Robust Inspection for Invasive Species with a Limited Budget

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Reports

L. J. Moffitt, J. K. Stranlund, and C. D. Osteen. "Robust Detection Protocols for Uncertain Introductions of Invasive Species." *Journal of Environmental Management* Vol. 89 (2008): 293-299.

L. J. Moffitt, J. K. Stranlund, B. C. Field, and C. D. Osteen. "Robust Inspection for Invasive Species with a Limited Budget." in Lansink, Alfons G. J. M. Oude, (Ed.), New Approaches to the Economics of Plant Health, Amsterdam: Springer, 2007, 7-22.

L. J. Moffitt, J. K. Stranlund, and B. C. Field. "Inspections to Avert Terrorism: Robustness Under Severe Uncertainty." *Journal of Homeland Security and Emergency Management* Vol. 2 (2005): No. 3, Article 3. http://www.bepress.com/jhsem/vol2/iss3/3

Facts

→ Invasive species can accompany perishable commodities that enter the United States.

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→ Both inspection for and entry of invasives can be costly.

Question

Can inspection protocols be improved through application of economic decision criteria and, if so, how?

Overview

I. Background

II. Approach

III. Results

I. Background

→ USDA/DHS MOU

I. Background (cont)

USDA/DHS MOU

→ AQI

I. Background (cont)

AQI:

→ Allows for size, contents, and origin

I. Background (cont)

AQI:

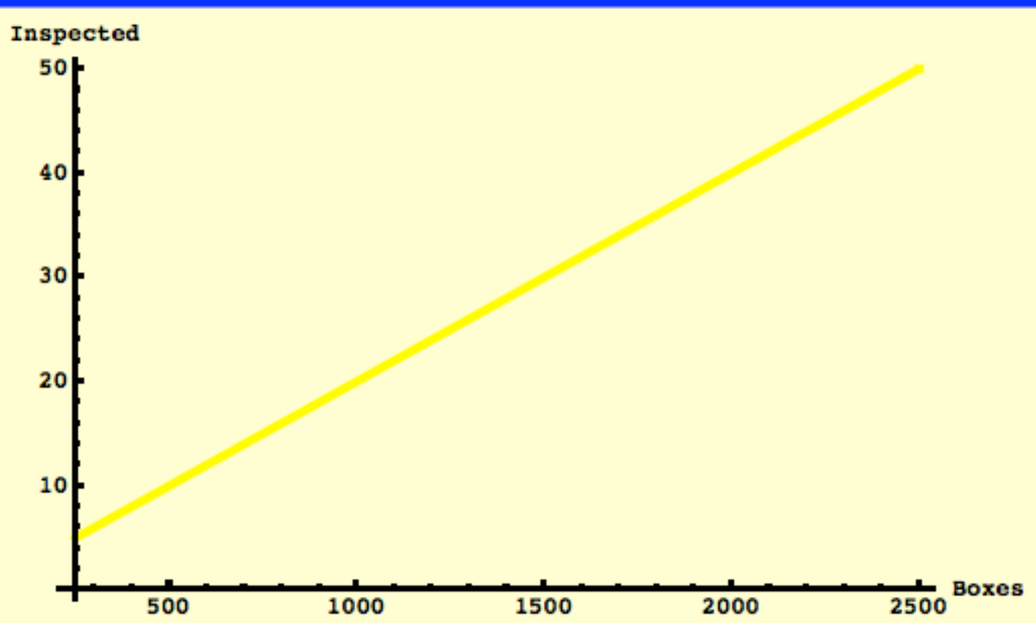
Allows for size, contents, and origin

→ Generally features a 2% inspection rate

I. Background (cont)

AQI:

