

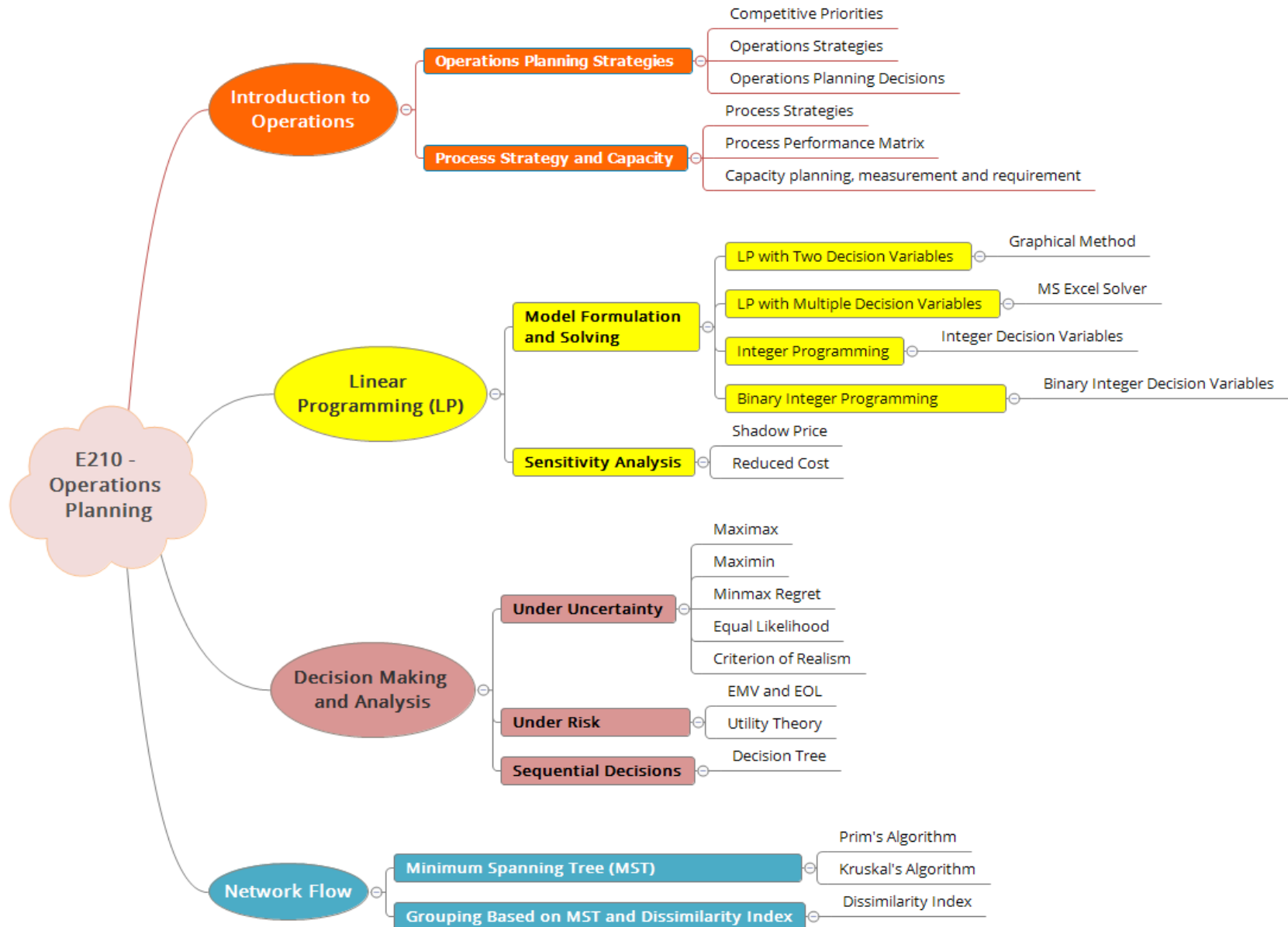
Problem 11

Value of Market Research

E210 – Operations Planning

SCHOOL OF
ENGINEERING

E210 Operations Planning Topic Tree



Expected Value of Sample Information (EVSI)



