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Climate-related financial risks

Material:

Presentations PDF,
Exercises: Python, R, SAS, Excel and JupyterLab.

Duration: 42 h

Price: 9.000 €

COURSE OBJECTIVE

Climate change poses both risks and opportunities for financial institutions, now and in the future. As the Earth's temperature rises, increasingly common natural disasters are disrupting ecosystems and human health, causing unforeseen business losses and threatening banks' assets and infrastructure. In response, governments and private sector entities are considering a variety of options to reduce global emissions, which could result in disruptive changes across all economic sectors and regions in the near term.

Supervisors classify two types of risks: physical and transition. The first refer to specific meteorological phenomena (heat waves, floods, forest fires, storms) and long-term changes in the climate, such as a rise in sea level, and these could detract from the value of the properties that act as collateral in mortgages, increasing credit risk.

The objective of the course is to incorporate mainstreaming climate change financial risks into existing financial risk management practice, how to use scenario analysis to inform strategy setting and risk assessment and identification, and how to develop an approach to disclosure. the financial risks of climate change.

The objective of the course is to show the best practices for quantifying and managing climate risk. Various regulations such as Basel and IFRS S1 and IFRS S2 are explained as well as the Task Force Climate-related Financial Disclosure (TCFD) standard.

Regarding climate risk management, governance, organization, scenario generation, risk assessment, risk appetite, as well as monitoring and disclosure of this risk are explained.

The impact of climate change on credit risk models and methodologies such as credit rating, credit scoring, modeling of PD, LGD and EAD parameters of the advanced IRB approach of Basel III, credit risk methodologies

for IFRS 9 impairment models is quantified. and credit risk stress testing models. In addition, the impact of COVID-19 on credit risk models is explained.

The course also exposes the impact of climate change on market risk, liquidity risk, operational risk and reputational risk.

The estimation of the Climate Value at Risk is addressed using Monte Carlo Simulation and Delta Normal methodologies. Liquidity risk metrics affected by climate change are explained.

Advanced backtesting techniques are shown, such as discriminant power, stability tests, and calibration.

The use of machine learning to develop advanced models of credit risk and climate change is explained. In addition, it explains how to take advantage of machine learning to validate models and quantify credit risk.

Powerful model risk and credit risk exercises done in Python, R, SAS, Excel and JupyterLab are delivered.

WHO SHOULD ATTEND?

This program is aimed at Directors, Managers, Analysts and Financial Risk Consultants and specialists in credit risk and those interested in climate risk. The content of the course is absolutely practical to apply immediately at work.

CLIMATE RISK

Module 1: Introduction to climate change and financial risk management

- Summary of climate change risk
- How does climate change translate into financial risk?
- Exposure to weather-related risks
    - physical risks
        - Climate change as a physical and meteorological phenomenon and its impacts on natural and artificial systems
        - Basic science of climate change
        - the latest scientific knowledge compiled by the Intergovernmental Panel on Climate Change (IPCC).
    - transition risks
        - The economic transition with low carbon emissions, its risks and impacts
        - The social response to climate change as a political, economic and technological response
        - the international climate change regime, and current debates and challenges, such as the "Tragedy on the horizon"
        - main policy responses to climate change at the national level (for example, emissions trading
        - introduction to the risks and opportunities that climate change implies for the financial sector (mitigation and adaptation)
        - introduction to transition risks and opportunities in the context of the new Task Force on Climate Related Financial Disclosure (TCFD)
- Risks of climate change risk
- Understand the performance of carbon as an asset class.

Module 2: Emerging regulatory expectations

- Background to regulatory initiatives: Paris Agreement and other frameworks
- Overview of current regulatory standards (for example, PRA, ECB, HKMA, MAS, etc.)