Out[16]=



I. Background (cont)

→ Constant inspection rate is not uncommon

I. Background (cont)

Constant inspection rate is not uncommon

→ No apparent basis in economic considerations

II. Approach

→ Base inspection on cost

II. Approach (cont)

Base inspection on cost

→ Recognize that presence of invasives is uncertain

II. Approach (cont)

Base inspection on cost

Recognize that presence of invasives is uncertain

→ Seek robustness to uncertain presence of invasives

II. Approach (cont)

Cost involves two components:

loss due to entry

II. Approach (cont)

Cost involves two components:

loss due to entry

+

inspection cost

II. Approach (cont)

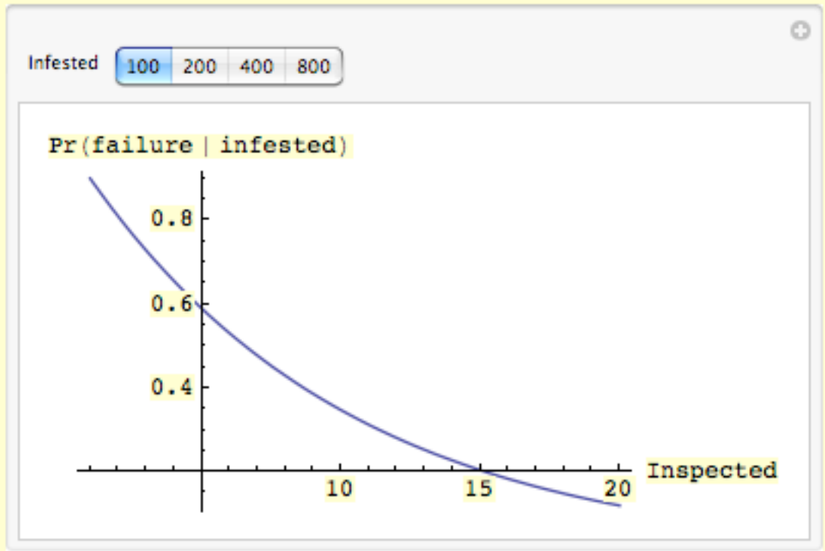
Expected loss due to entry:

$$\Pr(\text{inspection failure}) \times E(\text{loss})$$

II. Approach (cont)

Probability of inspection failure (1000 boxes):

Out[28]=



II. Approach (cont)

Decreasing expected loss, increasing inspection cost:

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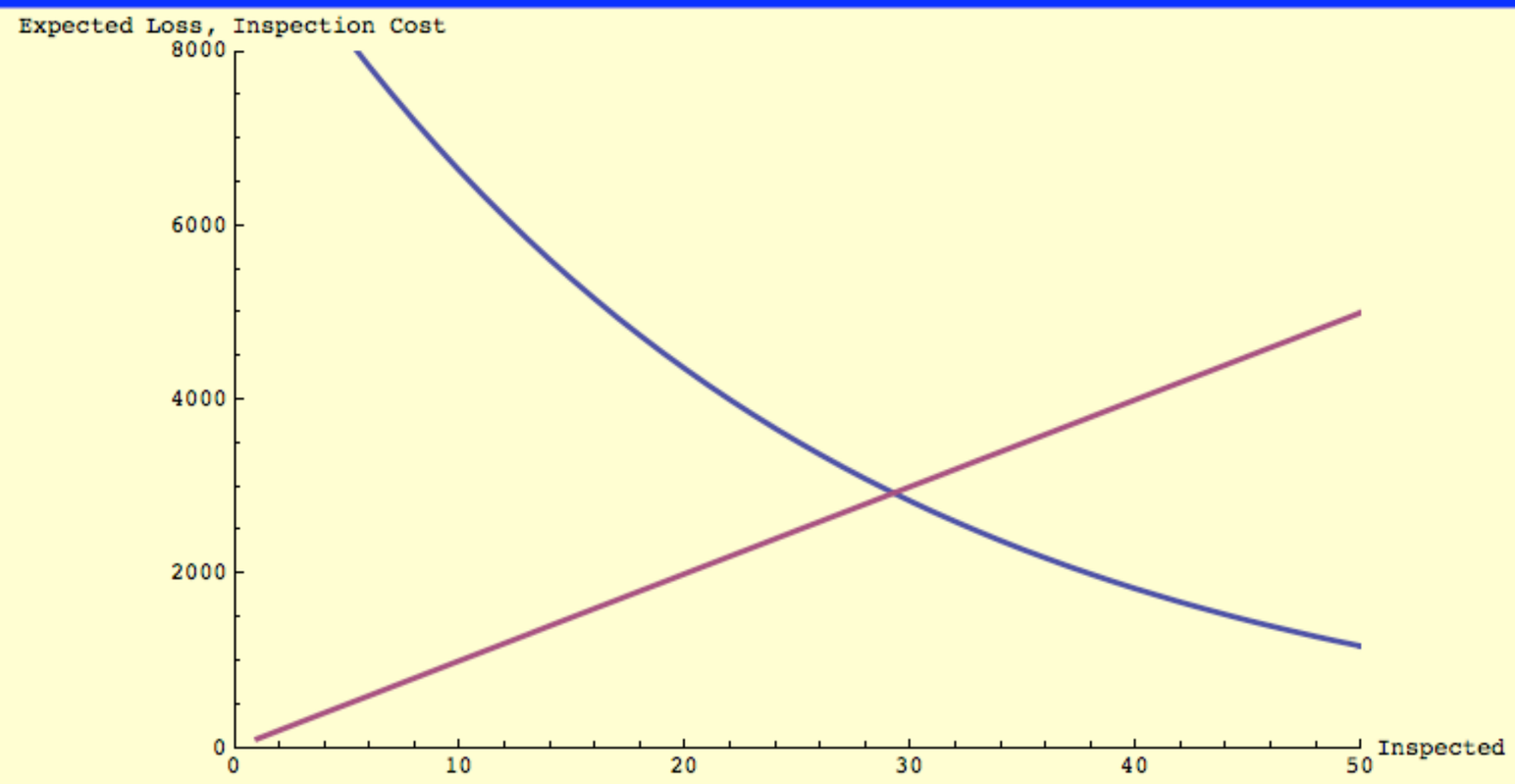