- Recall: Expected Value of Perfect Information (EVPI)
 - EVPI is the maximum amount that should be paid to gain information that would result in a better decision than those decisions made without perfect information — P08
 - It is under the ideal case that perfect information is available.
- Most commonly, perfect information is **not** available. However, additional information regarding future events can be gained through **tests or experiments**, such as market research, medical tests, sampling of physical environments, etc.
- This additional information can help a decision maker more accurately estimate probabilities of possible future events and therefore make better decision. The value of this additional information is often called the **Expected Value of Sample Information (EVSI)**.

Expected Value of Sample Information (EVSI)



- EVSI is calculated as:
$$\text{EVSI} = \text{Expected payoff with sample (additional) information} - \text{Expected payoff without sample (additional) information}$$
- In general, obtaining sample (additional) information includes an associated cost. Is it worthwhile to pay for the sample (additional) information?
 - When $\text{EVSI} > \text{cost of obtaining the sample information through test or experiment}$, it is worthwhile to conduct the test or experiment.
 - When $\text{EVSI} \leq \text{cost of obtaining the sample information through test or experiment}$, it is not worthwhile to conduct the test or experiment.

Efficiency of Sample Information



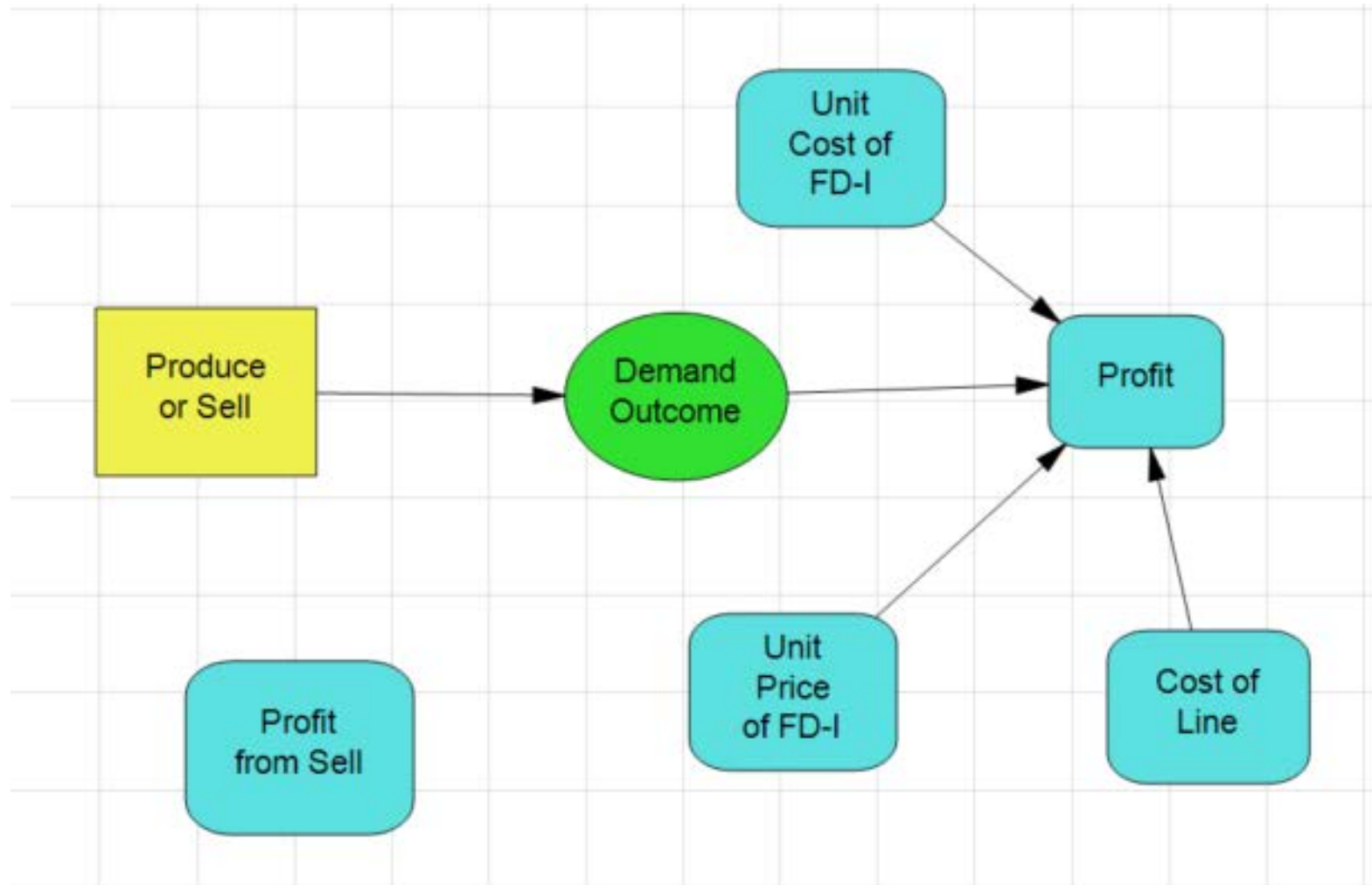
- One way to judge how much information is generated by a sample (via test or experiment) is to compute the ratio of EVSI to EVPI times 100, expressed as a percentage.
- This is known as the **efficiency of sample information**.
- For example, with perfect information, the expected payoff is \$100,000; with market research, the expected payoff is \$80,000; without any information regarding future events, the expected monetary value is \$50,000. What are the values for EVPI, EVSI, and efficiency of sample information?
 - $EVPI = 100,000 - 50,000 = \$50,000$
 - $EVSI = 80,000 - 50,000 = \$30,000$
 - $\text{Efficiency of sample information} = (EVSI/EVPI) * 100 = (30,000/50,000) * 100 = 60\%$.

