Low Incidence High Impact Events – Seed Sprouts – Cost Benefit Analysis

Jason March
Principal Economist

What I am going to cover ...

- Set the scene from a theoretical point of view
- Seed Sprouts case study
- How we applied the above theory to justify regulation

Risk and Uncertainty

- Risk – the actual outcome is not known but the probability of various possible outcomes can be estimated.
- Uncertainty – it is not possible to estimate a probability distribution of outcomes.

Four Types of Decision Making

Decision making:

- with certainty
- with risk
- with uncertainty
- in ignorance

Approaches to Uncertainty

Does a compelling justification exist – precautionary principle

Sensitivity Analysis

Game Problems

Precautionary Principle

- In the Australian context – is there a compelling reason to act despite uncertainty.
- Precautionary principle:

… This notion of precaution is based upon the assumption that in certain cases, scientific certainty, to the extent that it is obtainable . . . may be achieved too late to provide effective responses . . . (*OECD Joint Working Party on Trade and Environment 2002*)

Sensitivity Analysis

- Values included in a cost benefit analysis are typically 'most likely' or 'best estimates' – these can be varied across a range you are reasonably confident contains the true value.
- Switching values of key variables can be estimated – break even analysis.

Game Problems

Project	*Scenario 1*	*Scenario 2*	*Scenario 3*	*EV with = P_i*
Option A	+250	+250	+300	266
Option B	+100	+400	+500	333
Option C	+200	+300	+600	366

Case Study - Seed Sprouts

- Consumption of seed sprouts was associated with two food-borne illness outbreaks in 2005-06 in Australia.
- The first outbreak resulted in 125 reported illness cases whereas the second outbreak involved 7 reported cases – assumed to be around 987 cases due to our knowledge of under reporting.

Seed Sprouts

- The cost per case was estimated to be $2,165 AU on average.
- Therefore the overall cost was around 2.1 million AU.

Cost	Amount (2011 $)
Productivity Loss	$638,016
Gastroenteritis individual welfare cost	$290,803
Sequelae individual welfare costs	$372,090
Less allowance for double counting	$-95,702
Total business and individual costs from illness	$1,205,206
Cost to industry	$675,339
Costs incurred by government/states	$256,789
Total cost	**$2,137,335**
Cost per illness	**$2,165**

Seed Sprouts

What we know –

- Outbreaks can and do happen and they are clearly detrimental to human health (clear rational basis for concern)
- That outbreaks have occurred in Australia and in numerous overseas locations.
- The size and timing of outbreaks have been highly variable.

Seed Sprouts

What we don't know:

- The likely size and timing of future outbreaks
- The actual effectiveness of our proposed regulatory intervention

Seed Sprouts

Challenges:

- Not widely eaten compared to other types of foods – attribution
- Voluntary changes had been made by industry

Seed Sprouts

Options Considered

- Status Quo
- Industry Self Regulation
- Measures for Seed Processors, Seed Processors and Sprout Producers
- Measures for Sprout Producers Only

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A compelling story ...

- Two outbreaks have occurred and there maybe have been more . . .
- Microbiological testing has since detected a range of pathogens on sprouts
- Whilst action has been taken by some we can not assume risk is evenly distributed . . . industry wants regulation.

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Low Probability High Impact Event

- Japanese radish sprouts outbreak 1996 – 12,680 illnesses, 3 deaths – e-coli
- USA – between 1995 – 2010 – 2,046 reported cases, 3 deaths - salmonella
- German Outbreak 2011 – 3,910 illnesses, 46 deaths – as at 27 July 2011 – e-coli

Sensitivity Testing

Effectiveness of intervention

- The likely effectiveness was assumed to be in a range between 23% and 65% reduction in disease in Australia. A mean rate of effectiveness was estimated at 44%

