Advance AI/ML Training – Telecom Data Analytics

MODULE 4 - Cloud, NLQ & Prescriptive Analytics

Course Outline

- **Module 1**: Foundation Recap and Telecom Analytics Basics
  - structured, semi-structured, and unstructured data in telecom with examples
  - Review SQL and Python basics for data collection and cleaning
  - Summarise ETL concepts and role of data pipelines in analytics
  - Visit Telecom predictive Models – Churn, telecom KPIs, and their role in decision making
  - Practical outcomes and use cases

- **Module 2**: Advanced Data Engineering & Automation
  - Explain advanced ETL pipeline design and automation.
  - Role of data warehouses and data lakes in telecom
  - Introduce scalable data processing methods for large datasets.
  - Explain importance of data governance, privacy, and compliance
  - Practical outcomes and use cases

Course Outline

- **Module 3**: Advanced Machine Learning in Telecom
  - Differentiate supervised, unsupervised, and semi-supervised learning in ML
  - Explain clustering techniques for customer segmentation and fraud detection.
  - Describe hyperparameter tuning (GridSearch, RandomSearch).
  - Explain model validation methods.
  - Discuss real-world ML challenges in telecom datasets
  - Practical outcomes and use cases

- Module 4: Cloud, NLQ & Prescriptive Analytics
  - Benefits of deployment of ML models on cloud platforms
  - Describe Natural Language Query (NLQ) and its use in BI dashboards
  - Explain Natural Language Generation (NLG) for automated reporting.
  - Discuss prescriptive analytics for churn reduction, fraud detection, and network optimisation
  - Explain importance of real-time analytics in telecom operations
  - Practical outcomes and use cases

Session Overview

01

ML Model Deployment on Cloud

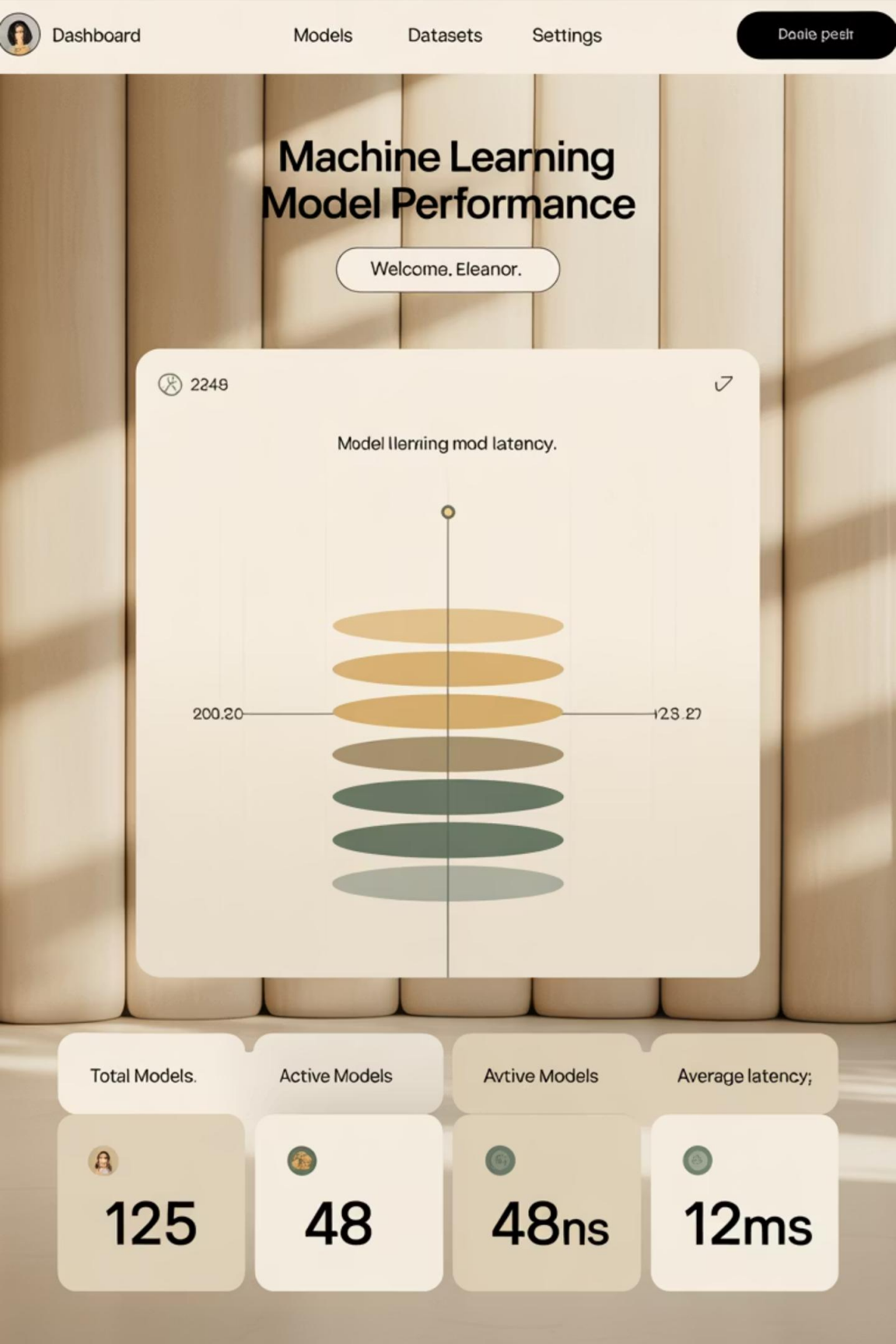Importance of moving trained models from your laptop to cloud platforms where business users can access them.