Problem 11

Suggested Solution

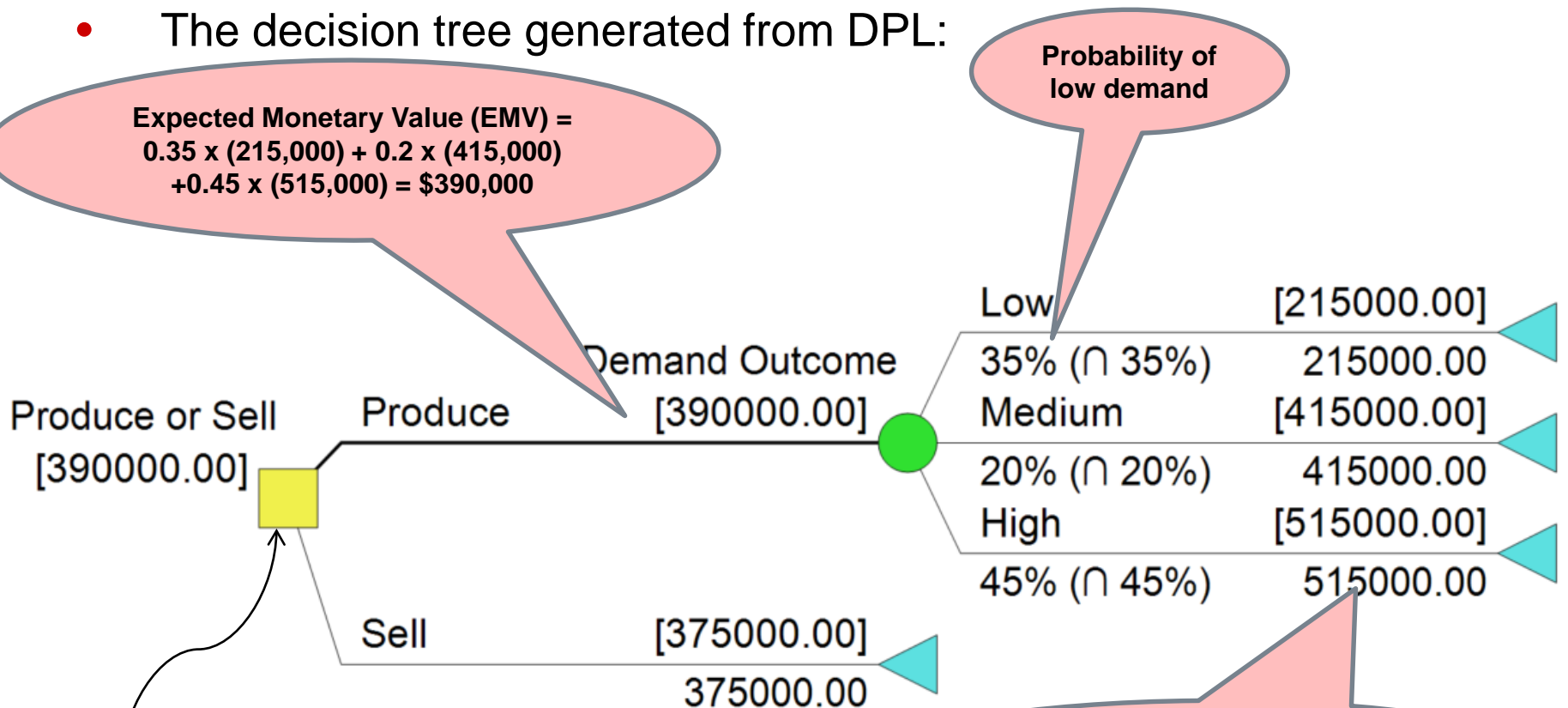
Today's Problem: No Market Research

- The DPL influence diagram when there is no market research:



Today's Problem: No Market Research

- The decision tree generated from DPL:



The best course of action is 'Produce' rather than 'Sell' with an expected payoff of \$390,000.