- Role of NGFS and standard setters
- Risk Management Expectations
- Challenges and opportunities Disclosure, reporting and governance frameworks
- Growing pressure for financial disclosure
- Strong ownership and oversight of climate change risk management practices
- **Task Force on Climate-related Financial Disclosures TCFD**
    - Understand the guiding principles of TCFD
    - Develop a comprehensive TCFD program
    - implement recommendations
- **Basel**
    - The role of climate-related financial risks in the regulatory and supervisory framework
    - Research related to the measurement of climate-related financial risks
    - Measures to raise stakeholder awareness of climate-related financial risks
    - Bank approaches to managing and disclosing weather-related financial risks
    - The supervisory treatment of weather-related financial risks
    - Other initiatives that are underway among the respondents.
- **IFRS**
    - Making materiality judgments
    - Apply Materiality Judgments to Weather-Related and Other Emerging Risks
    - Financial reporting considerations
    - Disclosure of weather-related risks and other emerging risks
    - Management comment: provides context to the financial statements
    - Abstract: Materiality judgments must satisfy the information needs of investors.

Module 3: ESG and climate change risk

- Environmental, social and corporate governance (ESG) refers to the three central factors in measuring the sustainability and social impact of an investment in a company or business.
- Current trends in the ESG market
- Analysis of ESG ratings
- Adapt investment strategies to the effects of climate change
    - Build a portfolio that reflects the transition to a low carbon economy
    - Integrating the carbon transition and physical climate risk
- Distinguish the risks, challenges and opportunities associated with ESG

Module 4: Climate Risk Management

- **Scenario Analysis and Stress Testing**
- What is the difference between "normal" stress tests and climate change risk stress tests?
    - Bank of England stress test
- Summary of scenario analysis in the context of climate change risk
- Data management to assess the risks of climate change.
- Benefits and Issues of performing scenario analysis
- Climate change risk methodologies
- How to model the risk of climate change?
- Using and evaluating data
- Understand modeling methodologies
    - temperature alignment
    - Decarbonization Pact Methodology
    - Climate change applied to credit risk
- Challenges in climate change risk modeling
- **Incorporation of climate change risk strategies**
- Integrate climate change risk management into financial risk management frameworks
- Adoption of KPI, KRI to monitor climate risks.
- Use of self-assessments
- Improvement and management of business commitment
- How to successfully integrate climate risk strategies into the business.

Module 5: Credit risk transition risk

- Scenario analysis to assess the transition risk component of a portfolio's credit risk
- Introduction: preparing banks for the low carbon transition
    - A growing need for climate scenario analysis
    - The challenge for banks
    - Take advantage of and integrate the resources available to banks
- An integrated approach to transition risk assessment Transition scenarios
    - Understand transition scenarios and their sources
    - Using scenarios for transition risk assessment
    - Closing the gap between climate scenarios and financial risk assessment
- Borrower Level Calibration
- Portfolio Impact Assessment
    - Link expected loss to transition impacts on portfolios
    - Assessment of probability of default (PD)
    - Loss Given Default (LGD) Assessment
- Putting the Approach to Work: Lessons Learned from Banking Pilots
- Piloting the transition risk methodology
- Definition of sectors and segments
- Evaluate the relative sensitivities of the segments
- Determination of calibration points at the borrower level Case studies and results
- The pilot transition scenario
- pilot results
- Transition Opportunities: Exploring an Institutional Strategy
- evaluating the market
- Grounding Opportunity Assessments in Scenario Analysis
- Assessing the market attractiveness of the segment
- Identification of banking capabilities
- Discovering the opportunities with the greatest potential
- Future Directions: Developing the Next Generation of Transition Risk Analysis

