Decision Analysis cont.

Lecture 3

Expected Value of Perfect Information (EVPI)

- EVPI places an upper bound on what you should pay for additional information.

$$\text{EVPI} = \text{EVwPI} - \text{Maximum EMV}$$

- EVwPI is the long run average return if we have perfect information before a decision is made.

EVwPI = (best payoff for first state of nature)
x (probability of first state of nature)
+ (best payoff for second state of nature)
x (probability of second state of nature)
+ … + (best payoff for last state of nature)
x (probability of last state of nature)

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Expected Value of Perfect Information (EVPI)

- **Suppose Scientific Marketing, Inc. offers analysis that will provide certainty about market conditions (favorable).**
- **Additional information will cost $65,000.**
- **Should Thompson Lumber purchase the information?**

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Expected Value of Perfect Information (EVPI)

Decision Table with Perfect Information

ALTERNATIVE	STATE OF NATURE: FAVORABLE MARKET ($)	STATE OF NATURE: UNFAVORABLE MARKET ($)	EMV ($)
Construct a large plant	200,000	-180,000	10,000
Construct a small plant	100,000	-20,000	40,000
Do nothing	0	0	0
With perfect information	200,000	0	100,000
Probabilities	0.5	0.5	

EVwPI

Table 3.10

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Expected Value of Perfect Information (EVPI)

The maximum EMV without additional information is $40,000.

EVPI = EVwPI – Maximum EMV

= $100,000 - $40,000

= $60,000

So the maximum Thompson should pay for the additional information is $60,000.

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Expected Value of Perfect Information (EVPI)

The maximum EMV without additional information is $40,000.

EVPI = EVwPI – Maximum EMV

= $100,000 - $40,000

= $60,000

So the maximum Thompson should pay for the additional information is $60,000.

Therefore, Thompson should not pay $65,000 for this information.

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Expected Opportunity Loss

- ***Expected opportunity loss*** **(EOL) is the cost of not picking the best solution.**
- **First construct an opportunity loss table.**
- **For each alternative, multiply the opportunity loss by the probability of that loss for each possible outcome and add these together.**
- **Minimum EOL will always result in the same decision as maximum EMV.**
- **Minimum EOL will always equal EVPI.**

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Expected Opportunity Loss

ALTERNATIVE	STATE OF NATURE: FAVORABLE MARKET ($)	STATE OF NATURE: UNFAVORABLE MARKET ($)	EOL
Construct a large plant	0	180,000	90,000
Construct a small plant	100,000	20,000	60,000
Do nothing	200,000	0	100,000
Probabilities	0.50	0.50	

Table 3.11

Minimum EOL

$$\text{EOL (large plant)} = (0.50)(\$0) + (0.50)(\$180,000)$$
$$= \$90,000$$
$$\text{EOL (small plant)} = (0.50)(\$100,000) + (0.50)(\$20,000)$$
$$= \$60,000$$
$$\text{EOL (do nothing)} = (0.50)(\$200,000) + (0.50)(\$0)$$
$$= \$100,000$$

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Sensitivity Analysis

- Sensitivity analysis examines how the decision might change with different input data.
- For the Thompson Lumber example:

P = probability of a favorable market

(1 – P) = probability of an unfavorable market

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Sensitivity Analysis

$$\text{EMV(Large Plant)} = \$200{,}000P - \$180{,}000)(1 - P)$$
$$= \$200{,}000P - \$180{,}000 + \$180{,}000P$$
$$= \$380{,}000P - \$180{,}000$$

$$\text{EMV(Small Plant)} = \$100{,}000P - \$20{,}000)(1 - P)$$
$$= \$100{,}000P - \$20{,}000 + \$20{,}000P$$
$$= \$120{,}000P - \$20{,}000$$

