

**Raiffeisenlandesbank
Oberösterreich**



Participation Risk with R and R Shiny A Case Study

Webinar, December 12 2024



Scope of the webinar

This webinar focusses on approaches around quantifying risks from participations, describing an end-to-end approach from collecting data to deploying the RShiny application on internal servers. A case study, specifically created for the webinar, will be presented and made available through GitHub.

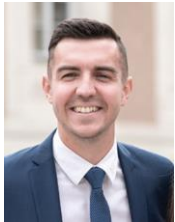
Agenda:

- Quick review of DCF approach for participations
- Data collection using APIs or/and web scraping
- Modelling
- User Interface with Rshiny
- Deployment of the tool/ application

- 1** Overview and „Who is Who“
- 2 Participations and DCF approach
- 3 Data Collection and Modelling
- 4 User Interface with RShiny
- 5** Deployment of an application in a nutshell



Who is who?



Simon Aigner

Simon Aigner holds his Master's degree in Economic and Business Analytics. He has been with Raiffeisenlandesbank OÖ in Risk Management for nearly two years, gaining valuable experience in the financial sector. He focuses on improving operational efficiency by automating internal processes using R, while continuously enhancing his technical skills. To maintain a balance between handling R error messages and his mental well-being, he also coaches a football team in Austria's 7th division.



Goran Lovric

Goran Lovric has over 18 years of professional experience in reputable, national and international financial companies, carrying senior management and senior leadership responsibilities in (financial and non-financial) risk management. Mr. Lovric holds degrees in Law and Quantitative Finance and is certified Financial Risk Manager under GARP, Professional Risk Manager under PRMIA and is Certified in Risk and Information System Control under ISACA.

FROM UPPER AUSTRIA TO THE WHOLE WORLD



**Raiffeisenlandesbank
Oberösterreich**



- Largest bank in Upper Austria, leading regional bank in Austria
- Modern advisory bank that is available locally yet also has access to an international network of powerful partner banks
- Together with the 68 Upper Austrian Raiffeisen Banks with more than 400 branches, Raiffeisenlandesbank OÖ forms the Raiffeisen Bank Group Upper Austria, which more than 940,000 customers rely on
- Strategic business fields include Financial Markets (ALM, Treasury), Corporates, Retail Customers incl. Private Banking and Equity Investments



Before we start...

Kudos and big thanks to R Consortium and the team for their outstanding support



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Participations and DCF

- **Participation¹** = rights in the capital of other undertakings, whether or not represented by certificates, which, by creating a durable link with those undertakings, are intended to contribute to the company's activities
- **Participation risk²** = change in value or/and cash flow generation of the undertaking
- **How to quantify participation risk**
 - Step 1: determine cash flow and cost of capital
 - Step 2: determine volatility of cash flows and cost of capital
 - Step 3: perform a Monte Carlo simulation and determine VaR
- **How to display/ present participation risk**
 - Rshiny application: <https://github.com/GoranLovric/RiskWebinar2024>

¹ Link: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31978L0660>

² Link: https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.icaap_guide_201811.en.pdf

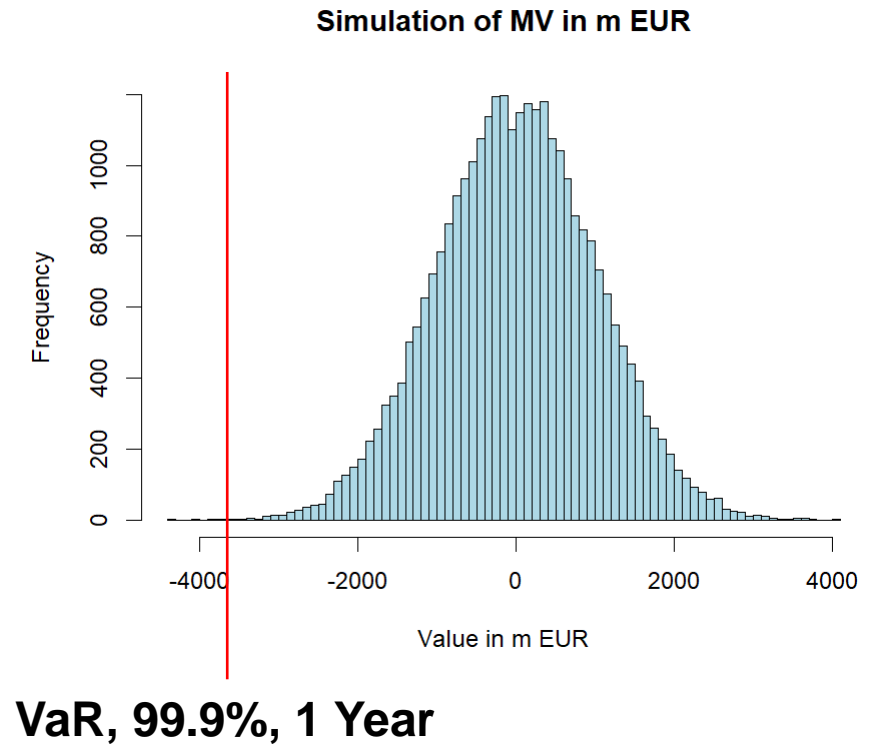
DCF – one-period model for participations (simplified)

