CREDIT RISK ANALYTICS & CREDIT SCORING MODELS

CCP CHAPTER 12B

🏦 Core Functions of Banks & Associated Risks

The primary function of banks is to **accept deposits** and use them for **lending and investment**.

📌 **Key Risk Areas:**

✓ **Deposit Mobilization (Liability Creation)** – Prone to **Non-Financial Risks (NFR)** ⚠.

✓ **Lending & Investment (Asset Creation)** – Exposed to **Credit Risk** & **NFR** 📊 .

🔍 Types of Banking Loans

Loan Type 🏛	Borrowers 👥	Purpose 🎯
Term Loans 📅	Farmers, traders, manufacturers, infrastructure providers	Used for **long-term asset creation**.
Working Capital Loans 🔄	Traders, manufacturers, businesses	Used for **short-term operational needs**.
Retail Loans 🏠	Salaried professionals, individuals	Used for **home purchases,**

		education, personal expenses.

📌 **Types of Lending:**

✓ **Fund-Based Lending** 💰 – Direct money disbursement (e.g., loans, overdrafts).

✓ **Non-Fund-Based Lending** 📝 – Contingent exposures (e.g., **letters of credit, bank guarantees**).

👉 Banks use a **Credit Conversion Factor (CCF)** to estimate the **probable actual credit exposure** from non-fund-based lending.

📌 🔄 **Credit Risk in Banking**

What is Credit Risk?

📌 **Credit Risk** refers to the **possibility of a borrower failing to repay their obligations** on time 📉.

- It applies to both **lending** and **investments**.
- It arises from **defaults, credit concentration, counterparty risks, and poor loan assessment**.

🔍 **Components of Credit Risk**

Credit Risk Type ⚠	Description 📝
Default Risk ❌	Probability of a borrower failing to meet loan repayment.

Portfolio Risk 📊	The overall risk in the bank's **loan & investment portfolio**.
Intrinsic Risk 🏛️	Risk associated with a particular **borrower or industry**.
Concentration Risk 🎯	Excessive exposure to a **single borrower, sector, or geography**.
Counterparty Risk 🔄	Risk from **non-performance of trading partners** in financial transactions.

📊 External vs. Internal Factors Affecting Credit Risk

External Factors 🌍	Internal Factors 🏦
📉 **Economic downturns**	❌ Weak credit policies & administration
🔄 **Commodity & equity price fluctuations**	📊 Inadequate credit risk monitoring
📈 **Interest rate movements**	💰 Over-reliance on collateral instead of repayment ability
🔁 **Foreign exchange fluctuations**	📄 Poor financial assessment of borrowers
🚫 **Trade restrictions & sanctions**	❌ Absence of loan review mechanisms

📌 **Key Insight:**

🔹 A **strong credit risk management framework** should address **both external and internal risks**.

📌 ⚖️ **Credit Risk Management Process**

A well-structured credit risk management framework should cover:

✓ **Risk Measurement** 📊 – Credit rating/scoring.

✓ **Risk Quantification** 🔍 – Estimating **expected & unexpected** loan losses.

✓ **Risk Pricing** 💰 – Determining interest rates based on risk levels.

✓ **Risk Control** 🚦 – Implementing **loan review mechanisms & portfolio management**.

📌 **Governance:**

✓ Banks should **document their Credit Risk Management Policy**.

✓ A **high-level Credit Policy Committee** should:

- Define **credit approval standards & Loan terms and conditions**
- Establish **delegation of credit authority**.
- Set **prudential limits** for risk exposure.

📌 🛠️ **Key Instruments for Credit Risk Management**

1 Credit Approving Authority

📌 **What is it?**

✓ Banks should establish a **well-defined delegation of credit approval powers**.

✓ **Credit Committees** should be set up at different operational levels.

✓ A **Loan Review Mechanism (LRM)** should evaluate credit quality **within 3-6 months**.

2 Prudential Limits

📌 **Why is it important?**

✓ Prevents **over-exposure to high-risk borrowers & sectors**.

