PART 1 Conditional Relationships

Identify the sufficient and necessary conditions first. Then translate the relationship into a diagram or plain English.

Conditional and “All” Statements

CONCEPT A relationship in which one condition guarantees another.

A → B “If A, then B”

A is sufficient: if A occurs, B follows.

B is necessary: B is required for A.

One direction only: A guarantees B, but B does not guarantee A.

You are in Paris.
If you are in Paris, then you are in France.
Therefore, you are in France. Paris → France

The Contrapositive

CONCEPT For A → B, the absence of B guarantees the absence of A.

A → B becomes ~B → ~A

Step 1: Reverse — place the conditions in reverse order.

Step 2: Negate — negate both conditions.

Equivalent: the contrapositive has the same meaning as the original conditional relationship.

You are not in France.
If you are not in France, then you are not in Paris.
Therefore, you are not in Paris. ~France → ~Paris

PART 2 Indicators

Which Condition Does the Indicator Introduce?

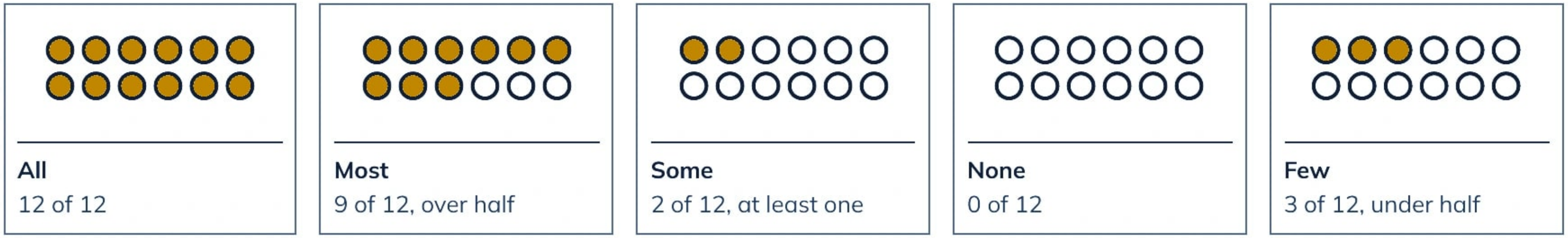
INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
Sufficient Condition The arrow points **away** from the term being modified by the indicator.			
Invariably / Inevitably / Ensures / Guarantees / Is	A → B	A valid ticket ensures entry.	Ticket → Entry
Will enable [someone] to / Allows	Condition → Outcome	A key allows you to open the door.	Key → Can Open Door
All / Every / Any / When(ever) / Provided that / As long as	A → B	Any valid contract is binding.	Valid Contract → Binding
Necessary Condition The arrow points **toward** the subject of the indicator.			
Can be explained only by	Phenom → Cause	A crash can be explained only by pilot error.	Crash Happened → Pilot Error
Only / Only if / Only by / Only through	A → B	The car starts only if there is gas.	Starts → Gas
Requires / Must / Essential / Presupposes / Precondition	A → B	Evolution requires time.	Evolution → Time
Depends on / Is contingent on / Is governed by	A → B	Survival depends on adaptation.	Survive → Adapt
Impossible without / In the absence of / But for	Result → Requirement	Victory is impossible without sacrifice.	Victory → Sacrifice

PART 3 Quantifiers

How Much of One Group Overlaps Another?

"Most" (>50%)	**Definition:** More than half of the members of one group are in another group. **Symbol:** "Most basketball players are tall" is symbolized as `Basketball Players` $\xrightarrow{\text{MOST}}$ `Tall People`. **Application:** "Most basketball players are tall" tells you that over 50% of basketball players are tall.
"Some" (at least one)	**Definition:** At least one member of a group is in another group. **Symbol:** "Some basketball players are short" is symbolized as `Basketball Players` $\overset{\text{SOME}}{\longleftrightarrow}$ `Short People`. **Application:** "Some basketball players are short" tells you that at least one basketball player is short.
Many	A vague quantity. Treat it as "some" ($\overset{\text{SOME}}{\longleftrightarrow}$).
Few	"Few politicians are independent" establishes two relationships: some politicians are independent (`Politician` $\overset{\text{SOME}}{\longleftrightarrow}$ `Independent`) and most politicians are not independent (`Politician` $\xrightarrow{\text{MOST}}$ ~`Independent`).
Hierarchy (All > Most > Some)	A stronger quantifier can also imply a weaker one. For example, "All dogs are mammals" also tells you that some dogs are mammals.

Filled circles show how many members also belong to the second group.