CF Operations
CF Investments
CF Financing

Volatility of CF
Volatility of CoE
Correlation CF/ CoE

$$MV_i = \frac{CF_i}{CoE_i}$$

Interest Rate
Market-risk premium
Other premia (e.g. ESG,
SMEs, Liquidity)



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Data – Web scraping & Co

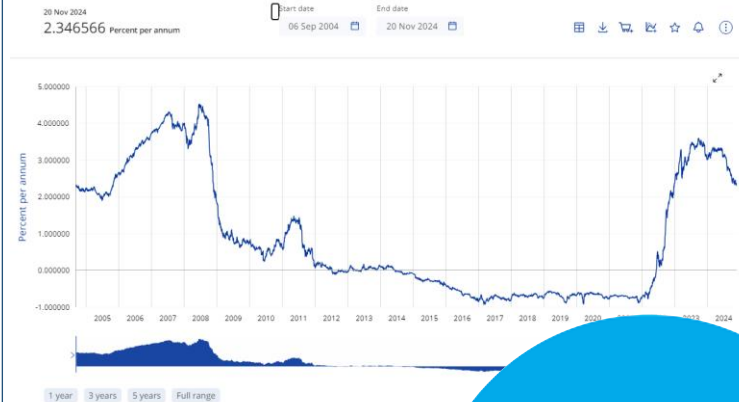
Cash Flows

e.g. Google Finance



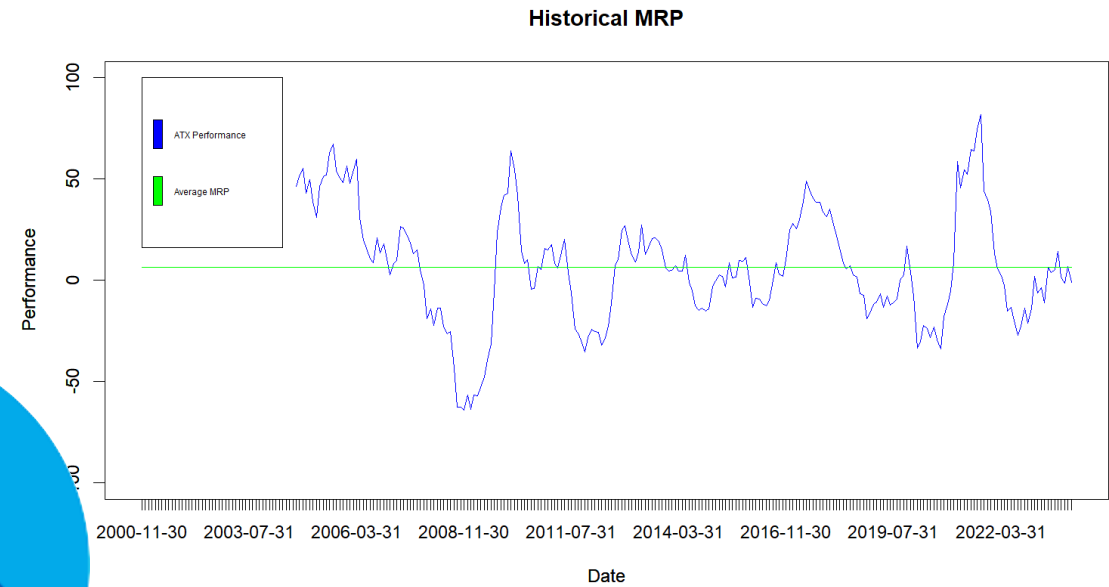
Interest Rates

e.g. European Central Bank



Market risk premia

e.g. Yahoo Finance + European Central Bank



Model

Name	Internal_ID	sigmaCoE	muCoE	sigmaCF	muCF	korr	MV	COE	Cashflow	Share	Peergroup
Company A	201	0.1483727	0.003599213	0.2791282	-0.002320812	0.6309883	7500	0.11688500	876.63750	0.0500	Food & Beverage
Company B	202	0.1302528	0.012554764	0.2521221	0.072334910	0.6352226	2150	0.11521000	247.70150	0.2500	Banks
Company C	203	0.1613737	0.005875139	0.2421230	0.110737184	0.8428299	350	0.08504000	29.76400	0.1150	Industrials
Company D	204	0.1651978	-0.025953300	0.2324753	0.022321054	0.8672789	1100	0.08650539	95.15593	0.1650	Consumer Discretionary
Company E	205	0.1370820	0.017295068	0.2715847	0.105776338	0.6570988	550	0.08750000	48.12500	0.9725	Utilities