📌 **Types of Prudential Limits**

Limit Type 🔢	Description 📝
Debt/Equity Ratio Limits 📊	Defines acceptable leverage levels.
Single/Group Borrower Limits 🚧	Prevents overexposure to **one borrower or business group**.
Substantial Exposure Limits 📉	Caps **total credit exposure** beyond a set percentage of capital funds.
Industry/Sectoral Limits 🌍	Restricts loans to **high-risk industries (e.g., real estate, equities)**.
Loan Maturity Limits 📅	Controls **long-term exposure risks**.

📌 **Key Insight:**

🔹 **Sector-specific caps** ensure that banks are not **overexposed** to a single **industry or borrower group**.

3 Risk Rating System

📌 What is it?

✓ Banks must use **risk scoring/rating models** to evaluate **borrower creditworthiness**.

✓ Ratings should be **standardized across all borrowers**.

📌 Why is it important?

✓ Helps determine **loan pricing**.

✓ Facilitates **early warning signals** 🚨 for potential defaults.

✓ Assists in **portfolio risk analysis** 📊.

📌 📉 Credit Risk Analytical Models

📌 What are they?

✓ Mathematical models that **quantify credit risk exposure** & determine **required economic capital**.

🔍 Comparison of Common Credit Risk Models

Model Type 📊	Methodology 📌	Application 🏦
Probability of Default (PD) Models 📉	Estimate likelihood of **borrower default**.	Used for **individual credit assessment**.
Loss Given Default (LGD) Models 💰	Estimate **potential loss** if default occurs.	Used to **calculate risk-based capital requirements**.

Monte Carlo Simulation 🎲	Runs multiple simulations to predict **credit loss distribution**.	Used for **stress testing & portfolio analysis**.
Credit Scoring Models 📋	Assigns scores based on **borrower characteristics**.	Used for **consumer & SME loans**.

📌 **Key Insight:**

🔹 Advanced banks use a **combination of models** to ensure **accurate risk estimation**.

📌 **12.2 Premises of Credit Risk Analytics**

🏦 **Evolution of Credit Risk Analytics**

📌 The **Bank for International Settlements (BIS)** has emphasized the **need for rigorous credit risk assessment** since the Basel-I framework.

📌 Historically, **credit risk assessment remained an academic concept** rather than a **practical tool** for lenders.

📌 The **2008 Global Financial Crisis** 🌍 was a **turning point**, a **massive credit defaults occurs worldwide**.

🔹 The crisis highlighted the **contagion effect of credit risk** across economies.

🔹 This **accelerated the development of advanced credit risk models** 📊.

🔍 Evolution of Credit Risk Models Post-2008

Era ⏳	Approach to Credit Risk 📊	Challenges Faced ⚠️
Pre-2008 🏛️	**Basic risk assessment** using historical data.	🚫 Risk models were **not forward-looking**.
2008 Global Crisis 🌍	Liquidity issues **triggered massive credit defaults**.	❌ No strong mechanisms to predict **contagion risk**.
Post-2008 📉	**Advanced credit risk models** using statistical analysis.	⚠️ Over-reliance on **historical data**, which does not always predict future risks.
Present (2020s & beyond) 🚀	**AI-driven risk analytics** & real-time credit monitoring.	🔄 Continuous **evolution needed** due to changing **economic behaviors**.

📌 **Key Learning:**

🔹 **Risk models must be forward-looking**, as history often **rhymes but never repeats itself**.

🔹 **"Information asymmetry"** remains a major challenge in predicting **future credit risks**.

🔄 Role of Credit Risk Analytics

📌 **Objective:**

🔹 To differentiate borrowers & exposures based on their **Probability of Default (PD)**, **Loss Given Default (LGD)**, and **Exposure at Default (EAD)**.

📌 **Key Metrics in Credit Risk Analytics:**

Metric 📊	Definition 📝	Formula 📌
Probability of Default (PD) 📉	Likelihood that a borrower will **default** on repayment.	Estimated using **historical behavioral patterns**.
Loss Given Default (LGD) 💰	The percentage of total exposure **lost** if default occurs.	**LGD = 1 - Recovery Rate**.
Exposure at Default (EAD) 📈	The total value of **outstanding exposure** at default.	**EAD = Total Loan Amount Outstanding**.
Expected Loss (EL) 🔍	The anticipated credit loss over a period.	**EL = PD × LGD × EAD**.