Quantifier Indicators

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
Some / Many / Several / Often / At least one	Some	Many birds migrate.	Birds $\xleftrightarrow{\text{SOME}}$ Migrate
Most / Majority / Usually / Typically / Almost all	**Most**	Most businesses fail.	Businesses $\xrightarrow{\text{MOST}}$ Fail
Few / Rarely / Seldom	**Not Most** Most of A are not B.	Few people live to 100.	People $\xrightarrow{\text{MOST}}$ ~Live to 100
Not all / Not every	Some A $\xleftrightarrow{\text{SOME}}$ ~B	Not all that glitters is gold.	Glitters $\xleftrightarrow{\text{SOME}}$ ~Gold
No / None	None	No square is a circle.	Square $\rightarrow$ ~Circle

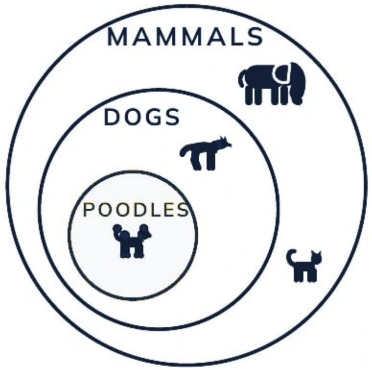
PART 4 Valid Conclusions

All-to-All Chain

RULE An "all" conditional carries forward whatever quantifier reaches it.

All poodles are dogs, and all dogs are mammals. Every poodle therefore belongs to the larger group of mammals.

Poodle → Dog		PREMISE
Dog → Mammal		PREMISE
Poodle → Mammal		CONCLUSION

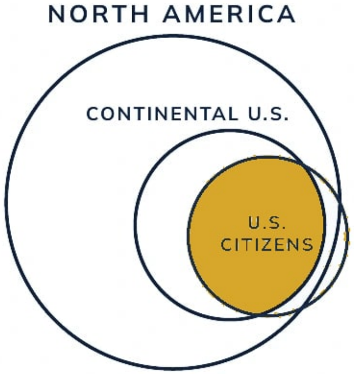


Most Followed by All

RULE An "all" conditional carries forward whatever quantifier reaches it.

Over 50% of US citizens live in the continental U.S., and everyone in the continental U.S. lives in North America. So over 50% of US citizens live in North America.

US Citizens $\xrightarrow{\text{MOST}}$ Continental US		PREMISE
Continental US → North America		PREMISE
US Citizens $\xrightarrow{\text{MOST}}$ North America		CONCLUSION

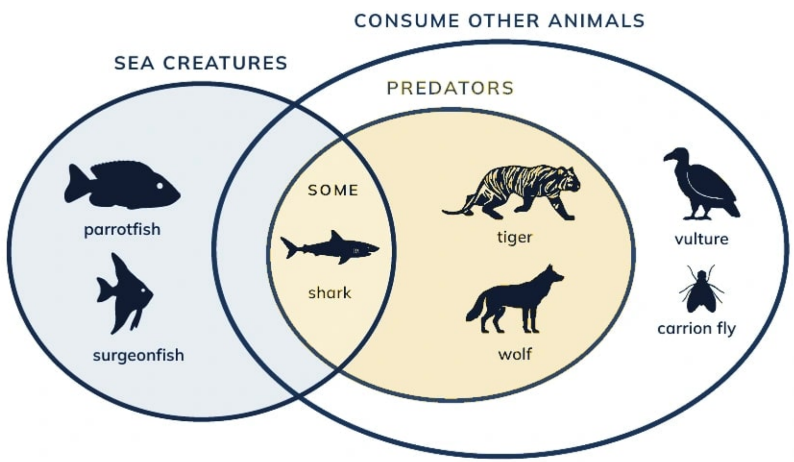


Some-to-All Chain

RULE An "all" conditional carries forward whatever quantifier reaches it.

Some sea creatures are predators. Since every predator consumes other animals, those same sea creatures must consume other animals.

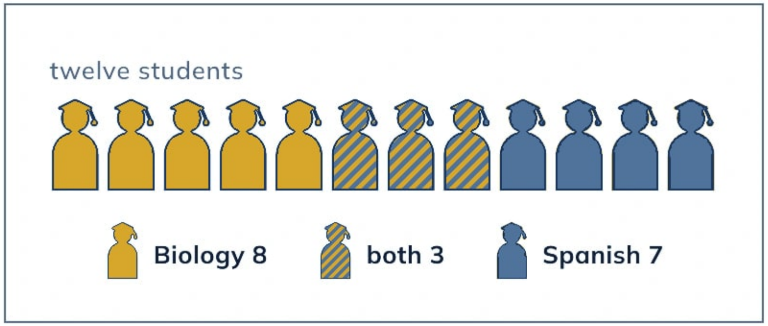
Sea Creatures $\xleftrightarrow{\text{SOME}}$ Predators		PREMISE
Predators → Consume Other Animals		PREMISE
Sea Creatures $\xleftrightarrow{\text{SOME}}$ Consume Other Animals		CONCLUSION



Two Majorities Within One Group

Eight of the twelve students study biology and seven study Spanish: fifteen enrollments among twelve students. Since each group is more than half the class, at least one student must study both. In this case, three do.