II. Approach (cont)

Expected cost:

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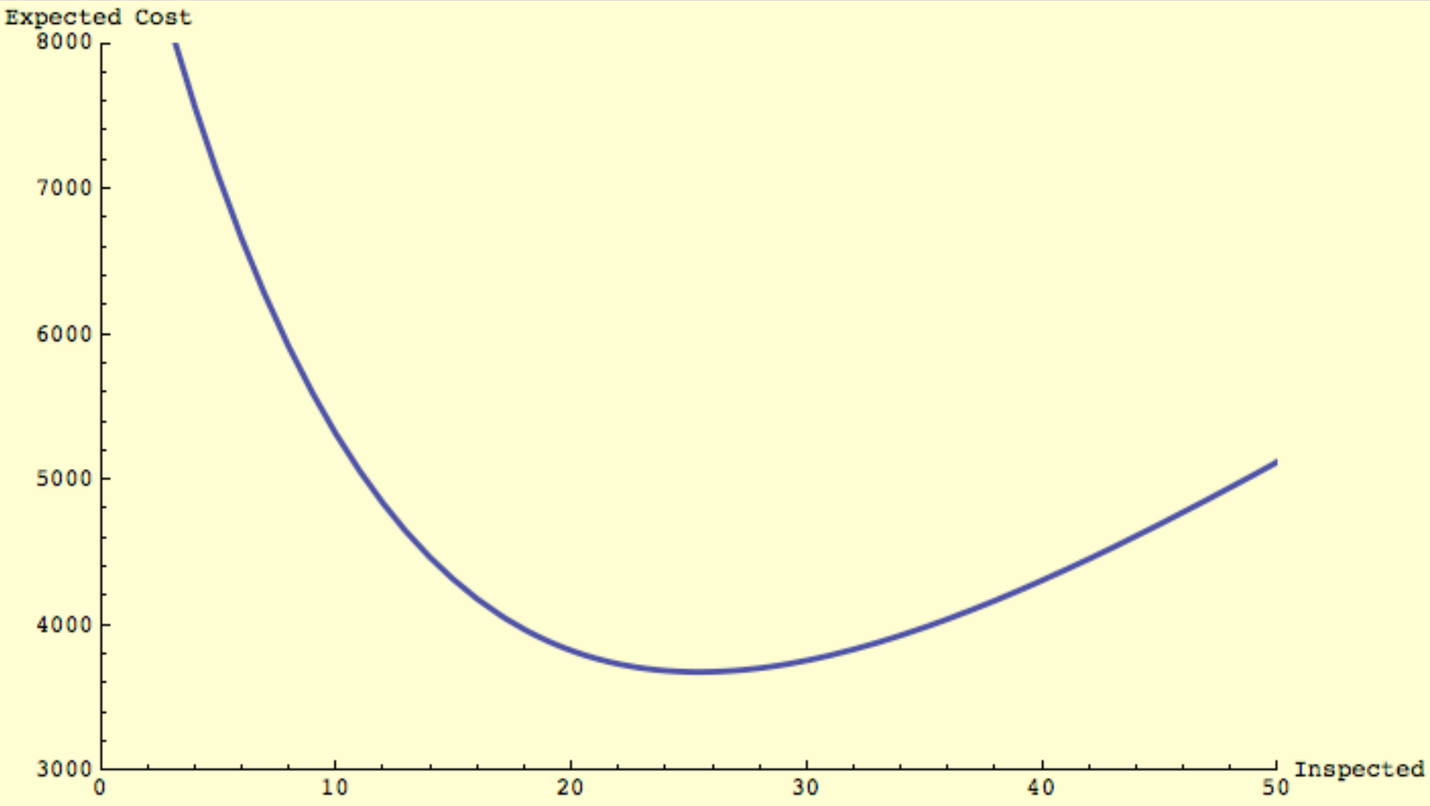