📌 **Key Insight:**

🔹 **Credit risk analytics models must incorporate both historical data & future economic conditions** to accurately predict **credit risk exposure**.

📌 **12.3 Advantages of Analytic Models**

📌 **Advantages of Modern Credit Risk Models**

Benefit ☑	Explanation 📌

1 Structured & Transparent 📄	Uses **predefined parameters**, ensuring **clarity & accuracy** in predictions.
2 Mathematical Precision 📊	Leverages **quantitative models** like **probability theory** for accurate analysis.
3 Easy Implementation 🏛️	Widely available **platforms** (e.g., Excel, Python, SAS) enable quick adoption.
4 Fast & Accurate Decision-Making 🚀	Reduces **delays & ambiguities**, ensuring **precise risk assessment**.
5 Adapts to Digital Economy 🌐	Supports **big data analysis**, aligning with **modern financial behavior**.

📌 **Key Learning:**

🔹 Credit risk analytics integrates **finance, economics, and data science**, making it a **multidisciplinary field**.

📌 🔍 **Evolution of Risk Analytics: From Statistics to Big Data**

🔹 Traditionally, risk models were **based on sample data & extrapolation** 📜.

🔹 **Big Data & AI** 🤖 have **transformed risk analysis**, enabling **real-time credit monitoring**.

🔹 **Empirical analytics** now replaces **traditional statistical assumptions**.

🔄 Traditional vs. Modern Credit Risk Analytics

Factor 🏦	Traditional Credit Risk Analytics 📜	Modern Credit Risk Analytics 🚀
Data Source 📊	Sample-based data	**Big Data & real-time analytics**
Prediction Approach 🔍	Historical extrapolation	AI-driven **predictive modeling**
Accuracy 🎯	Moderate – relies on past trends	**High – accounts for economic shifts**
Scalability 📈	Limited scalability	**Easily integrates with digital finance**

📌 **Key Insight:**

🔹 **Digitalization & Big Data have revolutionized credit risk analytics**, making predictions **more precise & adaptable**.

📌 💻 **Credit Risk Analytics Software & Tools**

🔹 Modern **credit risk models rely on software tools** for **data processing, visualization, and forecasting** 📊.

🔍 Comparison of Credit Risk Analytics Software

Software 💻	Type 🔍	Key Features ☑️	Challenges ❌
SAS 🏛️	Commercial	**User-friendly, widely used in banking**	Expensive 💰

Python	Open-source	AI & machine learning support	Needs programming expertise
R	Open-source	**Statistical computing & visualization**	Requires technical expertise
Matlab	Commercial	**Advanced mathematical modeling**	**Costly for small banks**
EViews	Commercial	**Time-series analysis for risk forecasting**	Less flexible than Python

📌 **Key Learning:**

🔹 Banks must **choose the right software** based on **data complexity, regulatory requirements, and cost factors**.

📌 **12.5 Credit Scoring Models: Advanced Risk Assessment in Banking**

🏦 **Evolution of Credit Risk Modeling Under Basel II**

The **Basel II framework** defines **three key approaches** for calculating credit risk capital requirements:

Approach 🏛	Methodology 🔍	Key Features ☑
Standardized Approach (SA)	External credit rating agencies provide	Uses **predefined PD values**

📊	ratings.	assigned to risk categories.
Foundation Internal Ratings-Based (F-IRB) Approach 📜	Banks estimate **PD** but use **regulatory estimates** for other parameters (LGD, EAD, Maturity).	More **flexibility than SA**, but still constrained.
Advanced Internal Ratings-Based (A-IRB) Approach 🚀	Banks estimate **PD, LGD, EAD, and Maturity (M)**.	Provides **maximum risk-sensitive capital requirement calculation**.

🛠 Key Credit Risk Components in Scoring Models

📌 **An ideal credit risk model should:**

✓ Estimate **Probability of Default (PD)** 📉.

✓ Determine **Loss Given Default (LGD)** 💰.

✓ Calculate **Exposure at Default (EAD)** 📊.

✓ Compute **Effective Maturity (M)** ⏳.

✓ Ensure **regulatory compliance for capital requirements** 📜.