02

Natural Language Query in BI Dashboards

Discover how to ask questions about your data using plain English instead of complex queries.

03

Natural Language Generation for Reports

Explore how AI can automatically write narrative summaries of your data insights.

04

Prescriptive Analytics for Telecom

Move beyond prediction to recommendation—learn what actions to take based on your insights.

05

Real-Time Analytics in Telecom

Build streaming dashboards that update live as new data flows in.

Session 1: ML Model Deployment - Cloud

You've built amazing machine learning models on your computer, but how do business users actually access them? **Deployment** is the process of moving your trained model from your local environment to a cloud platform where it can serve predictions to thousands of users simultaneously.

Think of it like this: building a model is like creating a recipe in your home kitchen. Deployment is like opening a restaurant where anyone can order that dish. The cloud provides the kitchen infrastructure, handles multiple orders at once, and ensures consistent quality.

The Cloud ML Toolkit

Google Cloud ML

Strong integration with TensorFlow and BigQuery. Excellent for teams already using Google Workspace. Free tier includes 300 compute hours for training models.

- AutoML for no-code solutions
- Vertex AI for advanced workflows
- Pre-built APIs for common tasks

Azure ML Studio

Visual drag-and-drop interface perfect for beginners. Seamless connection with PowerBI dashboards. We'll use this platform in today's hands-on exercise.

- Designer for visual workflows
- Automated machine learning
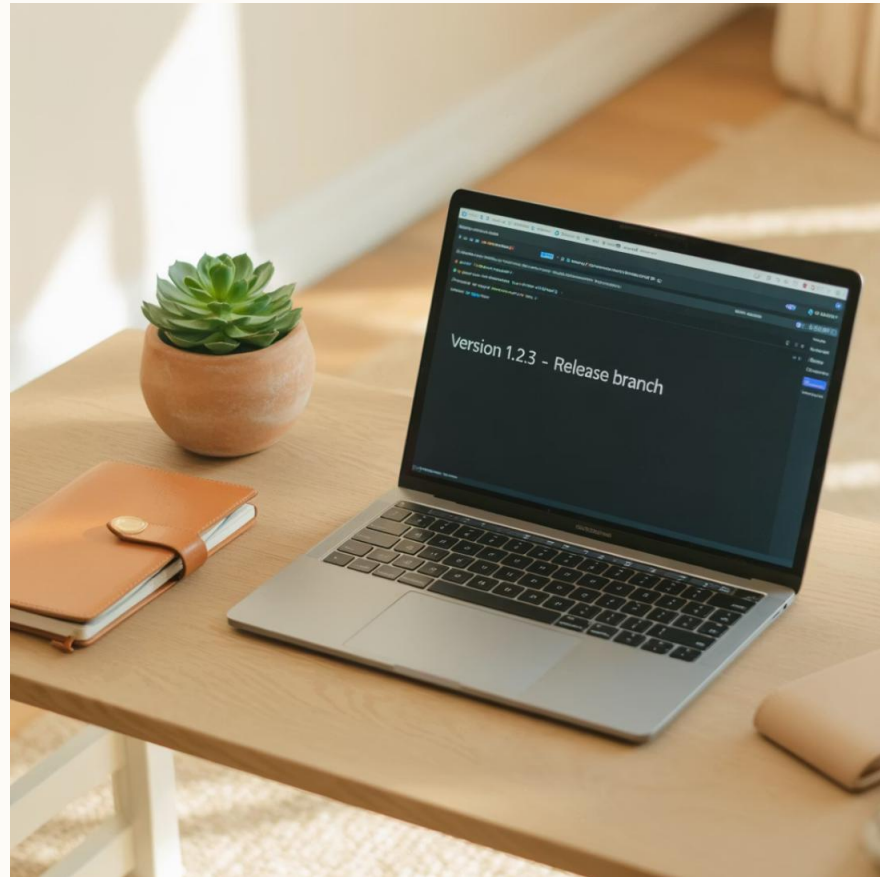- Enterprise-grade security

