

# DISCRETE MATHEMATICS

## Meeting 3

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- Compound Statements
- Truth Tables
- Implications (Converses, Inverses, Contrapositives)
- Drawing Conclusions
- Conclusion Patterns (Modus Ponens, Modus Tollens, Syllogism)
- Examples and Exercises

# Compound Statements

- **Disjunction:** Ana orders red sandals or basketball shoes.
- **Conjunction:** Father reads Tempo and Kompas newspapers.
- **Implication:** If today is Monday, then students wear white uniforms.
- **Biconditional:** I bring a 2B pencil if and only if the exam uses answer sheets.

## Disjunction and Conjunction

$p$	$q$	$p \vee q$	$p$	$q$	$p \wedge q$
$T$	$T$	$T$	$T$	$T$	$T$
$T$	$F$	$T$	$T$	$F$	$F$
$F$	$T$	$T$	$F$	$T$	$F$
$F$	$F$	$F$	$F$	$F$	$F$

## Implication and Biconditional

$p$	$q$	$p \rightarrow q$	$p$	$q$	$p \leftrightarrow q$
$T$	$T$	$T$	$T$	$T$	$T$
$T$	$F$	$F$	$T$	$F$	$F$
$F$	$T$	$T$	$F$	$T$	$F$
$F$	$F$	$T$	$F$	$F$	$T$

**Implication** in propositional logic is often divided into three important concepts:

- **Conversion:**  $q \rightarrow p$
- **Inverse:**  $\sim p \rightarrow \sim q$
- **Contrapositive:**  $\sim q \rightarrow \sim p$

This is useful for analysis and proof in propositional logic.

# Truth Table of Implication

$p$	$q$	$\sim p$	$\sim q$	$q \rightarrow p$	$\sim p \rightarrow \sim q$	$\sim q \rightarrow \sim p$
$T$	$T$	$F$	$F$	$T$	$T$	$T$
$T$	$F$	$F$	$T$	$T$	$T$	$F$
$F$	$T$	$T$	$F$	$F$	$F$	$T$
$F$	$F$	$T$	$T$	$T$	$T$	$T$

# Drawing Conclusions

## Terms for Drawing Conclusions:

- **Premise**
- **Conclusion**
- **Argument**

## Conclusion Patterns:

- Modus Ponens
- Modus Tollens
- Syllogism

# Example: Modus Ponens

**Premise 1:** If  $2 + 3 = 5$ , then  $5 > 4$ .

**Premise 2:**  $2 + 3 = 5$ .

**Conclusion:**  $5 > 4$ .

$p$	$q$	$p \rightarrow q$	$(p \rightarrow q) \wedge p$	$((p \rightarrow q) \wedge p) \rightarrow q$
$T$	$T$	$T$	$T$	$T$
$T$	$F$	$F$	$F$	$T$
$F$	$T$	$T$	$F$	$T$
$F$	$F$	$T$	$F$	$T$

# Example: Modus Tollens

**Premise 1:** If it rains, then the weather is cold.

**Premise 2:** The weather is not cold.

**Conclusion:** It is not raining.

$p$	$q$	$\sim q$	$p \rightarrow q$	$(p \rightarrow q) \wedge \sim q$	$((p \rightarrow q) \wedge \sim q) \rightarrow \sim p$
$T$	$T$	$F$	$T$	$F$	$T$
$T$	$F$	$T$	$F$	$F$	$T$
$F$	$T$	$F$	$T$	$F$	$T$
$F$	$F$	$T$	$T$	$T$	$T$

# Example: Syllogism

**Premise 1:** If Maher is a vocational student, then Maher undertakes PSG.

**Premise 2:** If Maher undertakes PSG, then Maher studies in the industry for at least 3 months.

**Conclusion:** If Maher is a vocational student, then Maher studies in the industry for at least 3 months.

# Truth Table of Syllogism

$p$	$q$	$r$	$p \rightarrow q(p1)$	$q \rightarrow r(p2)$	$p \rightarrow r(p3)$	$p1 \wedge p2$	$(p1 \wedge p2) \rightarrow p3$
$T$	$T$	$T$	$T$	$T$	$T$	$T$	$T$
$T$	$T$	$F$	$T$	$F$	$F$	$F$	$T$
$T$	$F$	$T$	$F$	$T$	$T$	$F$	$T$
$T$	$F$	$F$	$F$	$T$	$F$	$F$	$T$
$F$	$T$	$T$	$T$	$T$	$T$	$T$	$T$
$F$	$T$	$F$	$T$	$F$	$T$	$F$	$T$
$F$	$F$	$T$	$T$	$T$	$T$	$T$	$T$
$F$	$F$	$F$	$T$	$T$	$T$	$T$	$T$

# Examples and Exercises

- Please complete the truth tables for the following statements.
- Identify the types of compound statements.
- Create valid arguments based on premises.