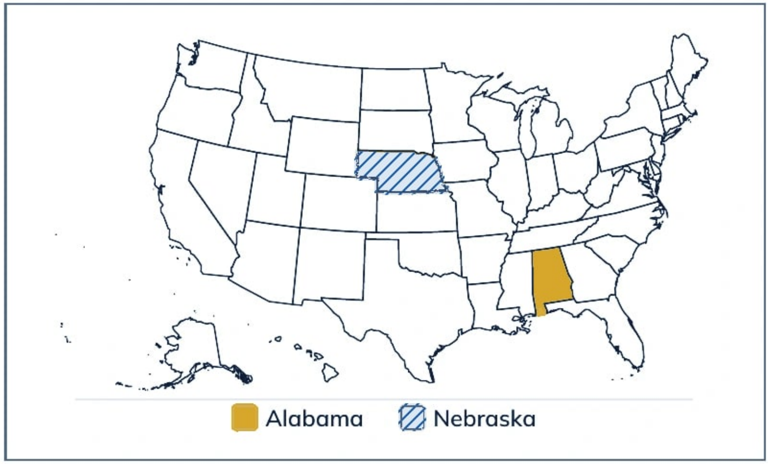
Students $\xrightarrow{\text{MOST}}$ Study Biology	PREMISE
Students $\xrightarrow{\text{MOST}}$ Study Spanish	PREMISE
Study Biology $\xleftrightarrow{\text{SOME}}$ Study Spanish	CONCLUSION



No Valid Conclusion

Be very careful in dealing with a mixture of all and some conditionals, as you can see in this example. Even though every single person born in Alabama may be American, a strong relationship, and some Americans are born in Nebraska, it s clearly the case that no one (not some) born in Alabama is born in Nebraska. And so you can never confidently conclude anything from an all into some relationship.

Born in Alabama $\rightarrow$ Americans	PREMISE
Americans $\xleftrightarrow{\text{SOME}}$ Born in Nebraska	PREMISE
Alabama $\rightarrow$ Americans $\xleftrightarrow{\text{SOME}}$ ~~Nebraska~~	DOES NOT FOLLOW



PART 5 Compound Statements

And/Or Translations

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
And / Both	A + B	He is rich and famous.	Rich + Famous
Or / Either ... or	A or B	We can walk or drive.	Walk or Drive
Neither ... nor	~A + ~B	Neither rain nor snow stops the mail.	~Rain + ~Snow

"And" and "Or" Within a Conditional Relationship

WHERE IT APPEARS	FORM	WHAT IT PRODUCES
"And" in the necessary condition	A → (B and C)	Two relationships: A → B and A → C.
"And" in the sufficient condition	(A and B) → C	Both sufficients are required. Do not split the statement.
"Or" in the necessary condition	A → (B or C)	At least one necessary is required. Do not split the statement.
"Or" in the sufficient condition	(A or B) → C	Two relationships: A → C and B → C.

Minimums, Maximums, and Nested Conditions

RULE	STATEMENT	TRANSLATION
At least one (minimum 1)	"You must choose A or B." Refuse one and you must take the other.	~A → B ~B → A
Not both (maximum 1)	"You cannot choose both A and B." Take one and the other is out.	A → ~B B → ~A
Nested conditional	"If A happens, then if B happens, C happens." Read it as an "and" sufficient condition.	(A and B) → C

PART 6 Negation

Negating “And” and “Or” DE MORGAN’S LAWS

Negating a statement means identifying its exact logical opposite.

When you take the contrapositive of a statement containing “and” or “or,” change “and” to “or” and “or” to “and.”

EXAMPLE 1

ORIGINAL

$A \longrightarrow (B \text{ and } C)$

If you get promoted, you get a raise and an office.

CONTRAPOSITIVE

$({\sim}B \text{ or } {\sim}C) \longrightarrow {\sim}A$

If you don’t get a raise OR you don’t get an office, you aren’t promoted.

EXAMPLE 2

ORIGINAL

$(A \text{ or } B) \longrightarrow C$

If it rains or snows, we stay inside.