II. Approach (cont)

Expected cost given number of infested boxes

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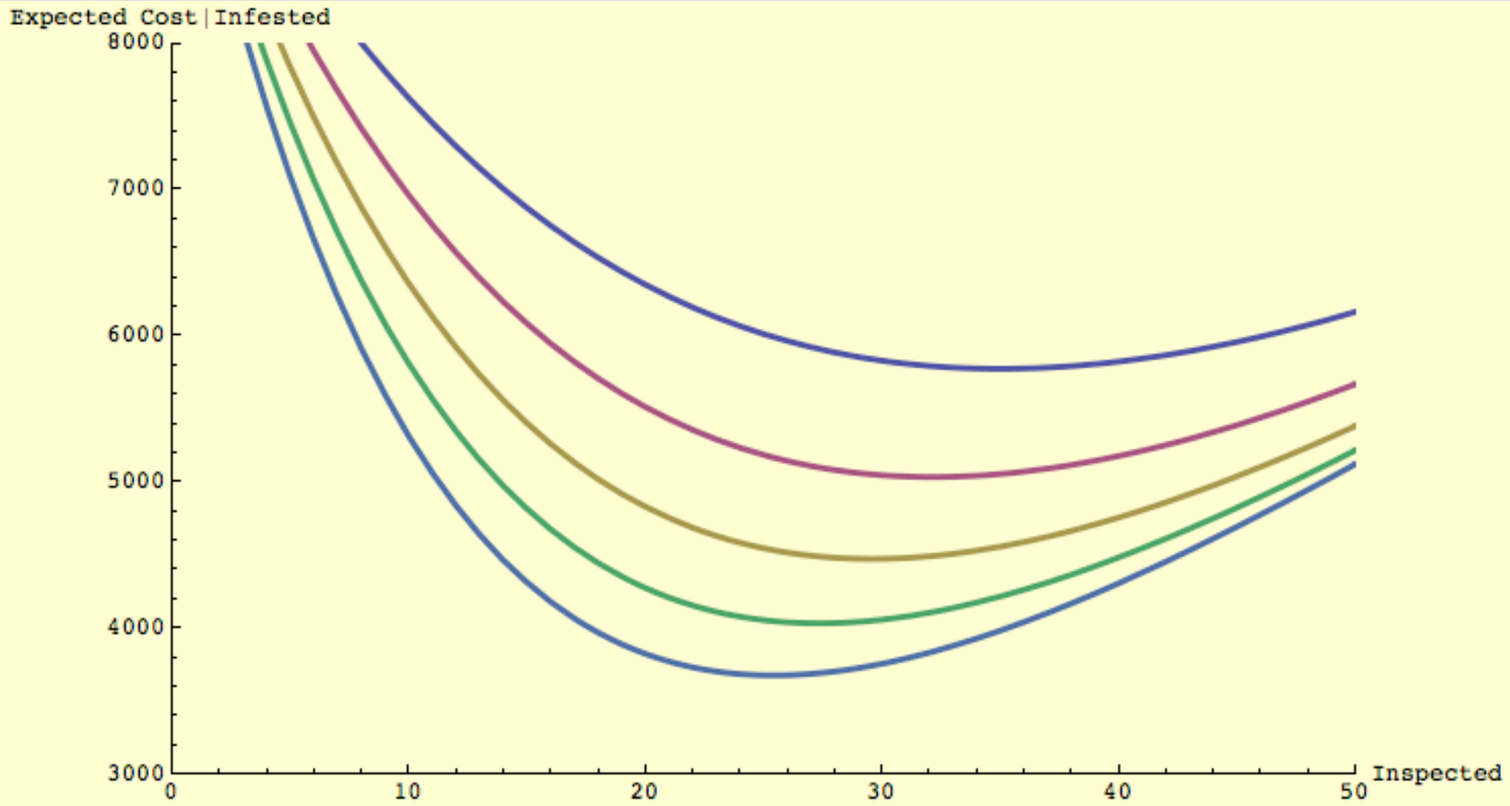