Company F	206	0.1370820	0.017295068	0.2715847	0.105776338	0.6570988	25	0.08750000	2.18750	1.0000	Real Estate

	Food.&Beverage	Banks	Industrials	Consumer.Discretionary	Utilities	Real.Estate
Food & Beverage	1.0000000	0.58749374	0.3441181	0.50008701	0.5964876	0.5645150
Banks	0.5874937	1.00000000	0.8994789	0.05426503	0.1073679	0.7238690
Industrials	0.3441181	0.89947893	1.00000000	0.50817586	0.9608559	0.6862515
Consumer Discretionary	0.5000870	0.05426503	0.5081759	1.00000000	0.3449156	0.2037923
Utilities	0.5964876	0.10736793	0.9608559	0.34491555	1.00000000	0.4951692
Real Estate	0.5645150	0.72386900	0.6862515	0.20379229	0.4951692	1.0000000

Input data (see previous slide)

$x_1 = z_1$

$x_2 = \rho * x_1 + \sqrt{(1 - \rho^2)} * z_2$

$z_1, z_2 \dots N(0,1)$ (uncorrelated)
 $x_1, x_2 \dots$ correlated random variables

Uncorrelated random variables for CoE and CF

$CoE = \mu_{CoE} + z_1 * \sigma_{CoE}$

$CF = \mu_{CF} + z_2 * \sigma_{CF}$

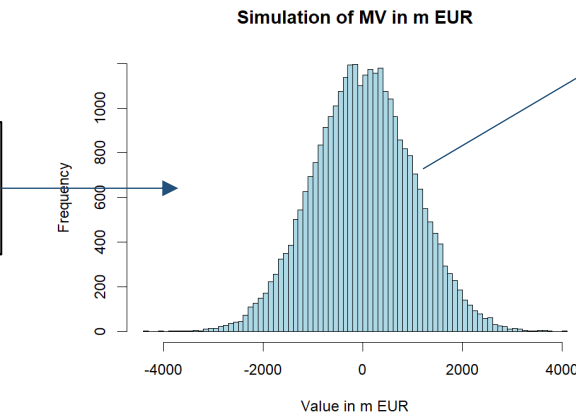
Correlated random variables for CoE and CF

$CoE = \mu_{CoE} + x_1 * \sigma_{CoE}$

$CF = \mu_{CF} + x_2 * \sigma_{CF}$

$$MV_i = \frac{CF_i}{CoE_i}$$

Input data (see previous slide)

