What is Probability?

It is the mathematical measure of the likelihood that a specific event, such as passing a mathematics exam, will occur, ranging from 0 (impossible) to 1 (certain).

Key Terminology:

Experiment: A process that leads to one of several possible outcomes, such as the final exam.

Sample Space: The set of all possible outcomes for a student, which is {Pass, Fail}.

Event: A specific outcome or subset of the sample space, such as a student achieving a passing grade.

Dataset Event Examples:

A student studying more than 10 hours per week.

A student maintaining an attendance rate higher than 80%.

A student participating in group discussions (Yes).

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2. Types of Events

Using the sample of 200 students:

Empirical Probability: Based on historical data observations.

Scenario: If 130 out of 200 students passed the exam.

Calculation: $P(Pass) = \frac{130}{200} = 0.65$ (65%).

Theoretical Probability: Based on the assumption of equally likely outcomes.

Scenario: The chance of a student passing or failing without considering external factors.

Calculation: $P(Pass) = \frac{1}{2} = 0.50$ (50%).

Understanding Relationships

Intuition of Conditional Probability: *This represents the updated probability of an event occurring given that another event has already happened. In this context, it tells us how much more (or less) likely a student is to pass if we already know they participated in group discussions.*

Independence vs. Dependence:

Relationship: *"Participating in group discussions" and "passing the exam" are* ***dependent events****.*

Justification: *The probability of passing is expected to change based on whether a student participates in discussions; if* $P(Pass \mid Discussion) \neq P(Pass)$*, the events are mathematically dependent.*

Bayes Theorem Application

Given Data:

$P(High\ Attendance \mid Pass) = 0.70$

$P(High\ Attendance \mid Fail) = 0.40$

$P(High\ Attendance) = 0.60$

Assume a base pass rate $P(Pass) = 0.50$ for the calculation.

Formula:

$$P(Pass \mid High\ Attendance) = \frac{P(High\ Attendance \mid Pass) \times P(Pass)}{P(High\ Attendance)}$$

Step-by-Step Calculation:

Substitute values: $\frac{0.70 \times 0.50}{0.60}$

Multiply numerator: $\frac{0.35}{0.60}$

Final Result: ≈ 0.5833 or **58.33%**

Final Summary

The analysis indicates that factors such as high attendance (which increases the pass probability to 58.33%) and group participation are key drivers of student success. These metrics should be prioritized in the "Expectation Decider" model to accurately predict student outcomes.