Module 6: Physical risks and opportunities

- **An Integrated Approach to Physical Risk Assessment**
- Borrower Characteristics
- Insurance as a risk mitigator due to extreme climatic and meteorological events
- climate change scenarios
- Impacts of climate change on the probability of default PD
    - Evaluation of changes in the productivity of the sector
    - Adjustment of income statement metrics
    - Determination of changes in the probability of default
- Real Estate: Climate Change Impacts on LTV Loan-to-Value
    - Estimation of the impacts of extreme events on the value of properties.
    - Determining Changes in LTV Loan-to-Value Ratio
- **Physical Opportunities: Exploring an Institutional Strategy**
- Taxonomy of opportunities and data sources
- evaluating the market
- Evaluation of the financing demand of the sector
- Sector evaluation
- Assess the institutional capacity and market positioning of a bank
- evaluate opportunities
- **Future Directions: Towards the Next Generation of Physical Risk and Opportunity Analysis**
- Develop internal analytics and capabilities within banks
- Strengthening the research base
- Develop analytical platforms and tools to support physical assessments of risks and opportunities.
- Improve information flows on physical risk and adaptation between banks and borrowers
- Improve dialogue with governments and insurers

Module 7: Decarbonization and disruption

- The oil and gas sector
    - market trends
    - The potential impacts of a disruptive transition
    - Ensure an orderly transition
    - Analysis of climatic scenarios of the messy transition
- Utilities and Power Generation Sector
    - market trends
    - The potential impacts of a disruptive transition
    - Ensure an orderly transition
    - Analysis of climatic scenarios of the messy transition
- Metals and mining sector (industrial)
    - market trends
    - The potential impacts of a disruptive transition
    - Ensure an orderly transition
    - Analysis of climatic scenarios of the messy transition
- Agricultural sector
    - market trends
    - The potential impacts of a disruptive transition
    - Ensure an orderly transition
    - Analysis of climatic scenarios of the messy transition

Module 8: Climate transition scenarios

- Analysis of climate scenarios in the financial sector
    - Analysis of scenarios before and after the global financial crisis
    - Climate scenario analysis
- Climate scenarios
    - Introduction to Integrated Assessment Models (IAM)
    - Where do AMIs come from?
    - Advantages and Limitations of IAMs
- Key assumptions
    - What do the IAM scenarios show?
    - What socioeconomic and policy assumptions do IAMs make?
    - What technological assumptions do IAMs make?
    - Elimination and overshoot of carbon dioxide
    - Many routes up to 15 ° C
- Sectoral perspectives of climate scenarios
    - Regional, sectoral and technological coverage in IAM
    - Future energy mix at IAM
    - Understand sector-specific impacts
- Bank assessments of climate scenarios (case studies)
    - Summary of UNEP FI transition risk approach used for bank case studies
    - Case studies and perspectives of the Bank on climate scenarios

CLIMATE CHANGE and CREDIT RATING

Module 9: Climate Impact on Credit Rating

- Analysis of Business Models of Corporate Credit Rating:
    - Moody's
    - Z-score
    - S&P
- Main Financial Ratios
- Data treatment

- Univariate Analysis
    - Beta transformation
- Selection of Variable Blocks
    - Principal component analysis
- Qualitative Variables
- Default definition
- Temporal horizon
- Multivariate models
    - Logistic regression
    - Multinomial Regression
- Weight of qualitative and quantitative factors
- Consistency Tests
- PD Estimation and Calibration
- Definition and creation of Master Scale
- PD Mapping to Master Scale
- Impact of climate risk
- Methodology to integrate climate risk
- Climate Risk Factors
- **Exercise 1:** Univariate Analysis with Financial Ratios in Excel
- **Exercise 2:** Analysis of Principal Components in SAS
- **Exercise 3:** Multivariate Model in SAS
- **Exercise 4:** Consistency Test in Excel
- **Exercise 5:** Qualitative and Quantitative Factors of the Rating
- **Exercise 6:** PD estimation and mapping to Master Scale
- **Exercise 7:** Credit rating and climate risk

Module 10: Climate Change in the Sovereign Rating

- Sovereign Risk
- transfer risk
- Country Rating Modeling
- Sovereign Rating Model emerging countries
- Sovereign Rating Model developed countries
- Univariate Analysis
- Shadow AR
- Advanced Multivariate Model for Sovereign Rating
- Climate risk impact
- **Exercise 8:** Impact due to climate risk Sovereign Rating