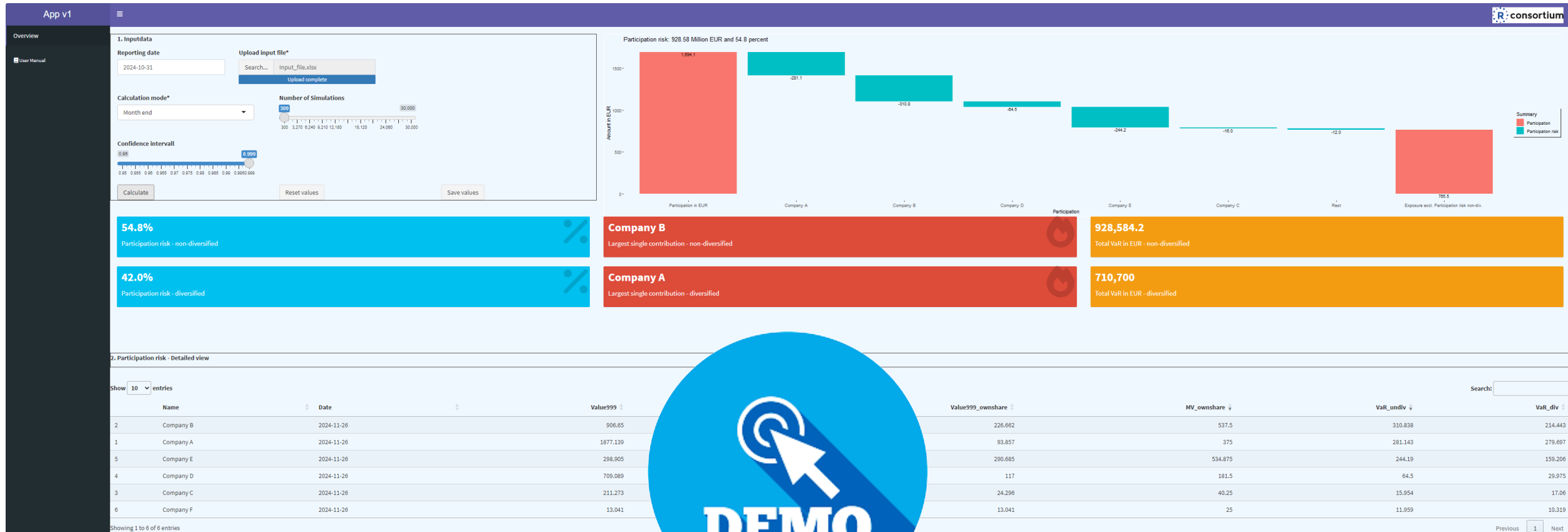


VaR, 99.9%, 1 Year, non-diversified

Marginal VaR

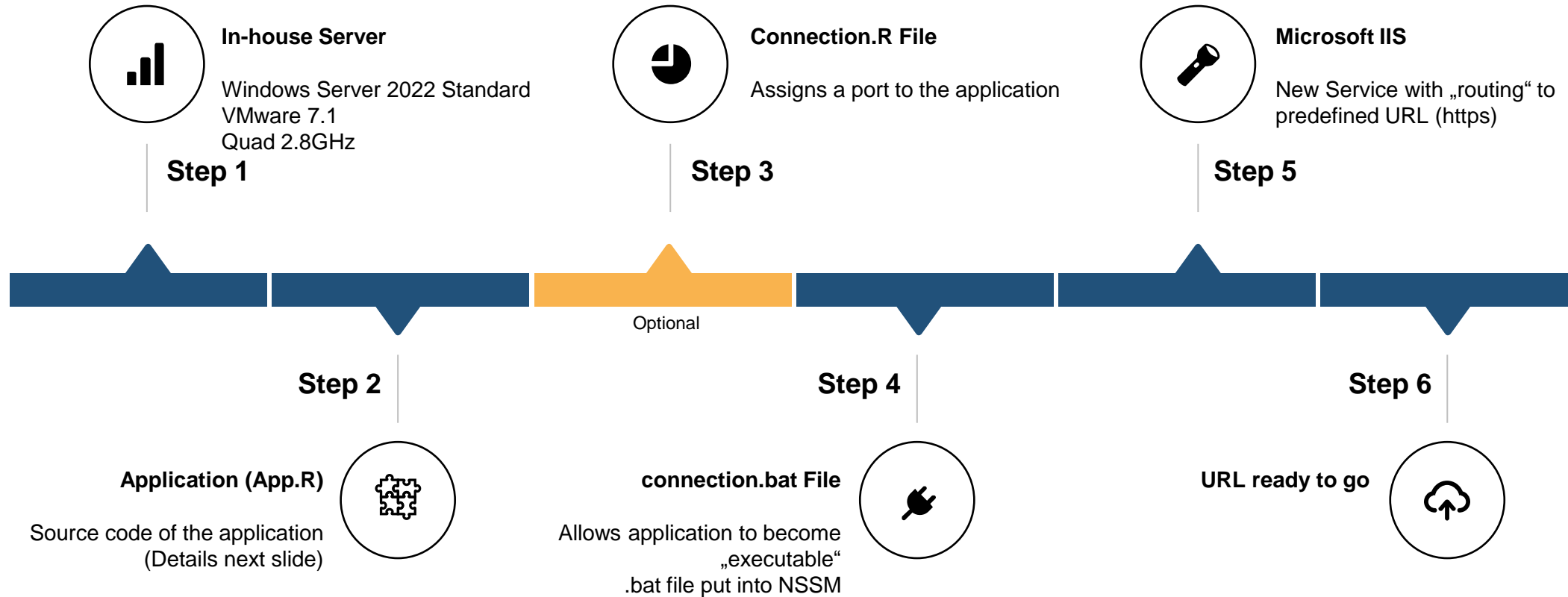
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Implementation in R and R Shiny



