🔹 1. Prescriptive Analytics

✅ What is it?

Prescriptive Analytics is the **third stage** of analytics (after descriptive and predictive). It goes **beyond prediction** and suggests **actions** or **decisions** to optimize outcomes.

Type	Purpose
Descriptive	What happened?
Predictive	What will happen?
Prescriptive	What should we do about it? ✅

📌 Key Tools:

- **Optimization models** (like Linear Programming)
- **Simulation**
- **Decision trees**
- **Business rules**

🎓 Example:

An EdTech company wants to **maximize profit** from course sales given:

- Limited marketing budget
- Limited counsellor availability
- Different course profit margins

👉 **Prescriptive analytics** would recommend how much to **invest in each marketing channel** and **how to allocate counsellors** to maximize enrolments and revenue.

🔹 2. Linear Optimization / Linear Programming (LP)

✅ What is it?

A **mathematical technique** used to determine the **best outcome (maximum or minimum)** of a linear objective function, subject to **linear constraints**.

📌 LP Components:

1. **Decision Variables** – What we are solving for (e.g., how many students per course)
2. **Objective Function** – What to maximize or minimize (e.g., maximize profit)
3. **Constraints** – Limitations (e.g., counselor availability, budget, seats)

🎓 **Example:**

Maximize:
Profit = 200x + 150y
Where:

- x = number of Premium Course enrollments
- y = number of Basic Course enrollments

Subject to:

- x + y ≤ 100 (Total capacity)
- 2x + y ≤ 150 (Counselor hours available)

Solve using:

- Simplex Method

🔹 **3. Applications of Linear Optimization**

✅ **Common Use Cases:**

Industry	**Application**
EdTech	Course allocation, marketing mix optimization
Retail	Inventory optimization, pricing models
Logistics	Route planning, supply chain optimization
Finance	Portfolio optimization
Manufacturing	Production planning, resource allocation

🛠 **Micro-Level Steps:**

1. Define the **goal** (maximize revenue, minimize cost)
2. Identify **decision variables** (e.g., how much to spend)
3. Set up the **objective function**
4. Identify **constraints**
5. Use optimization tools (Excel, Python)
6. **Interpret** the output (sensitivity, feasibility)

🔹 **4. Integer Programming (IP)**

✅ **What is it?**

A variation of Linear Programming where **decision variables must be integers** (whole numbers).

Used when **fractional solutions are not realistic**, like:

- You can't assign 2.6 counsellors
- You can't enrol 3.8 students

🎓 **Example:**

Select **courses to run** from a list of 10 where:

- You can only pick **5 whole** courses (not 5.3)
- You want to **maximize profit**
- Each course has a cost, and you have a budget

This is an **Integer Linear Program** (ILP)

📌 **Tools:**

- Excel Solver (with "Simplex & Integer")
- Python pulp, ortools, pyomo

🔹 **5. Logistic Models (Logistic Regression)**

✅ **What is it?**

Used to **predict probabilities** for **binary outcomes** (Yes/No, True/False, Enrolled/Not Enrolled)

Unlike linear regression, logistic regression maps values between 0 and 1 using a **sigmoid function**.

🎓 **Example:**

Predict if a **lead will convert** to a paid student:

Target (Y) = 1 if enrolled, 0 if not

Features:

- session_duration

- counselor_followups

- demo_rating

- email_response

Model:

P(Enrol)=1/(1+e−(b0+b1x1+b2x2+...+bnxn))

Output:

- If P > 0.5, predict enrolment
- If P ≤ 0.5, predict no enrolment

🛠 Steps to Build:

1. Collect labelled data (leads with outcome 1/0)
2. Preprocess: clean, encode, scale
3. Fit model using sklearn LogisticRegression()
4. Use in Power BI or app for scoring

✅ **Summary Table**

Term	Purpose	Tool	Example
Prescriptive Analytics	Suggest actions	Optimization, simulation	Maximize counsellor allocation
Linear Optimization	Max/min objective	LP solver, Python	Maximize revenue
Applications	Real-world use	Business planning	Budget allocation
Integer Programming	Whole number decisions	IP solver, Gurobi	Course selection
Logistic Models	Predict yes/no	Logistic regression	Will lead convert?

1. Prescriptive Analytics

🎓 **EdTech Example: Counselor Assignment Optimization**

Problem:

You have 10 counselors and 3 course types. Each counselor can handle a max of 5 calls/day. You want to assign them to **maximize conversion**.