🔄 Six Stages of Credit Risk Scoring Models

1 Defining the Problem & Scope

📌 **Why is it important?**

✓ Credit scoring **varies by borrower type** – a **one-size-fits-all model doesn't work** ❌.

✓ Banks must design **separate scoring models** for:

Segment 🏦	Borrower Type 👥	Risk Factors Considered ⚠
Corporate Lending 🏢	Large companies, institutions	Financial ratios, cash flow, industry risk.
Retail Lending 🏠	Individuals, consumers	Income stability, credit history, employment.
Microfinance 💰	Small businesses, MSMEs	Alternative credit data, repayment behavior.
Infrastructure Lending 🏗	Long-term projects	Government policies, execution risks.

2 Data Collection & Preprocessing

📌 **Data Sources for Credit Scoring Models:**

✓ **Internal Data** – Borrower's **past repayment history, transaction behavior**.

✓ **Peer Data** – Similar businesses/individuals for **comparative analysis**.

✓ **Industry Data** – Sector performance **benchmarks & trends**.

✓ **Macroeconomic Data** – National/global indicators like **GDP, inflation, interest rates**.

✓ **Alternative Data (Big Data)** – Social media activity, payment platforms, utilities.

📌 **Data Structuring:**

✓ **Vertically** – Across **time series** (historical trends).

✓ **Horizontally** – Across **geographies & industries**.

✓ **Correlated Data** – Relating economic conditions to borrower behavior.

3 Developing the Analytical Model

📌 **What is a Credit Risk Model?**

✓ A **predefined framework** that **consistently assesses borrower risk**.

✓ Uses **predictive analytics** to evaluate risk **over time**.

📌 **Key Model Types:**

Model Type 📊	Purpose 🎯	Application 🏦
Logistic Regression 📉	Predicts **PD** based on historical default patterns.	Used for **scoring retail & SME loans**.
Machine Learning (AI-based models) 🤖	Identifies risk patterns using **large-scale data**.	Applied for **real-time risk monitoring**.
Monte Carlo Simulations 🎲	Runs multiple simulations to stress-test risk	Used for **portfolio-level risk evaluation**.

	levels.	

4 Backtesting the Model

📌 **Objective:**

✓ Ensure **historical data aligns with model predictions**.

✓ Compare model outputs with **known credit events**.

✓ **Steps in Backtesting:**

1 **Select historical events** where default **outcomes are known**.

2 **Feed past data into the model**.

3 **Compare predicted vs. actual outcomes** 📊 .

4 **Refine parameters** if deviations exist.

5 Stress Testing & Scenario Analysis

📌 **Why is this important?**

✓ **Tests model resilience** under **worst-case economic scenarios**.

✓ **Key Stress Scenarios:**

Scenario 🌍	Possible Impact on Credit Risk 📉
Economic Recession 📉	Higher **default rates**, lower **repayment capacity**.
Rising Interest Rates 💰	Increased **EMIs**, lower **loan affordability**.
Stock Market Crash 📊	Corporate defaults **increase**.

Pandemic-like Shocks 🚑	Mass unemployment, economic slowdown.

6 Regulatory Capital Calculation & Compliance

📌 **Final Step:**

✓ Ensure the model aligns with **Basel II/III capital adequacy requirements** 📜.

✓ Integrate **real-time updates** for new **central bank regulations**.

✓ **Modern Credit Risk Models Must:**

✓ Automate **end-to-end data processing & risk calculations** 🤖.

✓ Allow seamless **adaptation to regulatory changes** 📑.

✓ Provide **customized risk estimation tools** for dynamic risk assessment 📊.

💻 **The Role of Fintech in Credit Risk Modeling**

📌 **How Banks are Leveraging Fintech?**

✓ Some banks **launch in-house Fintech startups** 🚀.

✓ Others **partner with Fintech firms** 🤝 to integrate AI-driven risk models.

🔍 **Technologies Used in Modern Credit Risk Modeling**

Technology 💻	Application in Credit Scoring 📊
Python, R, SAS 🐍	AI-driven predictive analytics, big

	data processing.
Machine Learning (ML) 🤖	Identifies borrower patterns & fraud detection.
Blockchain ⛓	Creates **tamper-proof credit history**.
Cloud Computing ☁	Enables **real-time credit risk evaluation**.