AWS SageMaker

Industry leader with the most comprehensive feature set. Powerful Jupyter notebook integration. Best for production-scale deployments requiring maximum flexibility.

- Built-in algorithms optimized for scale
- One-click deployment options
- Advanced monitoring tools

Three Pillars of Model Deployment

Versioning

Models improve over time as you train them with more data or refine algorithms. **Versioning** lets you track these changes, roll back if a new version performs poorly, and maintain multiple versions for different use cases.

Example: Churn Model v1.0 → v1.1 (improved accuracy from 82% to 87%) → v1.2 (optimized for speed).
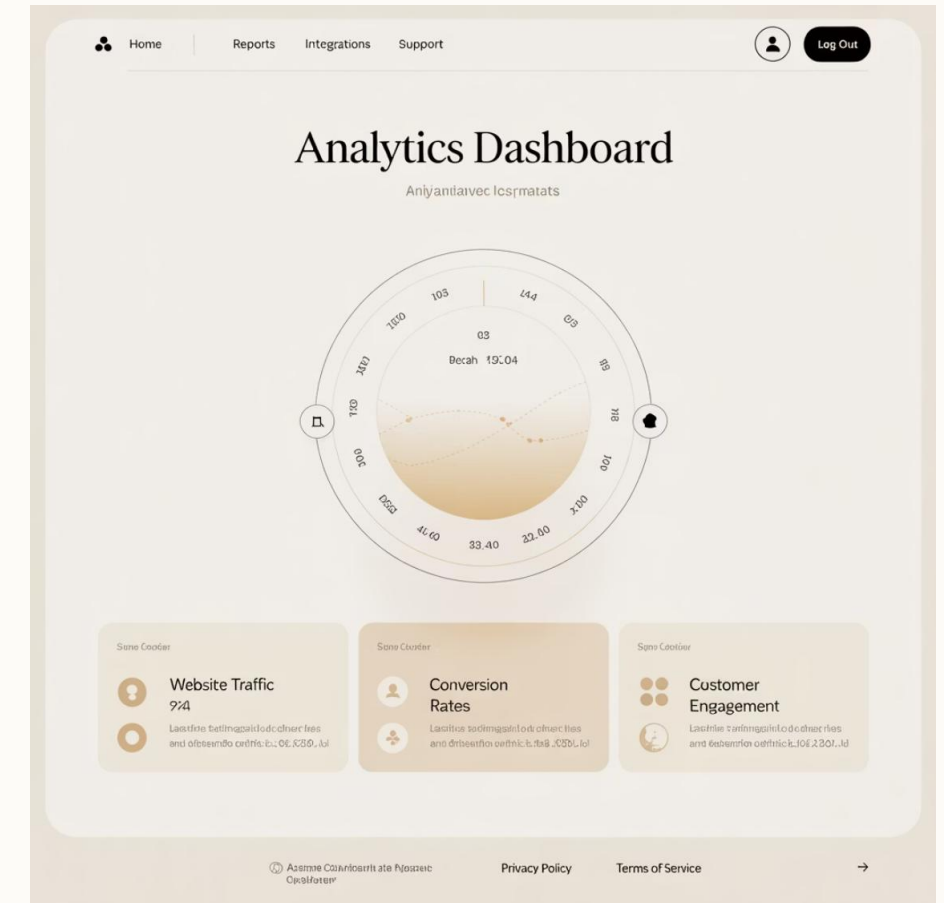
Scalability

Your model needs to handle anywhere from 10 to 10,000 prediction requests per second without slowing down. Cloud platforms automatically add computing resources during high-demand periods.