CLIMATE CHANGE and PD

Module 11: IRB PD Estimation

- Impact of COVID-19 on PD
- Basel III and EBA regarding the default before COVID-19
- Default definition
- Public or private moratorium
- PD PIT and PD TTC
- Detection of borrowers in default due to the Pandemic
- Adjustments for transition risks of climate change in the PD
- Adjustments for physical risks of climate change in the PD
- Credit scoring models
    - Explanatory variables of the impact of COVID-19
- Productive Behavior Score models of COVID-19
    - explanatory variables
- Credit Rating models for companies

    - Explanatory variables of COVID-19
- PD estimation
- Treatment of Panel data
- Econometric models to estimate PD
    - PD Logistic Regression
    - PD Probit Regression
    - PD COX regression of survival
    - PD Log-log Complementary
    - PD Regression Data Panel
- PD Calibration
- Calibration of econometric models
- Anchor Point Estimate
- Calibration of PD by vintages or vintages
- vintage analysis
    - PS Marginal
    - PS Forward
    - Cumulative PD
- **Exercise 9:** Building Advanced Credit Scoring in Python and R
- **Exercise 10:** Calibration of PD with COX regression in R
- **Exercise 11:** Calibration of PD with regression of R panel data
- **Exercise 12:** PD calibration with logistic LASSO model in R
- **Exercise 14:** Calibration of the PD with Bayesian regression probit in R
- **Exercise 15:** Calibration of PD with Bayesian COX regression in R
- **Exercise 16:** PD Calibration by Climate Adjustment

Module 12: Structural Models of PD

- Merton's model
- Physical Probability of Default
- Black-Scholes-Merton model
- Black–Cox model
- Vasicek–Kealhofer model
- CDS Pricing
- Curves in liquidity and non-liquidity conditions
- CDS Implied EDF
- CDS Spreads
- Fair Value Spread
- CDS Spread in Sovereigns
- DD Default Distance
- Impact of climate change
- Coal Price Sensitivity
- **Exercise 17:** Estimation of CDS Spread and PD
- **Exercise 18:** Estimate of EDF and DD adjusted for climate change

Module 14: Lifetime PD Models

- Adjustments for transition risks of climate change in the PD
- Adjustments for physical risks of climate change in the PD
- PD Lifetime consumer portfolio
- PD Lifetime mortgage portfolio
- PD Lifetime Wallet Credit Card
- PD Lifetime portfolio SMEs
- vintage model
    - Exogenous Maturity Vintage EMV Model
    - decomposition analysis
    - COVID-19 Pandemic Application
    - Advantages and disadvantages

- Basel ASRF model
    - Matrix ASRF model
    - Leveraging IRB in IFRS 9
    - Advantages and disadvantages
- Regression Models
    - Logistic Multinomial Regression
    - Ordinal Probit Regression
- Survival Models
    - Kaplan–Meier
    - Cox regression
    - Advantages and disadvantages
- Markov models
    - Multi-State Markov Model
    - Advantages and disadvantages
- Machine Learning Model
    - Support Vector Machine
- Deep Learning Models
- Neural network architecture
- PD Lifetime Extrapolation Models
- Lifetime PD Calibration
- **Exercise 19:** PD Lifetime using vintage EMV Decomposition model using pandemic data
- **Exercise 20:** PD Lifetime using multinomial regression in R
- **Exercise 21:** PD Lifetime using Markov model
- **Exercise 22:** PD Lifetime using matrix ASRF model
- **Exercise 23:** PD Lifetime using extrapolation approach
- **Exercise 24:** PD Lifetime using SVM in Python
- **Exercise 25:** PD Lifetime using Deep Learning in Python and PD calibration