Payoff for 'Produce' with demand outcome being high = $(180 - 130) \times (12,000) - 85,000 = \$515,000$

Unit Price

Unit Cost

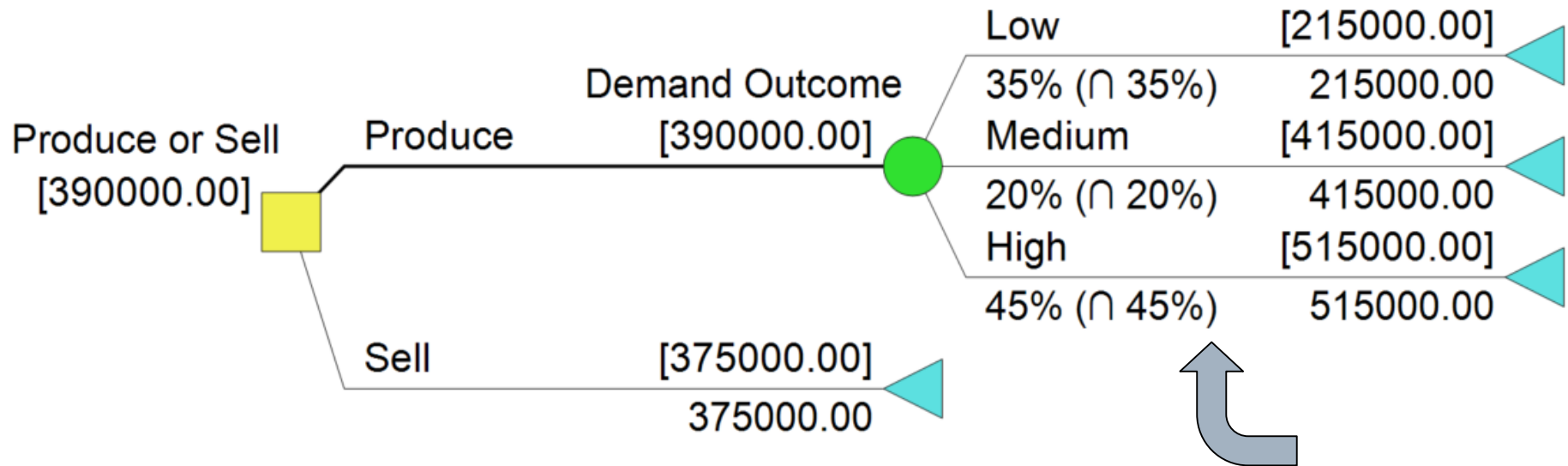
High demand

Line Cost

Today's Problem: Determining the EVPI



- The Expected Value of Perfect Information (EVPI):