A telecom call center might need predictions for 500 customers simultaneously during peak hours—scalability makes this possible.

Monitoring

Models can degrade over time as customer behavior changes. **Monitoring** tracks prediction accuracy, response times, and error rates in real-time so you can retrain when performance drops.

Set alerts for accuracy below 80% or if prediction latency exceeds 2 seconds to maintain service quality.

Telecom Use Case: Real-Time Churn Churn Prediction

Imagine a customer service representative on a call with a frustrated customer. Before the call even starts, a deployed churn prediction model has already analyzed the customer's usage patterns, payment history, and support tickets. The system flags this customer as **high churn risk (87% probability)** and suggests specific retention offers.

The representative sees a dashboard recommendation: *"Offer 3 months of premium data at 20% discount—estimated retention value: $480."* This real-time intelligence turns a potential cancellation into a retention opportunity. Without cloud deployment, this prediction would sit unused in a data scientist's notebook.
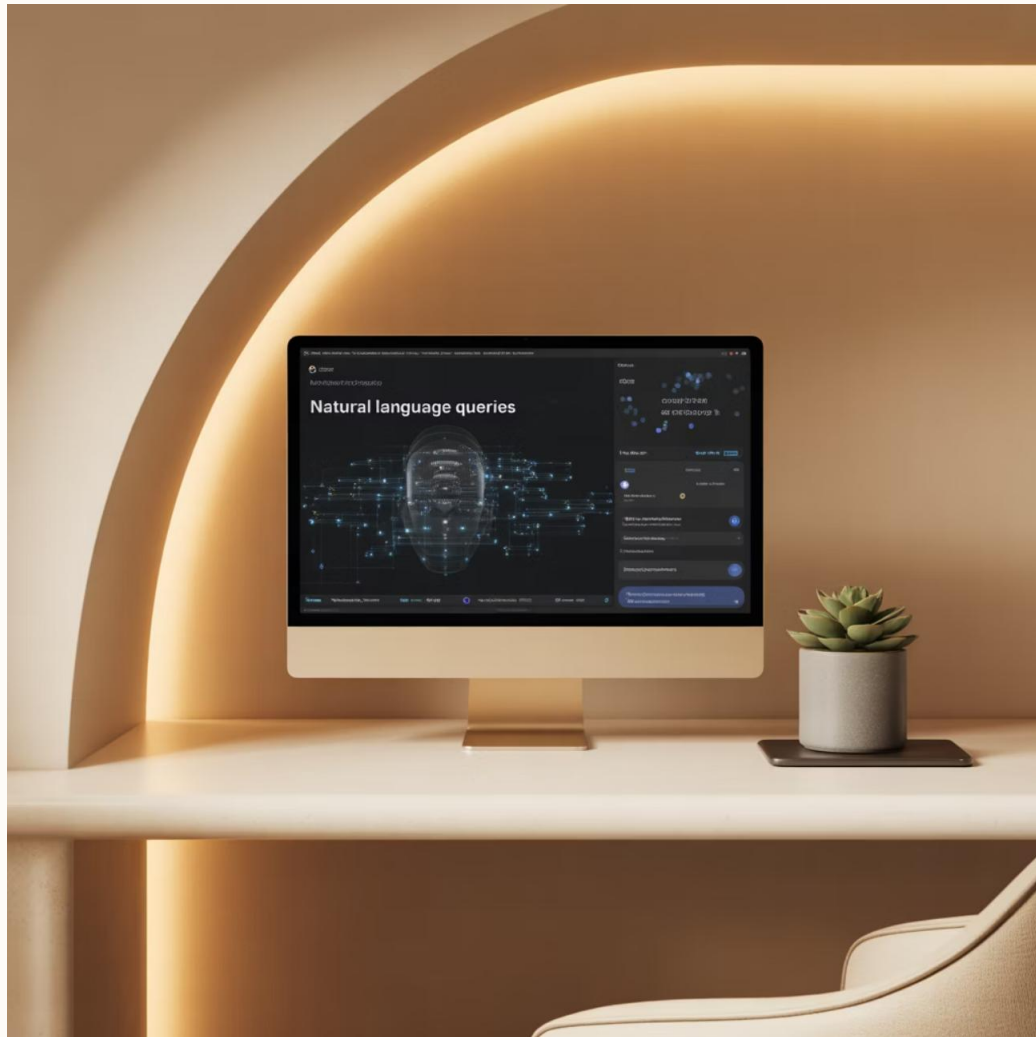
Session 2: Natural Language Query in BI Dashboards