Burden of Illness	Net Present Value		
	3%	7%	11%
Low reduction @23%	-1.5 m	-1.4 m	-1.2 m
Mean reduction @44%	2 m	1.7 m	1.2 m
High reduction @ 65%	5.7 m	4.9 m	4.2 m

Break Even Analysis

	Discount Rate	7.00%		Number of illness	298.91
	Upfront costs	288360	270000		
	Ongoing costs	608760	570000		
	Benefit per illness avoided	2165			
Year	Benefits	Cost	Total	Discount rate	NPV
0	$647,130.07	$897,120.00	-$249,989.93	1.0000	-$249,989.93
1	$647,130.07	$608,760.00	$38,370.07	0.9346	$35,859.88
2	$647,130.07	$608,760.00	$38,370.07	0.8734	$33,513.91
3	$647,130.07	$608,760.00	$38,370.07	0.8163	$31,321.41
4	$647,130.07	$608,760.00	$38,370.07	0.7629	$29,272.34
5	$647,130.07	$608,760.00	$38,370.07	0.7130	$27,357.33
6	$647,130.07	$608,760.00	$38,370.07	0.6663	$25,567.60
7	$647,130.07	$608,760.00	$38,370.07	0.6227	$23,894.95
8	$647,130.07	$608,760.00	$38,370.07	0.5820	$22,331.73
9	$647,130.07	$608,760.00	$38,370.07	0.5439	$20,870.78
				Total	$0.00

Goal Seek
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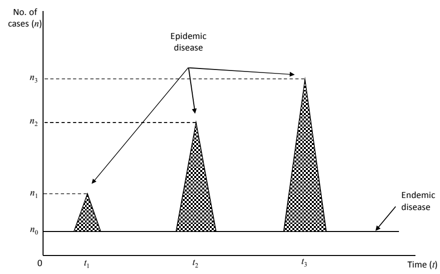
Game Problems

Professor Jim Butler – Australian National University

- Unnecessarily limited to the past disease experience in Australia
- Analysis did not take into account the endemic as opposed to the epidemic component of the total number of cases caused by sprouts in Australia



Game Problems

$$N = n_0 + \sum_j p_j n_j$$

where *N* is the total number of cases in time period *i* and is obtained as the sum of the (constant) number of endemic cases each year and the probability weighted sum of different number of cases that potentially will emerge in an epidemic in time period *i*.

Game Problem

- Used expert opinion – but needed to be very careful to be clear what we were creating
- Made use of past outbreak data to estimate size and relative chance of occurrence
- Converted an unknown into a subjective probability

Annual cases of salmonellosis in Australia	Expected % of annual salmonellosis cases associated with seed sprout consumption	Potential number of cases in the year (n_j)	Probability of observing corresponding number of cases in that year (p_j)	Expected number of cases
A	B	C= (A x B)	D	E = (C x D)
84,056	0.75%	(n_0) 630.4	1.0	630.4
84,056	0.33%	(n_1) 277.4	0.25	69.3
84,056	1.67%	(n_2) 1403.7	0.1	140.4
84,056	5%	(n_3) 4202.8	0.02	84.1
Total (N)				**924.2**

Conclusion

- The **process** is a policy one not a scientific one – a decision needs to be made and insufficient scientific information exists
- Limits of information made clear to decision makers
- Multiple techniques used to provide the best guidance possible

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FOOD STANDARDS Australia New Zealand
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Contact Details

Australia

Boeing House
55 Blackall Street
BARTON ACT 2600
Ph: +61 2 6271 2222
Fax: +61 2 6271 2278

PO Box 7186
Canberra BC ACT 2610
Australia
Email: info@foodstandards.gov.au
Website: www.foodstandards.gov.au

New Zealand

Level 6
108 The Terrace
WELLINGTON NEW ZEALAND
Ph: +64 4 978 5630
Fax: +64 4 473 9855

PO Box 10559
The Terrace, Wellington 6036
New Zealand
info@foodstandards.govt.nz
www.foodstandards.govt.nz