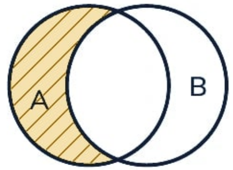
CONTRAPOSITIVE

${\sim}C \longrightarrow ({\sim}A \text{ and } {\sim}B)$

If we don’t stay inside, it isn’t raining AND it isn’t snowing.

Negating a Quantifier EXACT OPPOSITES

ALL	“All A are B” ($A \longrightarrow B$) negates to “Some A are NOT B” ($A \xleftrightarrow{\text{SOME}} {\sim}B$).
MOST	“Most A are B” (>50%) negates to “Half or less” (0–50%).
SOME	“Some A are B” (≥1) negates to “None” ($A \longrightarrow {\sim}B$).



Negating **“All A are B”**: the shaded region represents members of A that are not members of B.

PART 7 Exclusion

Translating "Unless"

To translate a statement using **"unless,"** identify the idea that follows "unless," negate that idea, and make the negated form sufficient. The other part of the sentence goes on the necessary side of the arrow.

TRANSLATION PATTERN	EXAMPLE
[B] **unless** [A]	"I will go to the movie **unless** it rains."
NEGATE [A] AND MAKE IT SUFFICIENT ↓	NEGATE "IT RAINS" AND MAKE IT SUFFICIENT ↓
If not [A] , then [B]	If it does not rain , then I will go to the movie.
CONVERT THE IF-THEN STATEMENT TO AN ARROW DIAGRAM ↓	CONVERT THE IF-THEN STATEMENT TO AN ARROW DIAGRAM ↓
~[A] → [B]	~Rains → Go

Use the same method for **"except," "without," "until,"** and **"or else."**

The “Unless” Family

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
Unless / Except / Without / Until / Or else	~A ⟶ B	The alarm rings unless the code is entered.	~Code ⟶ Alarm
No / None / Never / Fail to be	A ⟶ ~B	No mammal breathes water.	Mammal ⟶ ~Breathes Water
No [X] is both [Y] and [Z]	X ⟶ ~(Y + Z)	No number is both even and odd.	Number ⟶ ~(Even + Odd)
Unless [A] or [B]	~Trigger ⟶ (A or B)	The deal fails unless you pay cash or trade goods.	Deal Succeeds ⟶ (Pay or Trade)
Not [A], let alone [B]	~A + ~B	He is not a mayor, let alone a president.	~Mayor + ~President
No one who is not [A] is [B]	B ⟶ A	No one who is not a lawyer is a judge.	Judge ⟶ Lawyer

PART 8 Two-Way and Hypothetical Statements

Biconditionals

A biconditional is a two-way conditional relationship in which both A ⟶ B and B ⟶ A are true. Having either A or B guarantees the other.

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
If and only if / Then, and only then / All and only / When and only when	A ⟷ B	A number is even if and only if it is divisible by two.	Even ⟷ Divisible by 2
Equivalent to / Is the same as saying / Exactly when	A ⟷ B	Having exactly 100 cents is the same as having one dollar.	100 Cents ↔ One Dollar

Hypotheticals and Complex Statements

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
Otherwise	~A ⟶ B	Wear a helmet, otherwise you risk injury.	~Helmet ⟶ Risk Injury
Had [A] occurred, [B] would have occurred	A ⟶ B	Had the levee held, the city would have remained dry.	Levee Held ⟶ Dry
[B] would not have occurred had [A] not occurred	~A ⟶ ~B	The fire would not have started had the match not been struck.	~Match Struck ⟶ ~Fire Started
To [Verb] / In order to	Goal ⟶ Requirement	In order to make an omelet, you must break eggs.	Omelet ⟶ Break Eggs

PART 9 Cause and Obligation

Causal and Normative Relationships

These relationships can resemble conditional statements, but they describe causation, obligation, permission, or judgment rather than a guaranteed result.

Causal Indicators

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
Promotes / Leads to	Cause → Effect	Exercise promotes health.	Exercise $\xrightarrow{\text{CAUSE}}$ Health
As a result	Cause → Effect	The dam broke; as a result, the valley flooded.	Dam Broke $\xrightarrow{\text{CAUSE}}$ Flooded

Value Judgments, Obligations, and Rights

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
Should / Ought to / Is obliged to	Condition → Obligation/Duty	Citizens are obliged to pay taxes.	Citizen → Duty to Pay
Justified in	Condition → Permissible	A person is justified in acting in self-defense if attacked.	Attacked → Self-Defense Permissible
Permissible only if	Permissible → Condition	Entry is permissible only if you have a badge.	Entry Permitted → Badge
Unethical / Wrong / Should not [Action] except [Exception]	~Exception → ~Action	Drivers shouldn't park here except when permitted.	~Permitted → ~Park