CLIMATE CHANGE and LGD

Module 15: LGD in Mortgages and IRB companies

- Impact of COVID-19 on LGD
    - definition of default
    - moratoriums
    - Renovations and restructuring
    - Default Cycle
    - Real Default Cycles
- Adjustments for climate change transition risks in LTV and LGD
- Adjustments for physical risks of climate change in LTV and LGD
- Expected Loss and Unexpected Loss in the LGD
- LGD in Default
- Default Weighted Average LGD or Exposure-weighted average LGD
- LGD for performing and non-performing exposures
- Treatment of collaterals in the IRB
- Workout Focus
    - Techniques to determine the discount rate
    - Treatment of recoveries, expenses and recovery costs
    - Default Cycles
    - recovery expenses
- Downturn LGD in consumer portfolios
- Downturn LGD in Mortgages
- LGD in Mortgages adjusted for climate change
- LGD in companies adjusted to climate change
- **Exercises 26:** Estimation and analysis of LGD and Exp. Weighted Ave. LGD

Module 16: LGD Econometric Models

- Advantages and disadvantages of LGD Predictive Models
- Forward Looking models incorporating Macroeconomic variables
- Parametric and non-parametric models and transformation regressions
- Typology of LGD Multivariate Models
    - Linear regression and Beta transformation
    - Linear Regression and Logit Transformation
    - Linear regression and Box Cox transformation
    - Logistic and Linear Regression
    - Logistic and nonlinear regression
    - Censored Regression
    - Generalized Additive Model
    - neural networks
    - Beta regression
    - Inflated beta regression
    - Fractional Response Regression
- **Exercise 27:** Logistic and linear regression LGD in SAS
- **Exercise 28:** LGD Neural Networks
- **Exercise 29:** Beta Regression Model LGD in R and SAS
- **Exercise 30:** Comparison of the performance of the models using Calibration and precision tests.

Module 17: LGD for IFRS 9

- Comparison of IRB LGD vs. IFRS 9
- Impact on COVID-19
- IFRS 9 requirements
    - Probability Weighted
    - Forward Looking
- IRB LGD adjustments
    - Selection of Interest Rates
    - Allocation of Costs
    - floors
    - Treatment of collateral over time
    - Duration of COVID-19
- LGD PIT modeling
- Collateral Modeling
- LGD IFRS 9 for portfolio companies
- LGD IFRS 9 for mortgage portfolio
- LGD IFRS 9 for corporate portfolios
    - credit cycle
    - Tobit Regression
- IFRS 9 LGD using LASSO Regression
- Machine Learning Models
    - Support Vector Machine
    - Neural Networks
- **Exercise 31:** Estimation and adjustments for LGD IFRS 9 using Tobit regression in R
- **Exercise 32:** Censored Regression Model LGD in R
- **Exercise 33:** Estimating IFRS 9 LGD using LASSO regression in Python
- **Exercise 34:** LGD Estimation IFRS 9 SVM
- **Exercise 35:** LGD estimation IFRS 9 NN

CLIMATE CHANGE AND STRESS TESTING

Module 18: Time series of climate change and projections

- Financial and macroeconomic series in stress testing

- **Econometric Models**
    - ARIMA models
    - ARCH models
    - GARCH models
- **Machine Learning Models**
    - Supported Vector Machine
    - neural networks
    - deep learning
    - Recurrent Neural Networks RNN
- **Model Validation**
    - Data processing
    - Non-Stationary Series
    - Dickey-Fuller test
    - Cointegration Tests
    - non-normality tests
    - heteroscedasticity
    - Outliers
    - autocorrelation
- **Backtesting of time series**
    - Validation of machine learning models
    - Train test split
    - K-fold cross-validation
    - Walk-forward validation
- **Exercise 36:** Non-stationary and cointegration series
- **Exercise 37:** ARCH modeling climate change
- **Exercise 38:** Facebook Prophet modeling climate change
- **Exercise 39:** Machine Learning LSTM modeling of climate change
- **Exercise 40:** Bakctesting machine learning time series