🧠 **Micro-Level Process:**

Step	Description
1️⃣ Define Goal	Maximize enrollment conversions
2️⃣ Identify Decisions	How many calls each counselor should make per course
3️⃣ Objective Function	Maximize: Total_Conversions = Σ (calls_per_course × conversion_rate)
4️⃣ Constraints	Counselor call capacity, budget, course availability
5️⃣ Solve	Use Linear/Integer Programming
6️⃣ Output	Recommended call distribution per counselor per course

---

🔹 **2. Linear Optimization (Linear Programming)**

🎓 **Example: Course Profit Optimization**

Courses:

- Premium Course: Profit ₹200, Time required: 2 hrs

- Basic Course: Profit ₹150, Time required: 1 hr

Total available time = 150 hours

Total max enrolments = 100

🔧 **Math Form:**

Decision Variables:

- x = # of Premium courses
- y = # of Basic courses

Objective Function:

Maximize Profit = 200x + 150y

Constraints:

$x + y \leq 100$ (max enrolments)

$2x + y \leq 150$ (available time)

$x, y \geq 0$

🔁 Use tools:

- **Python**: SciPy

📉 **Output:**

Optimal x = 40, y = 60
→ This gives highest profit under constraints.

🔹 **3. Applications of Linear Programming**

Area	Example
EdTech	Optimizing counselor-to-lead allocation
Retail	Inventory order quantity under budget
Airlines	Crew scheduling
Hospitals	Doctor-patient time optimization
Marketing	Max ROI from ad spend across channels

🔹 **4. Integer Programming (IP)**

🎓 **Example: Select Courses to Launch**

You want to **select 5 out of 10 courses** to launch. Each has:

- A cost (within budget)
- A profit score

You can't pick 5.4 courses → So you use IP.

🔧 **Binary Integer Programming:**

Decision Variables:

- xi = 1 if course i is selected, 0 otherwise

Objective:

Maximize Total_Profit = Σ (xi × profit_i)

Constraints:

Σ (xi × cost_i) ≤ budget

Σ xi = 5 (only 5 courses allowed)

xi ∈ {0, 1}

🔹 **5. Logistic Regression Models (Binary Classification)**

🎓 **EdTech Example: Predict Enrolment**

Inputs (features):

- demo_attended = 1
- session_duration = 45 mins
- counselor_followups = 2
- response_time = fast

Output:

- Probability that student enrolls = 0.87
- Since 0.87 > 0.5 → **Predict Enroll**

🧠 **Micro Steps:**

Step	Action
1️⃣ Define Problem	Binary classification: Enroll or Not
2️⃣ Data Collection	CRM leads data with outcomes
3️⃣ Feature Engineering	Convert duration, channels, followups into features
4️⃣ Train Model	Use sklearn LogisticRegression()
5️⃣ Evaluate	ROC Curve, AUC, Accuracy, Precision
6️⃣ Deploy	Score new leads in real-time
7️⃣ Decision	Prioritize leads with high probability to convert

---

🔢 **Logistic Equation:**

$P(enroll) = 1/(1 + e^{-(b0 + b1 * x1 + b2 * x2 + ...)})$

Example output:
Lead A = 0.83 → enroll
Lead B = 0.25 → not enroll

🔄 Integration Example in EdTech Pipeline

Phase	Tool	Task
Data Extraction	Zoho API → Python/Airbyte	Pull raw leads, enrollments
ETL	Pandas/Talend	Clean, structure data
Warehouse	Snowflake	Store fact/dim tables
Predictive	Logistic Regression	Score lead conversion chance
Prescriptive	Linear/Integer Programming	Allocate counselors, optimize ads
BI Layer	Power BI	Visualize insights & decisions

🔹 What is Making a Decision?

Making a decision means choosing the **best possible option** from a set of alternatives to achieve a specific **goal** or solve a **problem**.

It can be as small as:

"Should I study Python or Power BI tonight?"

Or as big as:

"Should our EdTech company invest in hiring more counsellors or expand to new cities?"

✅ Key Elements of Decision-Making:

Element	Description	Example
Goal	What are you trying to achieve?	Maximize course enrolments
Alternatives	What are your options?	Hire more staff, increase ad spend
Information	What do you know about the problem?	Budget, current conversion rates
Criteria	How will you evaluate options?	ROI, enrolment impact, time
Constraints	What limits your decision?	Budget, time, team size
Outcome	What's the result of your choice?	Higher enrolments or overspending

---

🔄 Micro-Level Steps in Decision-Making

Step	Action	Example
1 **Define the Problem**	Clearly identify the challenge	Enrolment is low in Tier-2 cities
2 **Set the Objective**	What is the goal?	Increase Tier-2 enrolments by 25%
3 **List Alternatives**	Identify available choices	A) Local ads, B) More counsellors
4 **Gather Data**	Analyze facts, metrics, predictions	Cost of ads, conversion rates
5 **Evaluate Options**	Compare alternatives based on data	Calculate expected ROI
6 **Make a Choice**	Choose the best fit option	Select local ads for quick reach
7 **Take Action**	Implement the decision	Run targeted regional campaigns
8 **Review Results**	Evaluate impact & learn	Monitor uplift, adjust strategy