□ Demand outcome 'Low':

best payoff = $\max(215,000, 375,000) = \$375,000$

□ Demand outcome 'Medium':

best payoff = $\max(415,000, 375,000) = \$415,000$

□ Demand outcome 'High':

best payoff = $\max(515,000, 375,000) = \$515,000$

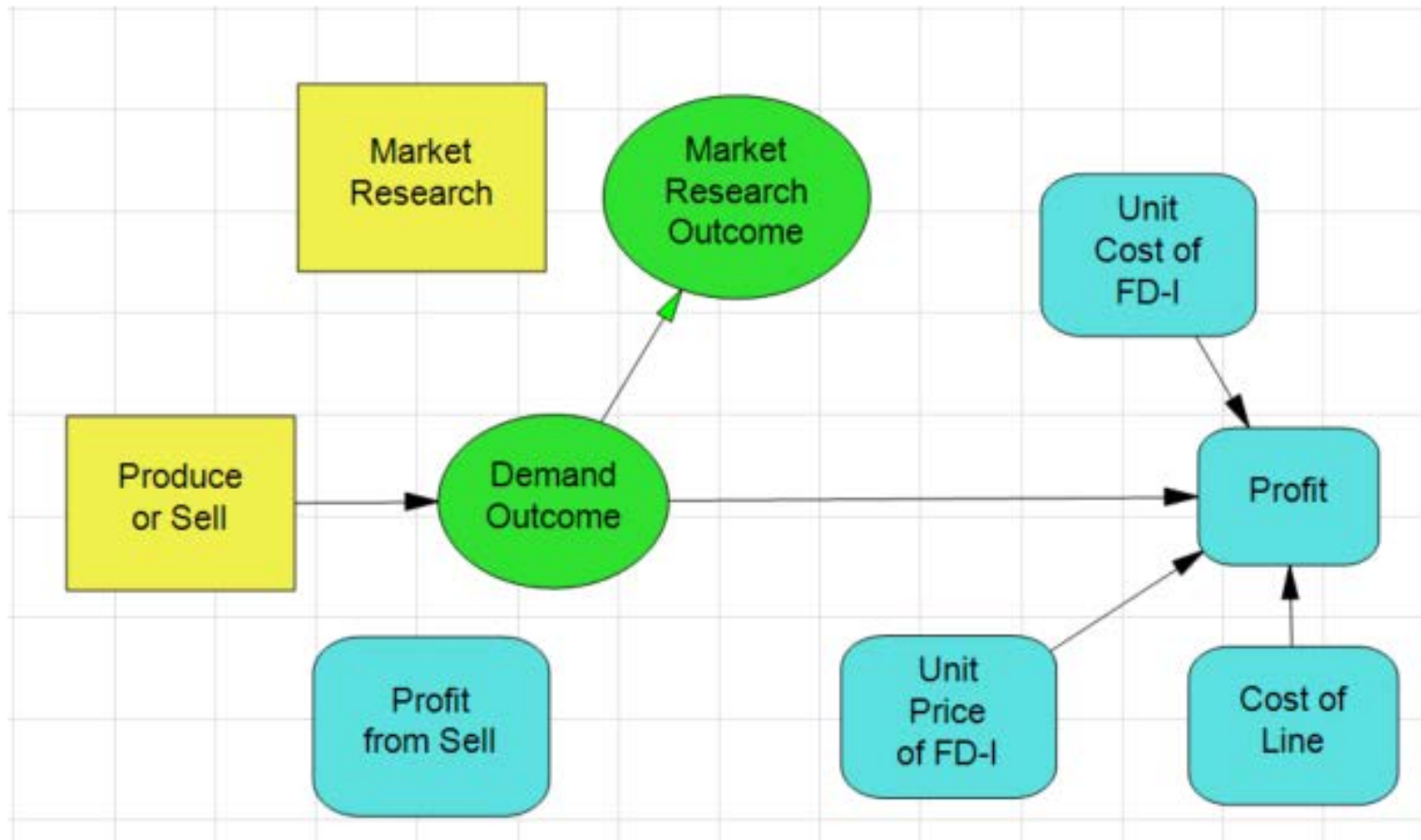
□ EV with PI = $375,000 \times 0.35 + 415,000 \times 0.2 + 515,000 \times 0.45$
= \$446,000