Module 19: Climate and Macroeconomic Scenarios in IFRS 9

- IFRS 9 Macroeconomic Scenarios
- climate scenarios
- Converting climate scenarios to macroeconomic scenarios
- Analysis of scenarios in EBA
- Design of adverse scenarios
- Financial and economic shocks
- Important macroeconomic variables
- Structural macroeconomic models
- Bayesian VaR
- balance models
    - Dynamic Stochastic General Equilibrium (DSGE)
- Non-equilibrium models
    - Sensitivity Analysis
- Integrated assessment model (IAM)
- Computable general equilibrium (CGE)
- Overlapping generation
- input-output
- agent-based
- Scenario analysis
- Expert judgment in stage design
- Scenario severity score
- Scenario validation
- **Exercise 41:** Advanced model of BVaR and DSGE macroeconomic scenarios
- **Exercise 42:** Converting climate scenarios to macroeconomic scenarios

Module 20: Measurement and validation of Stress Testing Net Charge-Off

- **Stress Testing Net Charge-Off**
    - Temporal horizon
    - Multi-period approach
    - Data required
    - Failed balance or penalty
    - Selection of Macroeconomic scenarios
    - Climate change scenarios
    - Charge Off
    - Net Charge Off
    - Losses on new impaired assets
    - Losses on old impaired assets
    - Net charge-off forecasting
- **Multivariate time series**
    - Vector Autoregressive (VAR)
    - Vector Error Correction (VEC) Models
- **Machine Learning Models**
    - Multivariate adaptive regression spline (MARS)
- **Stress testing validation**
    - Performance metrics
    - Out of sample
    - Generalized Cross Validation – GCV
    - Squared Correlation - SC
    - Root Mean Squared Error – RMSE
    - Cumulative Percentage Error – CPE
    - Aikaike Information Criterion - AIC
    - Backtesting
    - Temporal horizon
    - Magnitude of the error
- **Exercise 43:** VAR stress testing model
- **Exercise 44:** VEC stress testing model
- **Exercise 45:** MARS stress testing model
- **Exercise 46:** Validation and backtesting of VAR, VEC and MARS models

Module 21: Model Risk in Stress Testing

- Climatic Stress Testing
- Climate Scenarios
- Converting climate scenarios to macroeconomic scenarios
- **PD Stress Testing**
    - Credit Portfolio View
    - Multiyear Approach ASRF
    - Reverse Stress Testing
    - Rescaling
    - Cox regression
- **Stress Testing of the Transition Matrix**
    - Approach Credit Portfolio View
    - credit cycle index
    - Use of Credimetrics
    - Multifactor Extension
- **LGD Stress Testing**
    - LGD Downturn: Mixed Distribution Approach
    - PD/LGD Multiyear Approach modeling
    - Frye-Jacobs PD/LGD modeling
    - Stress test and simulation of PD and LGD
- **ECL IFRS 9 Stress Testing**
    - Transition matrix S1,S2 and S3
    - Changes in the stock of provisions

    - Changes in the stock of provisions of exposures S1
    - Changes in the stock of provisions of exposures S2
    - Changes in the stock of provisions of S3 exposures
- Model risk in stress testing
- Uncertainty in model specification
- Uncertainty in the selected sample
- Uncertainty in the scenarios
- Mean Deviation (MD)
- **Exercise 47:** Stress testing PD credit portfolio views approach and climate risk integration
- **Exercise 48:** PD and LGD estimation Multiyear approach
- **Exercise 49:** Stress Test LGD adjusted for climate risk
- **Exercise 50:** Stress Test LGD, projection and simulation
- **Exercise 51:** Stress Test of Transition Matrices