---

🧠 Types of Decision-Making

Type	Description	Example
Strategic	Long-term, high impact	Expand to new markets
Tactical	Medium-term	Choose pricing for new course
Operational	Daily, routine	Assign leads to counsellors

🔍 Example: Decision-Making in Your EdTech Project

Scenario:

You want to **maximize conversions** from Zoho CRM leads.

Decision-Making Path:

1. Problem: Low conversion rates
2. Goal: Improve enrollments by 20%
3. Alternatives:
    - Train counselors
    - Shorten response time
    - Launch chatbot
4. Criteria:
    - Cost
    - Speed of deployment
    - Predicted improvement
5. Use Prescriptive Analytics:
    - Run an optimization model
    - Predict with logistic regression
6. Choose: Launch chatbot for faster lead response
7. Track: Monitor conversion improvement after 1 month

💡 Summary

Decision-making = structured thinking + data + trade-offs
Good decisions come from:

- Clear goals
- Relevant data
- Structured methods (like analytics & optimization)

🔷 What is Decision Analysis?

Decision Analysis is a **systematic approach** to decision-making under **uncertainty**.
It combines:

- **Decision theory**
- **Probability**
- **Utility (value)**
- **Modelling tools** like **decision trees**, **payoff tables**, or **sensitivity analysis**

It helps decision-makers **evaluate different strategies** by quantifying:

- Risks
- Rewards
- Trade-offs
- Probabilities

🎯 Purpose of Decision Analysis

- To **choose the best alternative** when outcomes are uncertain
- To **reduce risk** in business or personal decisions
- To **justify** decisions with clear logic and data

🧠 Micro-Level Steps in Decision Analysis

Step	Description	Example in EdTech
1 Define the Decision Problem	What decision needs to be made?	Choose between two marketing strategies
2 identify Alternatives	List all possible options	Facebook Ads, Google Ads, Counsellor Outreach
3 Determine Outcomes	What could happen under each option?	High/Medium/Low enrolments
4 Assign Probabilities	Estimate likelihood of each outcome	70% high success with Facebook ads
5 Assign Payoffs (or Costs)	Determine value/cost of each outcome	Profit, enrolments, cost of ads
6 Calculate Expected Value	Multiply probability × payoff for each branch	Use math or tools

Step	Description	Example in EdTech
7 Choose Best Option	Select based on expected value or utility	Facebook Ads if it gives highest value
8 Conduct Sensitivity Analysis	What if assumptions change?	What if ad cost increases?

🔢 **Example: Decision Tree (EdTech Lead Conversion)**

🎓 **Problem:**

You can:

- Hire More Counsellors (Option A)
- Launch a Chatbot (Option B)

Strategy	Outcome	Probability	Enrolments	Net Profit
A: Counsellors	High	60%	100	₹1,00,000
	Low	40%	40	₹20,000
B: Chatbot	High	50%	80	₹80,000
	Low	50%	30	₹10,000

✅ **Expected Values:**

- EV(A) = 0.6×100000 + 0.4×20000 = ₹72,000
- EV(B) = 0.5×80000 + 0.5×10000 = ₹45,000

📌 **Choose Option A** based on higher expected value.

🧰 **Decision Analysis Tools**

Tool	Use
Decision Tree	Visualize options, outcomes, and probabilities
Payoff Table	Tabular layout of outcomes, costs/profits
Expected Value	Weighted average of possible outcomes
Sensitivity Analysis	Test effect of changing inputs
Simulation (e.g., Monte Carlo)	Test large uncertainty with random variables
Utility Theory	If decision isn't purely financial (e.g., user satisfaction)

📊 Application in EdTech or Business

Scenario	How Decision Analysis Helps
Campaign Planning	Choose best ad strategy based on risk/reward
Product Pricing	Compare profits under different price points
Hiring Plans	Evaluate full-time vs part-time counsellor costs
Expansion	Analyse risk-return of entering a new city

🔄 When to Use Decision Analysis?

- When **multiple uncertain outcomes** are possible
- When you need to **justify or explain** a choice
- When data can **help you model future outcomes**
- When stakes are **too high** for guesswork

✅ Summary

Feature	Value
What is it?	A structured method for making decisions under uncertainty
Inputs	Alternatives, probabilities, outcomes, values
Outputs	Optimal decision, expected values, risk understanding