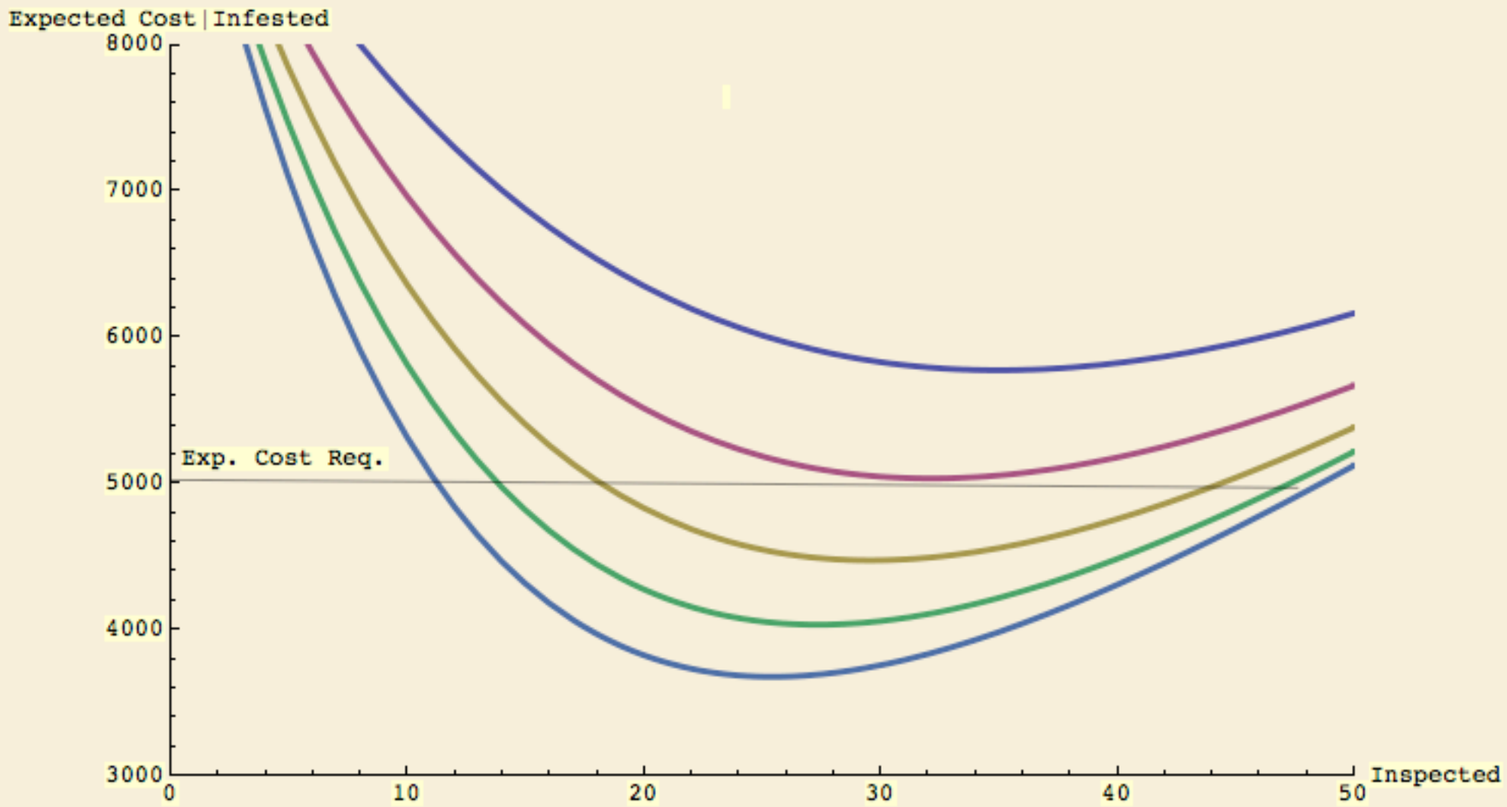
II. Approach (cont)