Ask Your Data Questions

Imagine if you could talk to your data like you talk to a colleague: *"Show me churn rate by state"* or *"Which customers used more than 20 GB last month?"* That's exactly what **Natural Language Query (NLQ)** enables. Instead of learning complex query syntax or navigating through multiple menus, you simply type your question in plain English.

How Natural Language Query Works

Behind the scenes, NLQ systems use natural language processing to interpret your question. The system identifies **entities** (churn rate, state), **metrics** (rate calculation), and **dimensions** (grouped by state). It then translates this into a proper database query.

When you ask "Show churn rate by state," the system recognizes:

- **Metric:** Churn rate (calculated field)

- **Dimension:** State (grouping category)

- **Visualization:** Bar chart (best for comparisons)

The result appears instantly as an interactive chart you can further explore, filter, and add to your dashboard.

NLQ Examples in Telecom Analytics

Customer Insights

"List customers with usage above 20 GB in September"

Returns a filtered table of high-usage customers, perfect for upselling premium plans or identifying data-heavy user segments.

Revenue Analysis

"Compare average revenue per user across regions"

Generates a comparison chart showing ARPU differences, helping identify underperforming markets or pricing opportunities.

Network Performance

"Show downtime trends over the last quarter"

Creates a time-series line chart revealing patterns in network reliability, highlighting periods requiring investigation.

Churn Monitoring

"What's the churn rate for month-to-month contracts?"

Instantly calculates and displays the specific churn rate for this contract type, comparing it against other contract categories.

Hands-On: Using NLQ in PowerBI

Import Your Dataset

Open PowerBI Desktop and click "Get Data" → "Text/CSV." Navigate to telecom_kpi.csv (provided) containing customer data, usage metrics, churn flags, and regional information. Click "Load" to import.

Access Q&A Feature

In the PowerBI ribbon, click "Q&A" visual. A text box appears with the prompt "Ask a question about your data." This is your natural language interface.

Try Your First Query

Type: "Show churn by region" and press Enter. PowerBI automatically creates a bar chart showing churn counts or percentages across different regions.

Explore More Questions

Try "Total ARPU last quarter" or "Customers by contract type." Notice how PowerBI interprets your intent and chooses appropriate visualizations—tables for detailed data, charts for comparisons.

Add to Dashboard

When you get a useful visualization, click the pin icon to add it to your dashboard. You can refine the visual further using PowerBI's standard formatting options.

Observe the Intelligence

Notice PowerBI's suggestions as you type. It learns your dataset's structure and recommends relevant queries. This intelligence improves as more people use the system.

Refer - MOP 4 - Exercise 12 – NLQ

Session 3: Natural Language Generation for Reports

From Visuals to Words: Automated Narratives

You've built stunning dashboards full of charts and numbers, but busy executives don't always have time to interpret them. **Natural Language Generation (NLG)** automatically writes narrative summaries of your data—turning visualizations into clear, readable sentences.

Instead of staring at a line chart showing a 3% increase, stakeholders read: *"Downtime increased by 3% in the South region compared to last month, affecting approximately 12,000 customers."* NLG bridges the gap between data and storytelling.

Why NLG Matters for Analysts

Time Savings

Writing repetitive monthly or weekly summaries consumes hours. NLG generates first drafts in seconds, letting analysts focus on deeper investigation rather than basic reporting.

Consistency

Human analysts might describe changes differently each time. NLG ensures consistent language and formatting across all reports, making comparisons easier.