□ EVPI = $446,000 - 390,000 = \$56,000$

Alternatives	Demand Outcome		
	Low	Medium	High
	35%	20%	45%
Produce	215,000	415,000	515,000
Sell	375,000	375,000	375,000

Today's Problem: With Market Research

- With market research, the DPL influence diagram (excluding cost of marketing research) is shown below:



Today's Problem: With Market Research

- The decision tree generated from DPL:

The best course of action:

- Do market research
- If Market Research Outcome is 'Low', 'Sell';
- Otherwise, 'Produce'
- **The Expected Payoff is 428,150 – 20,000 = \$408,150 where \$20,000 is the cost of market research**

Conditional Probability: Given that Market Research Outcome is Low, the probability that Demand Outcome is Low.

Unit Price
Unit Cost
Line Cost

Payoff =
 $(180 - 130) \times 6,000 - 85,000$
= \$215,000

Low demand

Low	[215000.00]
Medium	[415000.00]
High	[515000.00]

Demand Outcome [290690.61]

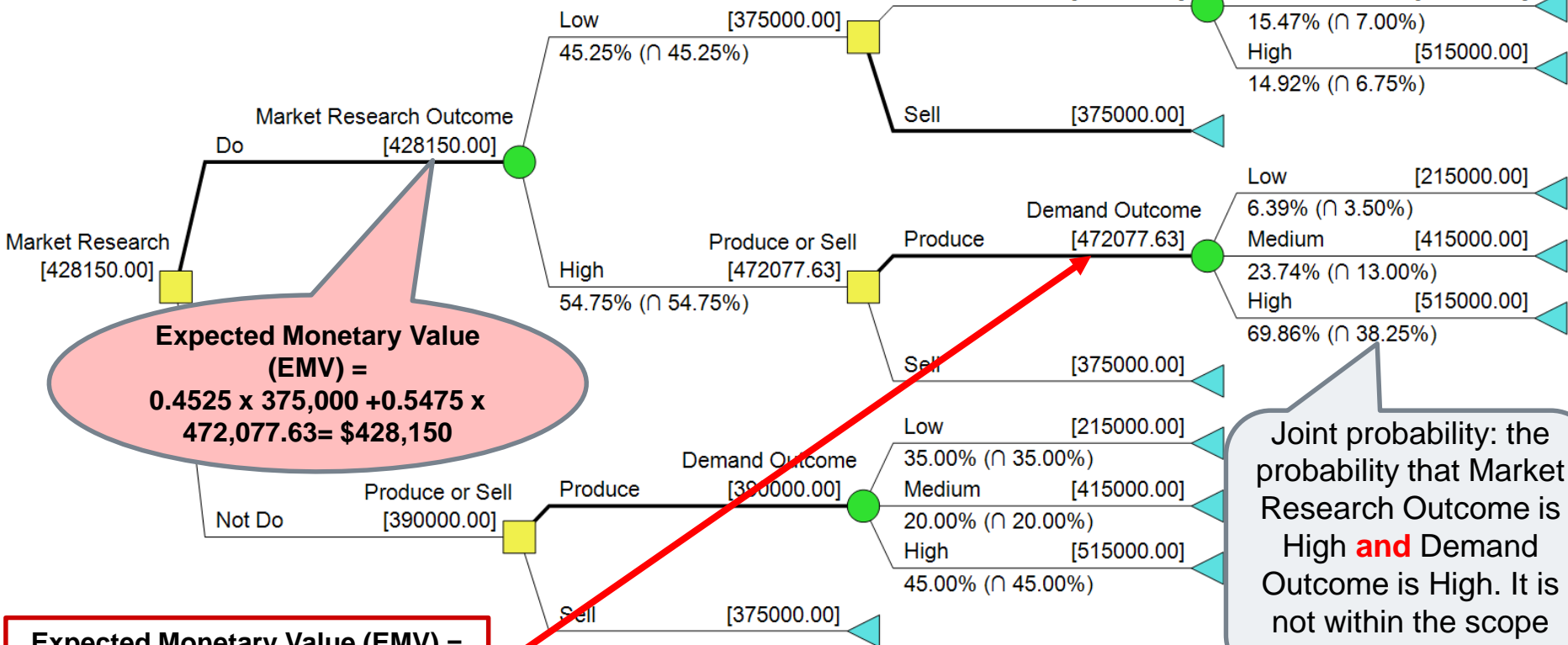
69.61% (∩ 31.50%)
15.47% (∩ 7.00%)
14.92% (∩ 6.75%)