$$\text{EMV(Do Nothing)} = \$0P + 0(1 - P)$$
$$= \$0$$

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Sensitivity Analysis

Substitute *P* once= 0 and once =1 in each equation

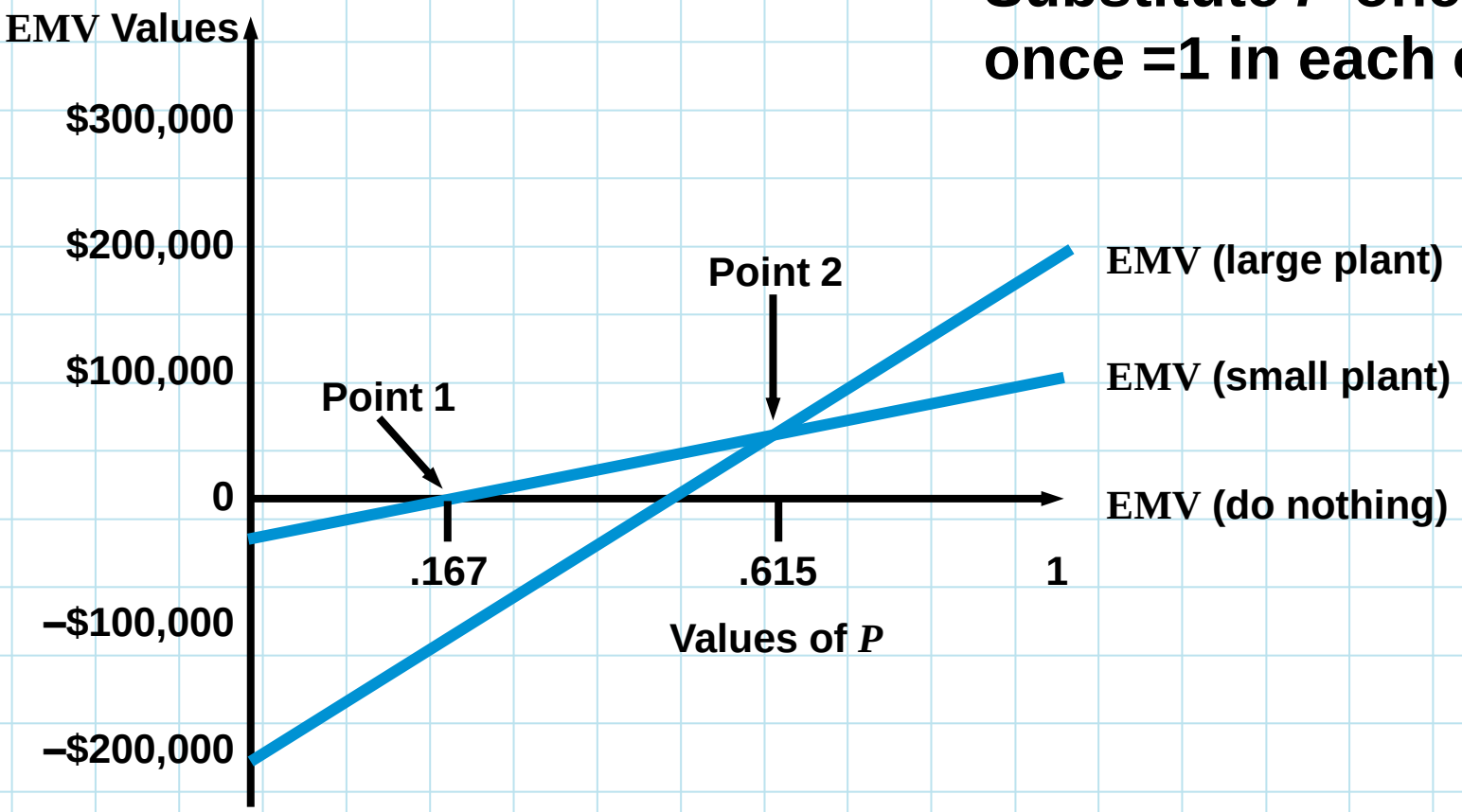

Figure 3.1

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Sensitivity Analysis

Point 1:

$\text{EMV}(\text{do nothing}) = \text{EMV}(\text{small plant})$

$$0 = \$120{,}000P - \$20{,}000 \qquad P = \frac{20{,}000}{120{,}000} = 0.167$$

Point 2:

$\text{EMV}(\text{small plant}) = \text{EMV}(\text{large plant})$

$$\$120{,}000P - \$20{,}000 = \$380{,}000P - \$180{,}000$$

$$P = \frac{160{,}000}{260{,}000} = 0.615$$

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Sensitivity Analysis

BEST ALTERNATIVE	RANGE OF P VALUES
Do nothing	Less than 0.167
Construct a small plant	0.167 – 0.615
Construct a large plant	Greater than 0.615