Accessibility

Not everyone is comfortable interpreting charts. Written summaries make insights accessible to non-technical stakeholders who prefer reading over visualization analysis.

Understanding NLG Limitations

What NLG Does Well

- Describe trends and patterns accurately
- Highlight significant changes in metrics
- Compare values across categories
- Summarize top/bottom performers
- Generate consistent formatting

What NLG Cannot Do

- Explain *why* changes occurred (lacks business context)
- Apply human judgment about importance
- Adjust tone for different audiences
- Incorporate external factors or qualitative insights
- Make strategic recommendations

Telecom Example: Adding Context

📝 **Machine-Generated Text**

"Network downtime increased by 3% in the South region during October, representing 240 additional hours of service disruption compared to September."

📝 **Analyst-Enhanced Version**

"Network downtime increased by 3% in the South region during October, representing 240 additional hours of service disruption compared to September. This increase was due to scheduled fiber optic cable upgrades in Georgia and Florida, which are expected to improve long-term reliability by 15%. Normal service levels should resume in November."

Notice how the analyst added critical context about *why* the change happened and *what* to expect next—information the algorithm couldn't know.

Hands-On: NLG in PowerBI

1

Build Your Dashboard

Create a PowerBI dashboard page with at least 3 visualizations: ARPU trend line chart, churn rate by contract type (bar chart), and regional customer distribution (map or bar chart).

2

Insert Smart Narrative

From the Visualizations pane, click the "Smart narrative" icon (looks like a text document with sparkles). Drag it onto your dashboard canvas.

3

Review Generated Summary

PowerBI automatically analyzes your visuals and writes a summary describing key findings, trends, and comparisons. Read through it carefully.

4

Edit for Clarity

Click into the narrative text box. Add explanations, fix awkward phrasing, and incorporate business context. Compare before/after versions to understand the improvement.

Students should document examples of raw vs. edited outputs in their notes, highlighting specific improvements they made.

Refer - MOP 4 - Exercise 12 – NLQ & NLG

Session 4: Prescriptive Analytics for Telecom

From Prediction to Action

You've mastered describing what happened (*descriptive*) and predicting what might happen (*predictive*). Now it's time for the most powerful level: **prescriptive analytics**—recommending what actions to take based on those predictions. This is where analytics directly drives business decisions.

The Three Levels of Analytics

Descriptive Analytics

Question: What happened?

Example: "Customer churn rate was 4.2% last month, up from 3.8% the previous month."

Tools: Dashboards, reports, basic visualizations

Predictive Analytics

Question: What might happen next?

Example: "Based on usage patterns, Customer #12847 has a 73% probability of churning within 30 days."

Tools: Machine learning models, statistical forecasting

Prescriptive Analytics

Question: What should we do about it?

Example: "Offer Customer #12847 a 10% discount on their premium plan— estimated retention value is $480 over 12 months."

Tools: Optimization algorithms, simulation, decision engines

Prescriptive Analytics in Telecom Operations

Churn Reduction Strategies

After predicting which customers will churn, prescriptive analytics determines the optimal retention offer for each individual based on their value, preferences, and likelihood of acceptance.
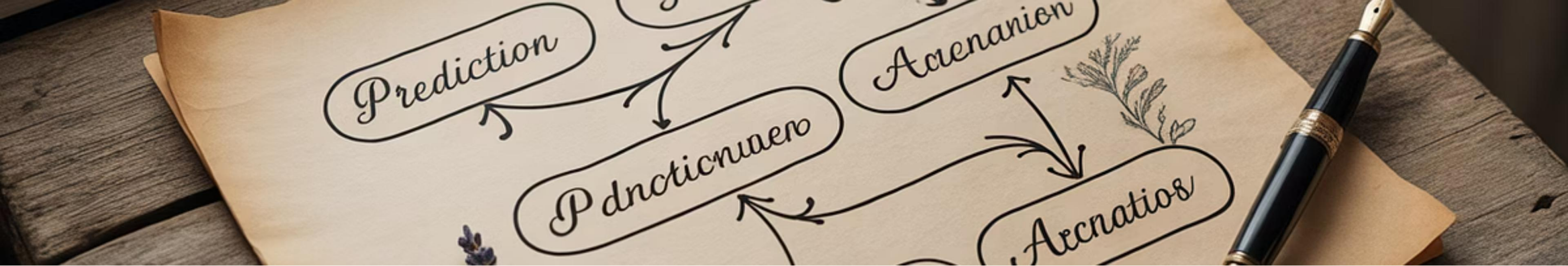
- High-value customers: personalized outreach + premium benefits
- Price-sensitive customers: targeted discounts
- Service-issue customers: priority support upgrade