Module 22: Stress Testing Corporate Credit Risk

- Temporal horizon
- Data required
- Main Macroeconomic variables
- Impact on P&L, RWA and Capital
- ASRF model
- Creditmetrics model
- Using Transition Matrices
- Use of the credit cycle index
- Default forecasting
- Stress Test Methodology for corporate portfolios
- Impact on RWA and Capital
- **Exercise 52:** Stress Testing of corporate portfolio provisions using transition matrix and ASRF model in SAS, R and Excel

STRESS TESTING ECL IFRS 9

Module 23: Stress Testing of ECL IFRS 9

- Stress testing IFRS 9 and COVID-19
- Pandemic scenarios applied to the ECL calculation
- Climate Scenarios
- Stress Testing of IFRS 9 parameters
- EBA Stress Testing 2021 and possible incorporation 2022 climate change
- Treatment of the moratorium
- Possible regulatory scenarios
- Impact on P&L
- PIT starting parameters
- PIT projected parameters
- Calculation of non-productive assets and impairments
- Changes in the stock of provisions
- Changes in the stock of provisions for exposures phase S1
- Changes in the stock of provisions for exposures phase S2
- Changes in the stock of provisions of exposures phase S3
- Sovereign Exposure Impairment Losses
- Impact on capital
- Internal Stress Testing Model for ECL IFRS 9
- **Exercise 53:** Stress Testing of the ECL using matrices and time series R and Excel

INCREASED RISK SICR IFRS 9

Module 24: Increase in Credit Risk SICR

- Significant increase in credit risk (SICR)
- Impact of COVID-19 on the increase in SICR risk
- Impact of climate change on the SICR
- Recommendations Basel, EBA, ESMA, IFRS
- Qualitative and quantitative criteria based on COVID-19
- Increase in collective credit risk
- Individual IFRS 9 credit risk increase
- Phase migration matrices
    - Roll rate models
    - Markov model
- Impact of COVID-19 on migrations
- Estimation of PD Lifetime and PD Origination thresholds
- Rating Variation
- Determination of thresholds
- KRIs for retail, mortgages and corporate
- Increase in collective IFRS 9 credit risk
    - Use of discriminant test
    - ROC curve
    - false alarm rate
    - target hit rate
    - S2 size
- **Exercise 54:** Estimation of SICR credit risk increase using ROC discriminant power test in R and Excel

CLIMATE CHANGE AND CONCENTRATION RISK

Module 25: Concentration Risk

- Economic Capital Methodologies
- PD Structural Models
- Merton's model
- Default Correlation
- Future Asset Correlation
- Unexpected Tax Loss
- ASRF Economic Capital Models
- ASRF model plus Stochastic LGD and correlations
- Business Models
    - KMV
    - Creditmetrics
    - Credit Portfolio View
    - Credit risk +
- Dependency modeling using copulas
- **Concentration Risk**
- Impact of climate change on concentration risk
- Individual Concentration Model
- Sector Concentration Model
- Multifactorial Model
- Pykthins model
- Cespedes et al model
    - CDI, beta and DF
- Dullmann model
- **Exercise 55:** EC with ASRF model and Granularity adjustment

- **Exercise 56:** Estimation of CDI, Beta and calibration of the DF

Module 26: Capital Allocation and Capital Planning

- Reallocation of capital for climate risk
- Definition and concept of Capital Allocation
- Capital planning in the ICAAP
- Capital Allocation using Euler's Principle
- RAROC credit risk
- Capital allocation process in business units
- ASRF model
- VaR and ES for estimating capital allocation
- **Exercise 57:** Capital allocation using the ASRF model and estimating ES and VaR

Module 27: ESG Risk

- ESG Risk Model Framework
- Definition of ESG Risk
- Definition of Financial Sustainable Investment Strategy
- Valuation of Instruments and ESG Factors
- Hazard rate calibration with ESG Rating
- Impact on the distribution of risk factors
- Delta Normal Approximation
- Historical simulation approach
- Monte Carlo simulation
- Approximation Analytical Properties of the Model
- ESG VaR Estimate
- Var vs. VaR ESG
- **Exercise 56:** Portfolio VaR and ESG VaR