PART 10 Probability and Belief

INDICATOR	LOGICAL TRANSLATION	EXAMPLE	EXAMPLE TRANSLATION
A is likely / probably / we would expect B	$A \xrightarrow{\text{MOST}} B$	If you speed, you will likely get a ticket.	$\text{Speed} \xrightarrow{\text{MOST}} \text{Ticket}$
A tends to B	$A \xrightarrow{\text{MOST}} B$	Power tends to corrupt.	$\text{Power} \xrightarrow{\text{MOST}} \text{Corrupt}$
A is unlikely unless B	$A \xrightarrow{\text{MOST}} B$	Success is unlikely unless you plan.	$\text{Success} \xrightarrow{\text{MOST}} \text{Plan}$
Can thus rule out	$A \rightarrow \sim B$	The alibi rules out the suspect.	$\text{Alibi} \rightarrow \sim\text{Suspect}$
[Person] says [A], so she believes [B]	Say(A) → Believe(B)	He says the bank is open, so he believes he can deposit checks.	Says(Open) → Believes(Deposit)

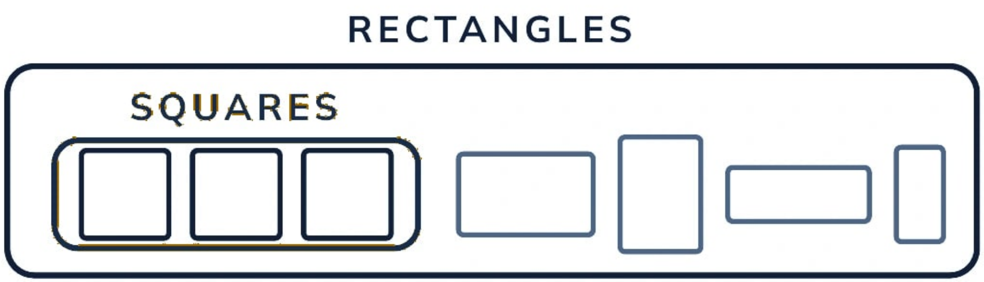
PART 11 Conditional Errors

Drawing an Unsupported Relationship

These errors take a narrow premise and read a broader relationship into it than the evidence supports.

Illegal Reversal and Illegal Negation

Illegal Reversal	"If A, then B" does not tell you "If B, then A."
Illegal Negation	"If A, then B" does not tell you "If not A, then not B."



Squares sit inside rectangles: every square is a rectangle, but most rectangles are not squares.

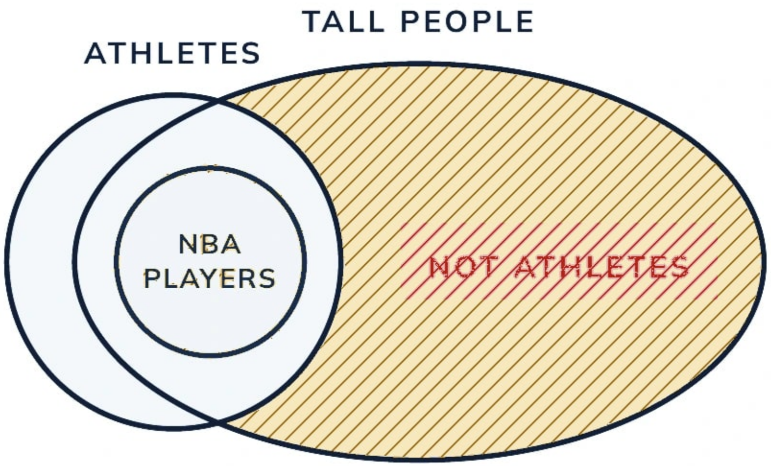
Square → Rectangle	FOLLOWS
Rectangle → Square	DOES NOT FOLLOW
Not Square → Not Rectangle	DOES NOT FOLLOW
Not Rectangle → Not Square	FOLLOWS

Most Error

You are not allowed to end a conditional chain in a most and draw a conclusion.

That is different from a most-most. In Two Majorities Within One Group the two majorities come from the same group rather than from a chain, so they have to overlap.

NBA Players → Tall People	PREMISE
Tall People $\xrightarrow{\text{MOST}}$ Non-Athletes	PREMISE
NBA Players $\xleftrightarrow{\text{SOME}}$ Non-Athletes	DOES NOT FOLLOW



All of the NBA players could be among the tall people who are athletes. Nothing requires even one NBA player to be a non-athlete.