Low	[215000.00]
Medium	[415000.00]
High	[515000.00]

Demand Outcome [472077.63]

6.39% (∩ 3.50%)
23.74% (∩ 13.00%)
69.86% (∩ 38.25%)

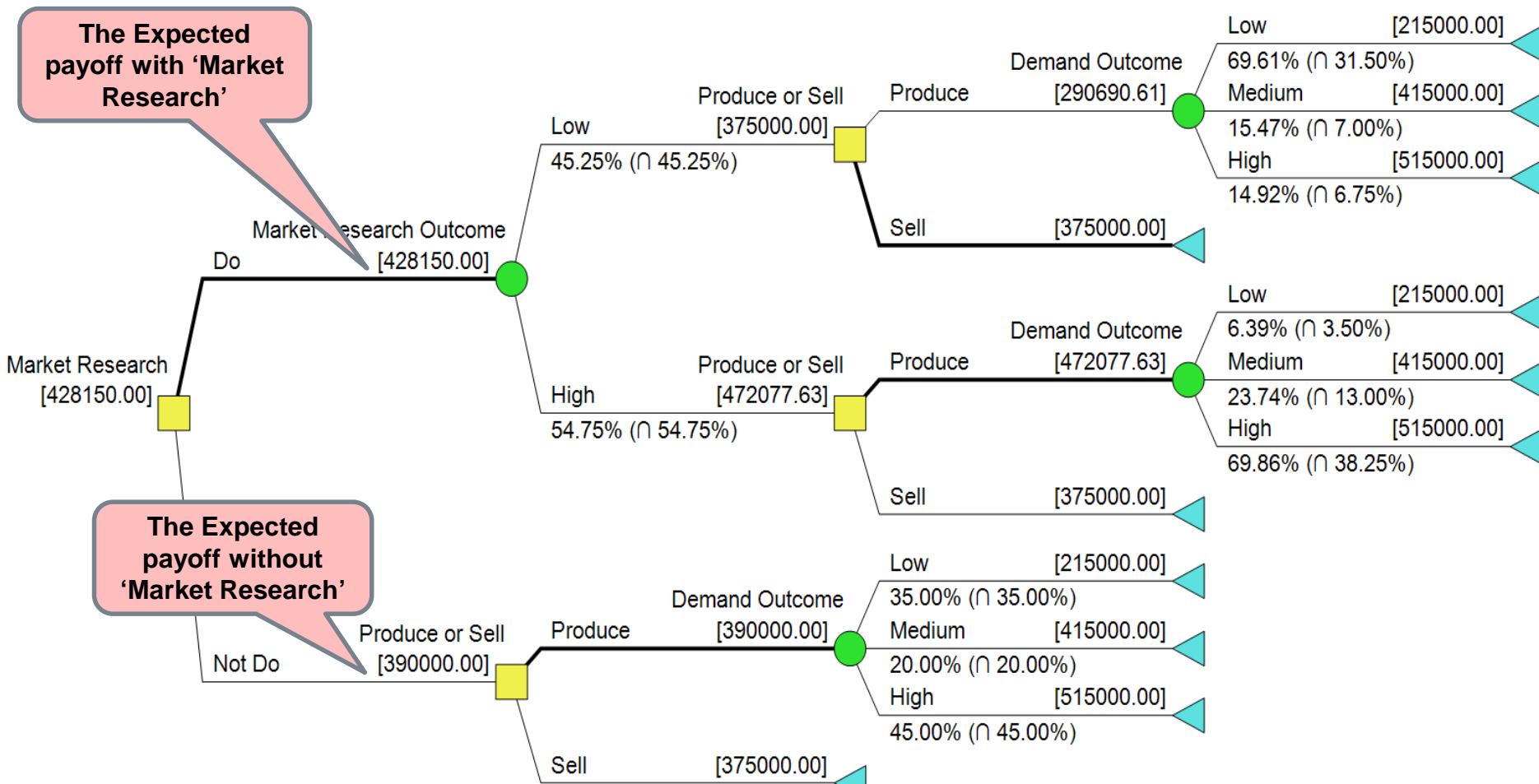
Joint probability: the probability that Market Research Outcome is High and Demand Outcome is High. It is not within the scope of this module.