Basis for inspection with an uncertain number of infested boxes:

→ Robustness in meeting an expected cost requirement

II. Approach (cont)

Robustness: maximize robustness to expected cost requirement



III. Results

1. Robust inspection

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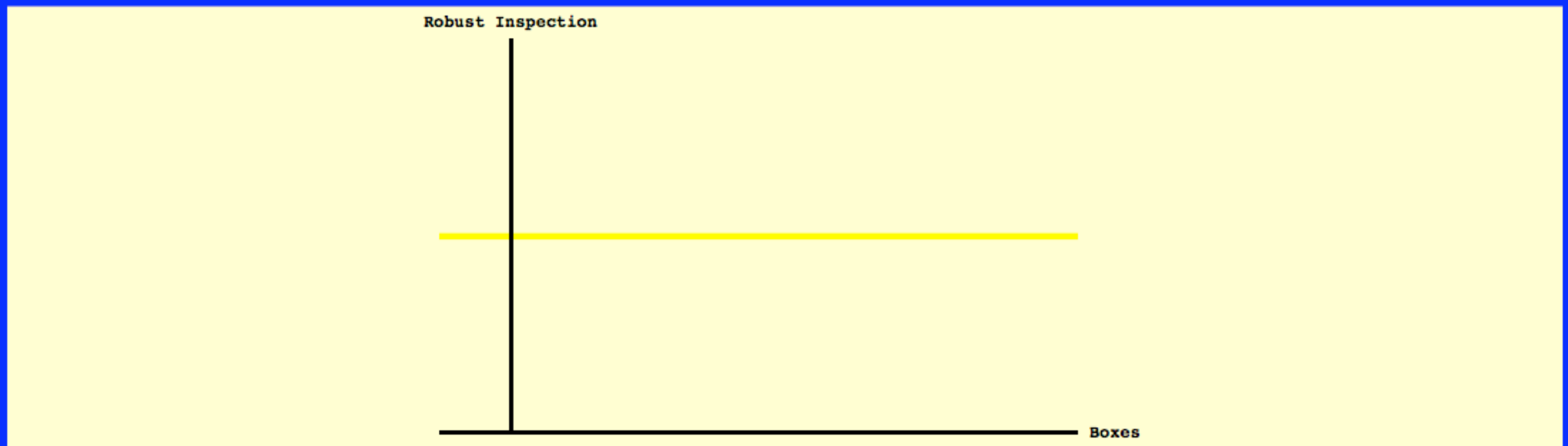
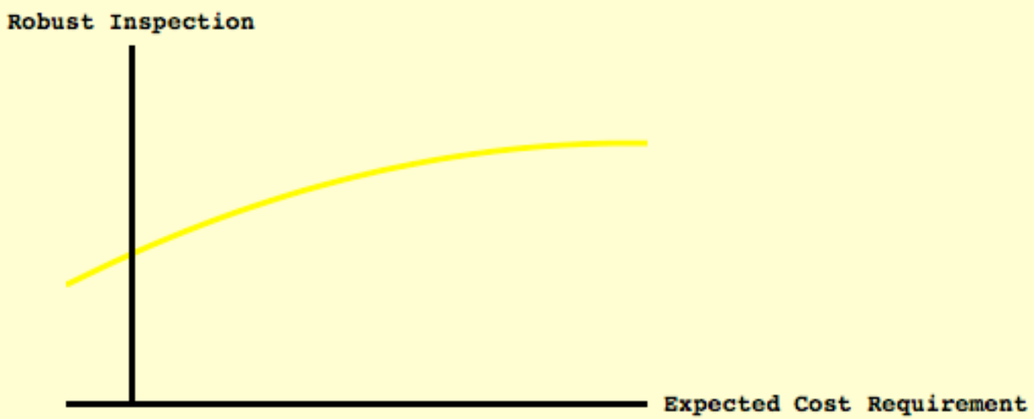


III. Results

2. Robust inspection and expected cost requirement

Out[115]=



III. Results

3. Robustness

Out[13]=