Fraud Detection Response

Beyond detecting suspicious activity, the system recommends specific actions: temporarily block number, require identity verification, or escalate to fraud investigation team based on risk level and pattern type.

Network Optimization

Prescriptive models analyze usage patterns and recommend bandwidth reallocation: shift capacity from low-usage areas to high-demand zones during peak hours, optimizing both performance and costs.

The Core Concept: Prediction + Simulation

Prescriptive analytics combines two powerful techniques. First, **prediction** identifies what's likely to happen (e.g., which customers will churn). Second, **simulation** models different possible actions and their outcomes.

For each high-risk customer, the system simulates scenarios: "What if we offer 10% discount?" vs. "What if we upgrade their plan for free for 3 months?" vs. "What if we do nothing?" It calculates the expected revenue, retention probability, and cost for each option, then recommends the action with the best ROI.

This "what-if" analysis at scale—running thousands of simulations across your entire customer base—is what makes prescriptive analytics so powerful.

Example Simulation Scenarios

For a high-risk prepaid customer, the system may simulate:

Scenario	Cost	Retention Probability	Expected ROI
No action	₹0	10%	Very low
Offer ₹50 top-up	₹50	45%	Moderate
Give 2 GB bonus data	₹70	60%	High ROI
Upgrade to 4G pack for 7 days	₹90	65%	Good, but higher cost

Real Telecom Simulation Tools

Category	Example tool	What it simulates
Customer behavior simulation	IBM SPSS Modeler, SAS Customer Intelligence, Google Vertex AI	Churn, ARPU change, retention uplift
Network simulation	EDX SignalPro, Atoll, Mentum, 5G Toolbox	RF planning, capacity, coverage
Traffic & policy simulation	MATLAB SimEvents, ns-3, OMNeT++	Traffic loads, QoS, routing impact
AIOps/Automation simulation	ABot	Policy impact, workflow success, RCA

Session 5: Real-Time Analytics in Telecom

Analytics That Never Sleep

Real-time analytics means insights flow continuously as events happen, not hours or days later. Instead of generating static reports, you create living dashboards that update every second. For telecom companies managing millions of calls, texts, and data connections, real-time visibility is critical for maintaining service quality.

Real-Time vs. Batch Analytics

Traditional Batch Processing

Real-Time Streaming

Real-Time Technologies in Practice

Apache Kafka

Distributed streaming platform that handles millions of events per second. Acts as a "highway" for data flowing between systems. Telecom companies use Kafka to stream call records, network events, and usage data.

Spark Streaming

Processing engine that analyzes streaming data in micro-batches. Can run SQL queries, machine learning, and aggregations on live data. Often paired with Kafka for complete streaming pipelines.

PowerBI Streaming Datasets

Built-in feature for real-time dashboards without complex infrastructure. Perfect for learning and smaller-scale applications. Accepts data via REST API and updates visuals automatically.

Telecom Real-Time Use Cases

Network Failure Detection

Real-time monitoring of cell tower status, network latency, and connection success rates. When downtime spikes above threshold, alerts trigger immediately and dashboards pinpoint affected regions.

Call Success Rate Monitoring

Live tracking of call connection success, drop rates, and voice quality metrics. Operations teams can identify degrading service and reroute traffic before customers are impacted.

Fraud Prevention

Streaming analysis of calling patterns to detect unusual activity. When suspicious behavior appears (e.g., sudden international calls), the system can block the number within seconds.

Knowledge Check: Quick Quiz

1 Cloud deployment makes models ?

Accessible for real-time predictions

2 Azure ML Studio or AWS Sagemaker is used for

Cloud model training

3 NLQ allows users to:

Ask questions in natural language

4 NLG automatically generates:

Text summaries

5 Prescriptive analytics helps to:

Suggest best actions