CLIMATE CHANGE IN LIQUIDITY RISK

Module 28: Liquidity Risk

- The interaction of climate risk and bank liquidity
- Climate risk drivers can affect liquidity risk
- Increase in funds
- liquidation of assets
- Increased demand for liquidity from customers.
- Liquidity Ratios
    - Basel III
    - Basel III LCR and NSFR Liquidity Ratios
    - Liquidity Coverage Ratio
    - Level 1 and 2 Liquid Assets
    - High Quality Liquidity Assets (HQLAs)
    - Net cash outflows
    - Net Stable Funding Ratio
    - Bank planning under Basel III
- Modeling of econometric models with liquidity metrics
- Climate risk variables
- **Exercise 57:** Regression models of liquidity metrics linked to climate change

CLIMATIC RISK COVERAGE INSURANCE-LINKED SECURITIES

Module 29: Insurance-Linked Securities

- Definition Insurance-Linked Securities
- derivatives market
- Derivatives and bonds linked to Property and Casualty risk
- Weather Derivatives
- Catastrophe Bonds
- Catastrophe Derivatives
- Derivatives and bonds linked to longevity and mortality risk
- Longevity Swaps
- Longevity Bonds
- Risk management in ILS portfolios
- **Exercise 58:** Valuation derived from Climate in Excel

CLIMATE CHANGE IN OPERATIONAL

Module 30: Operational Risk

- Climatic Stress Testing
- Climate Scenarios
- Introduction Operational Risk
    - Losses due to natural disasters
    - Physical risks of climate change
    - Extreme weather events
    - Gradual/chronic changes in Earth's climate
    - business interruption and damage
    - The hurricane can interrupt the supply of electricity
    - Mapping of Transition and Physical risks to Basel
- Loss Event Management
- Risk Control Self Assessment
- Scenario Based Assessment
- Key Risk Indicators
- Capital estimation LDA approach
- Distributions of Frequency and Severity:
- Frequency
    - Poisson
    - Negative Binomial
- Severity
    - lognormal
    - Inverse Gamma
    - Reverse Weibull
    - Inverse Gaussian
    - GDP EVT
    - LogLogistic
    - G-H 4 parameters
    - Mixture of Lognormals
    - lognormal-EVT
    - Alpha Stable
- Poisson-Gamma Bayesian approach
- Lognormal partition and GDP
- Scenarios with Expert criteria
- Climate Risk Modeling
    - Physical risks
    - Floods
    - Catastrophe science
    - Tsunamis
    - Hurricanes: Frequency, Regions
    - Hurricane Modeling

    - Earthquakes, frequency and severity
- Probability distribution of the different climate scenarios
- Climate Value at Risk
- **Exercise 59:** Selection of the best distribution using goodness-of-fit tests in Excel
- **Exercise 60:** Climate Value at Risk using Monte Carlo Simulation with effect of deductible / insurance excess in R
- **Exercise 61:** Climate Value at Risk with Monte Carlo Simulation with frequency distribution with Gaussian copulas in R
- **Exercise 62:** Climate Value at Risk with Monte Carlo Simulation of aggregate losses of the business units with t and frank copulas in R
- **Exercise 63:** Comparison of internal models with Recursive Panjer, Fast Fourier Transformation and Monte Carlo Simulation in R and Excel

CLIMATE CHANGE IN REPUTATIONAL RISK

Module 31: Measurement of Reputational Risk

- Definition and nature of Reputation
- Increased reputational risk for banks based on changes in the market or consumer sentiment
- Identification of reputational risk
- Reputational risk assessment
- Stakeholder expectations
- Risk areas and stakeholder categories
- Internal Reputational Risk
- External Reputational Risk
- Assessment through scenarios and impact
- Use of Risk Control Self Assessment in reputational risk
- Important KRIs of Reputational Risk
- Practical case of presenting results to Senior Management