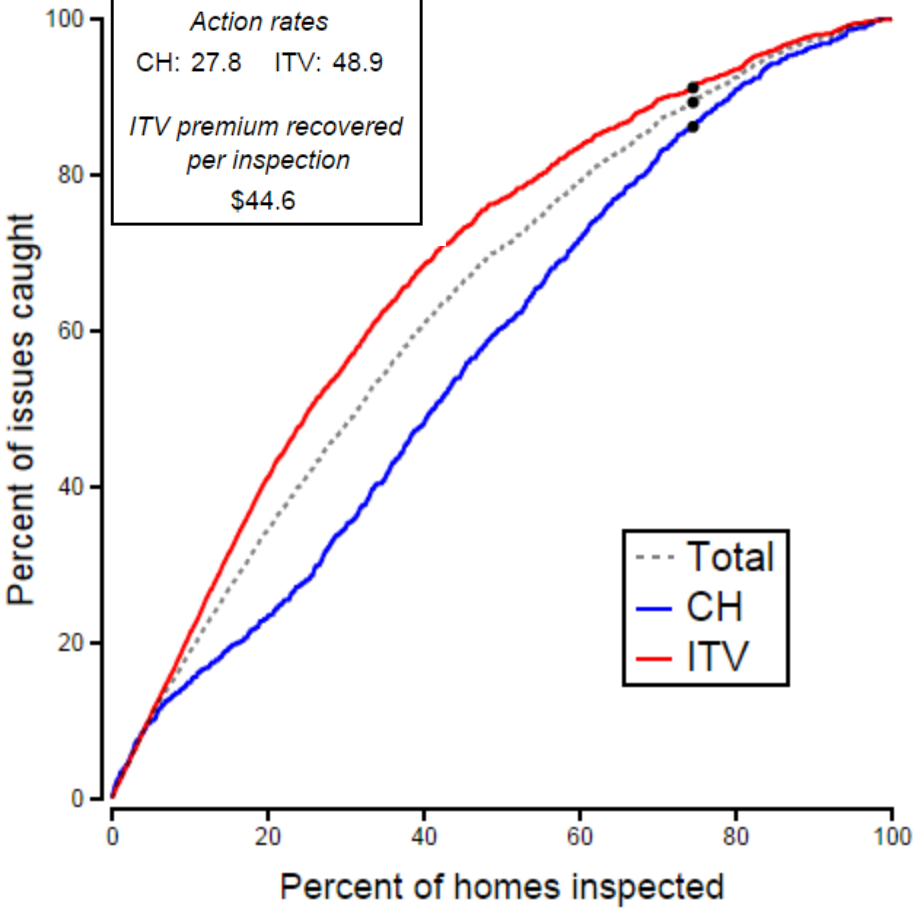- ITV premium recovered per inspection is $33.

State A - 2

Selected parameters
Inspection %: 74.8
Weight: 0.5

Issues caught
Total % caught: 89.6
% CH caught: 86.5
% ITV caught: 91.5

Action rates
CH: 27.8   ITV: 48.9

ITV premium recovered per inspection
$44.6

Left chart — x-axis: Percent of homes inspected; y-axis: Percent of issues caught. Legend: Total, CH, ITV

Right chart — x-axis: Weight; y-axis: Percent of issues caught

Select a CH weight:
Weight = 0.50

Select an inspection percentage:
% inspected = 75

Group Activity

(Please take out your device)