Expected Monetary Value (EMV) =
 $0.4525 \times 375,000 + 0.5475 \times 472,077.63 = \$428,150$

Expected Monetary Value (EMV) =
 $0.0639 \times 215,000 + 0.2374 \times 415,000 + 0.6986 \times 515,000 = \$472,077.63$

Today's Problem: Determining EVSI



- The Expected Value of Sample Information (EVSI):

$$\text{EVSI} = 428,150 - 390,000 = \$38,150$$

- Since EVSI (\$38,150) > cost of market research (\$20,000), FlyEagle should conduct market research before making the decision of 'Produce' or 'Sell'.

Today's Problem:

The Efficiency of Sample Information



- The Efficiency of Sample Information:

$$\begin{aligned} \text{Efficiency of Sample Information} \\ = (\text{EVSI}/\text{EVPI}) * 100 = (38,150/56,000) * 100 = 68.125\% \end{aligned}$$

EVSI
calculated on
slide 12

EVPI
calculated on
slide 9

- The efficiency of sample information can range from 0 to 1
 - The closer the number is to 1, the closer the sample information is to being perfect.
 - The closer the number is to 0, the less information there is in the sample.
 - Thus a value such as 68.125% is slightly above mid-range, meaning that relative to perfect information, the information that could be gained from the market research is moderate.

Conclusion



- Decision makers can improve decision making by bringing additional information into the process through market survey, forecasting, medical tests, etc.
- Based on the decision tree constructed,
 - FlyEagle should conduct market research to get better estimation of customer demand.
 - If the market research outcome is high, produce the product; otherwise, sell the rights to it to another company.
 - The total expected profit is \$408,150.
- For the market research to be done in FlyEagle,
 - The EVSI is \$38,150 with a cost of \$20,000.
 - As the EVPI is \$56,000, the efficiency of sample information is 68.125%.

Learning Objectives



- At the end of the lesson, students should be able to:
 - Analyze the use of sample (additional) information in decision tree for problems with sequence of dependent decisions.
 - Relate the value of sample (additional) information obtained through market research/test in decision making.
 - Evaluate sequence of dependent decisions when sample (additional) information is available.
 - Calculate Expected Value of Sample Information.
 - Calculate and interpret Efficiency of Sample Information in relation to the use of sample information in decision making.
 - Use of software DPL to perform Decision Analysis.

Overview of E210 Operation Planning Module

