CHAPTER 1

Problem Solving and Critical Thinking



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Inductive and Deductive Reasoning **1.1**

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Objectives

1. Understand and use inductive reasoning.

2. Understand and use deductive reasoning.

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Inductive Reasoning

The process of arriving at a general conclusion based on observations of specific examples.

Definitions:

Conjecture/hypothesis: The conclusion formed as a result of inductive reasoning which may or may not be true.

Counterexample: A case for which the conjecture is not true which proves the conjecture is false.

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Strong Inductive Argument

In a random sample of 380,000 freshman at 772 fouryear colleges, 25% said they frequently came to class without completing readings or assignments. We can conclude that there is a 95% probability that between 24.84% and 25.25% of all college freshmen frequently come to class unprepared.

This technique is called **random sampling**, discussed in Chapter 12. Each member of the group has an equal chance of being chosen. We can make predictions based on a random sample of the entire population.

Weak Inductive Argument

Men have difficulty expressing their feelings. Neither my dad nor my boyfriend ever cried in front of me.

This conclusion is based on just two observations.

This sample is neither random nor large enough to represent all men.

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Example: Using Inductive Reasoning

What number comes next?



Solution: Since the numbers are increasing relatively slowly, try addition.

The common difference between each pair of numbers is 9.

Therefore, the next number is 39 + 9 = 48.

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Example: Using Inductive Reasoning

What number comes next?



Solution: Since the numbers are increasing relatively quickly, try multiplication.

The common ratio between each pair of numbers is 4.

Thus, the next number is: $4 \times 768 = 3072$.

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Inductive Reasoning: More than one Solution!



Is this illusion a wine Goblet or two faces looking at each other? 2, 4, ?
What is the next number in this sequence?
If the pattern is to add 2 to the previous number it is 6.

If the pattern is to multiply the previous number by 2 then the answer is 8.

We need to know one more number to decide.

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Example: Using Inductive Reasoning

What comes next in this list of numbers?

1, 1, 2, 3, 5, 8, 13, 21, ?

Solution: This pattern is formed by adding the previous 2 numbers to get the next number:



So the next number in the sequence is: 13 + 21 = 34

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Example: Finding the Next Figure in a Visual Sequence



Describe two patterns in this sequence of figures. Use the pattern to draw the next figure.

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Example: continued

Solution: The first pattern concerns the shapes. We can predict that the next shape will be a Circle

The second pattern concerns the dots within the shapes. We can predict that the dots will follow the pattern from 0 to 3 dots in a section with them rotating counterclockwise so that the figure is as below



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Deductive Reasoning

Deductive reasoning is the process of proving a specific conclusion from one or more general statements. A conclusion that is proved to be true by deductive reasoning is called a **theorem**.

An Example in Everyday Life

Everyday Situation	Deductive Reasoning
One player to another in Scrabble. "You have to remove those five letters. You can't use TEXAS as a word."	General Statement: All proper names are prohibited in Scrabble. TEXAS is a proper name. Conclusion: Therefore TEXAS is prohibited in Scrabble.

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Example: Using Inductive and Deductive Reasoning

Using Inductive Reasoning, apply the rules to specific numbers. Do you see a pattern?

Select a number	4	7	11
Multiply the number by 6	4 x 6 = 24	7 x 6 = 42	11 x 6 = 66
Add 8 to the product	24 + 8 = 32	42 + 8 = 50	66 + 8 = 74
Divide this sum by 2	$\frac{32}{2} = 16$	$\frac{50}{2} = 25$	$\frac{74}{2} = 37$
Subtract 4 from the quotient	16 – 4 = 12	25 - 4 = 21	37 - 4 = 33

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Example continued

Solution:

Using Deductive reasoning, use *n* to represent the number

Select a number.nMultiply the number by 6.6n (This means 6 times n.)Add 8 to the product.6n + 8Divide this sum by 2. $\frac{6n + 8}{2} = \frac{6n}{2} + \frac{8}{2} = 3n + 4$ Subtract 4 from the quotient.3n + 4 - 4 = 3n

Does this agree with your inductive hypothesis?

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