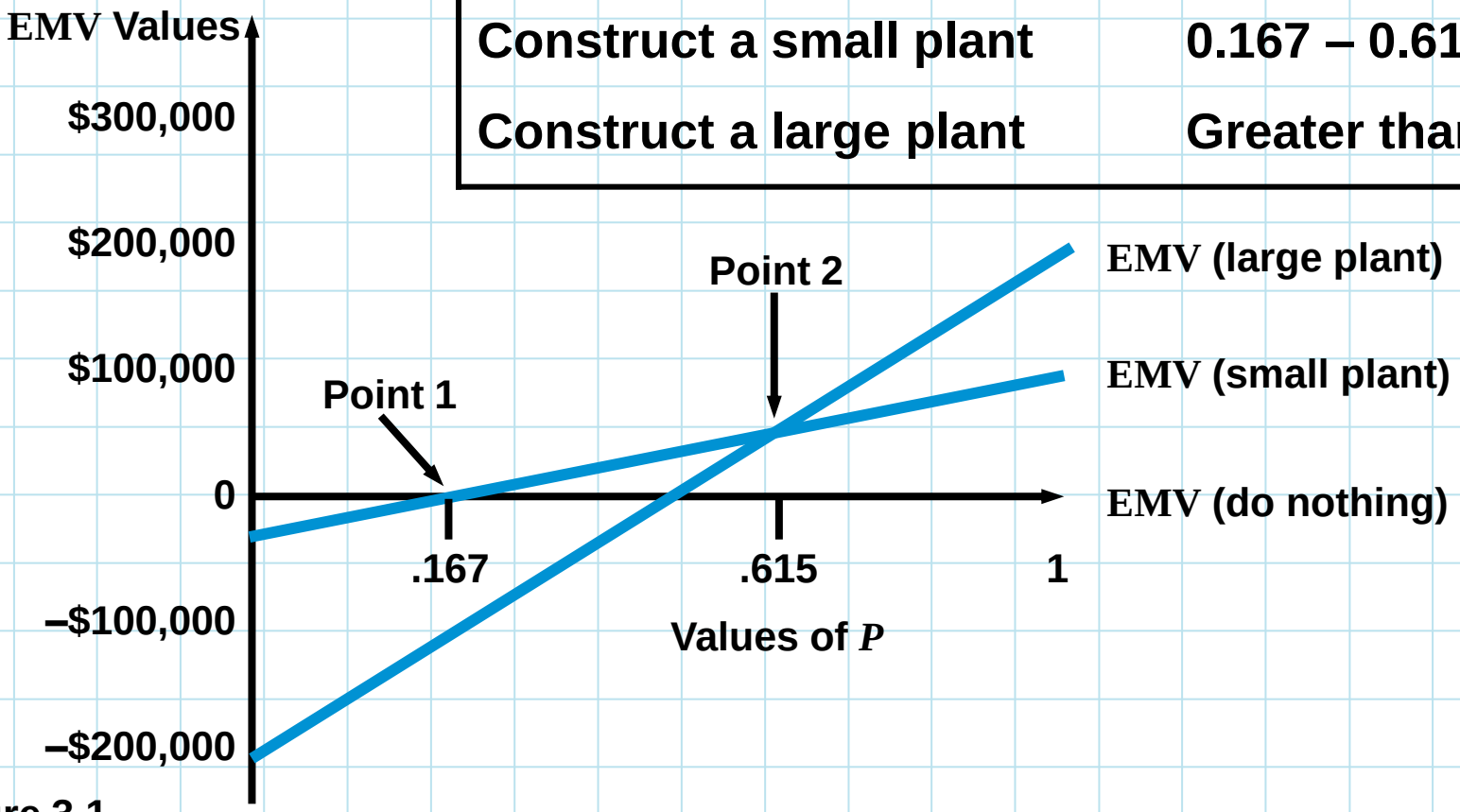

Figure 3.1

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Example

- **Calculate EVPI**

ALTERNATIVE	STATE OF NATURE		
	GOOD MARKET ($)	AVERAGE MARKET ($)	BAD MARKET ($)
Small shop	75,000	25,000	–40,000
Medium-sized shop	100,000	35,000	–60,000
No shop	0	0	0
Probabilities	0.20	0.50	0.30

Solution

EVPI = EVwPI – Maximum EMV

ALTERNATIVE	STATE OF NATURE: GOOD MARKET ($)	AVERAGE MARKET ($)	BAD MARKET ($)	EMV ($)
Small shop	75,000	25,000	–40,000	15,500
Medium-sized shop	100,000	35,000	–60,000	19,500
No shop	0	0	0	0
Probabilities	0.20	0.50	0.30	

b. $\text{EVwPI} = (0.2)\$100{,}000 + (0.5)\$35{,}000 + (0.3)\$0 = \$37{,}500$

$\text{EVPI} = \$37{,}500 - \$19{,}500 = \$18{,}000$