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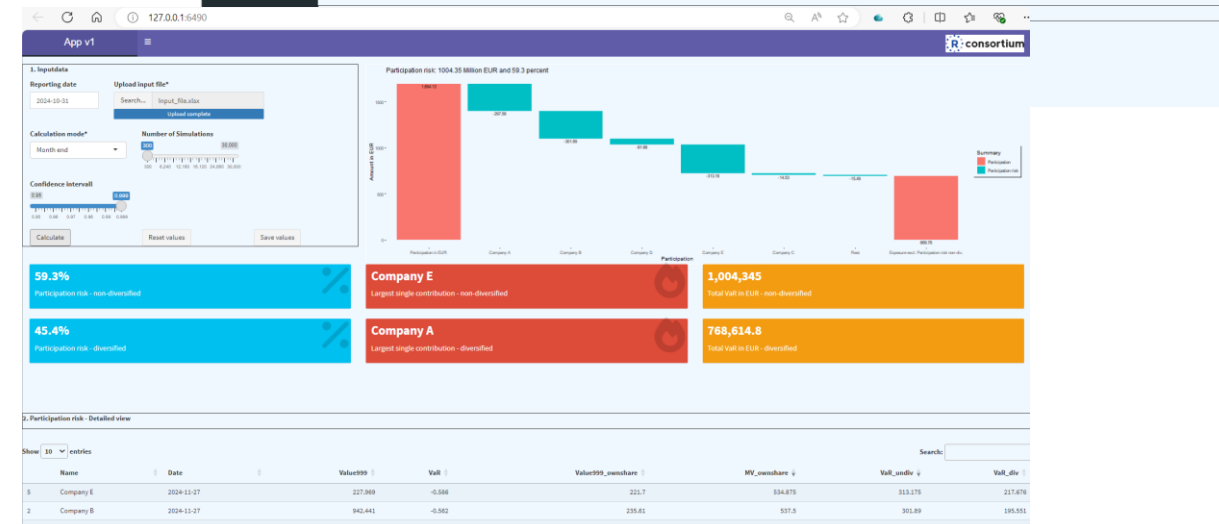
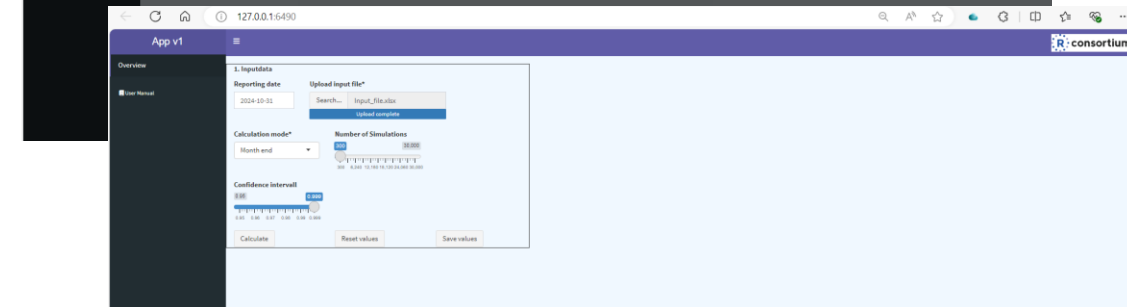
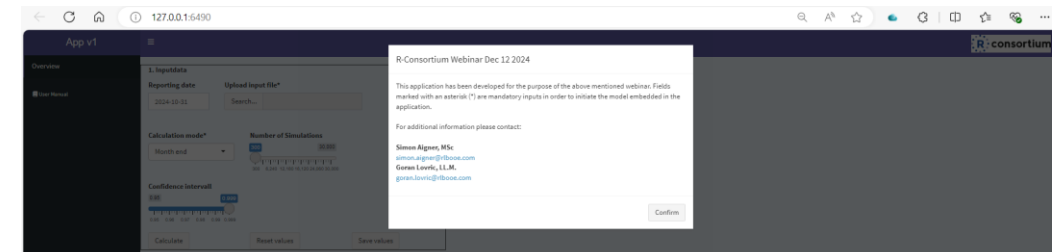
Deploying in a nutshell¹



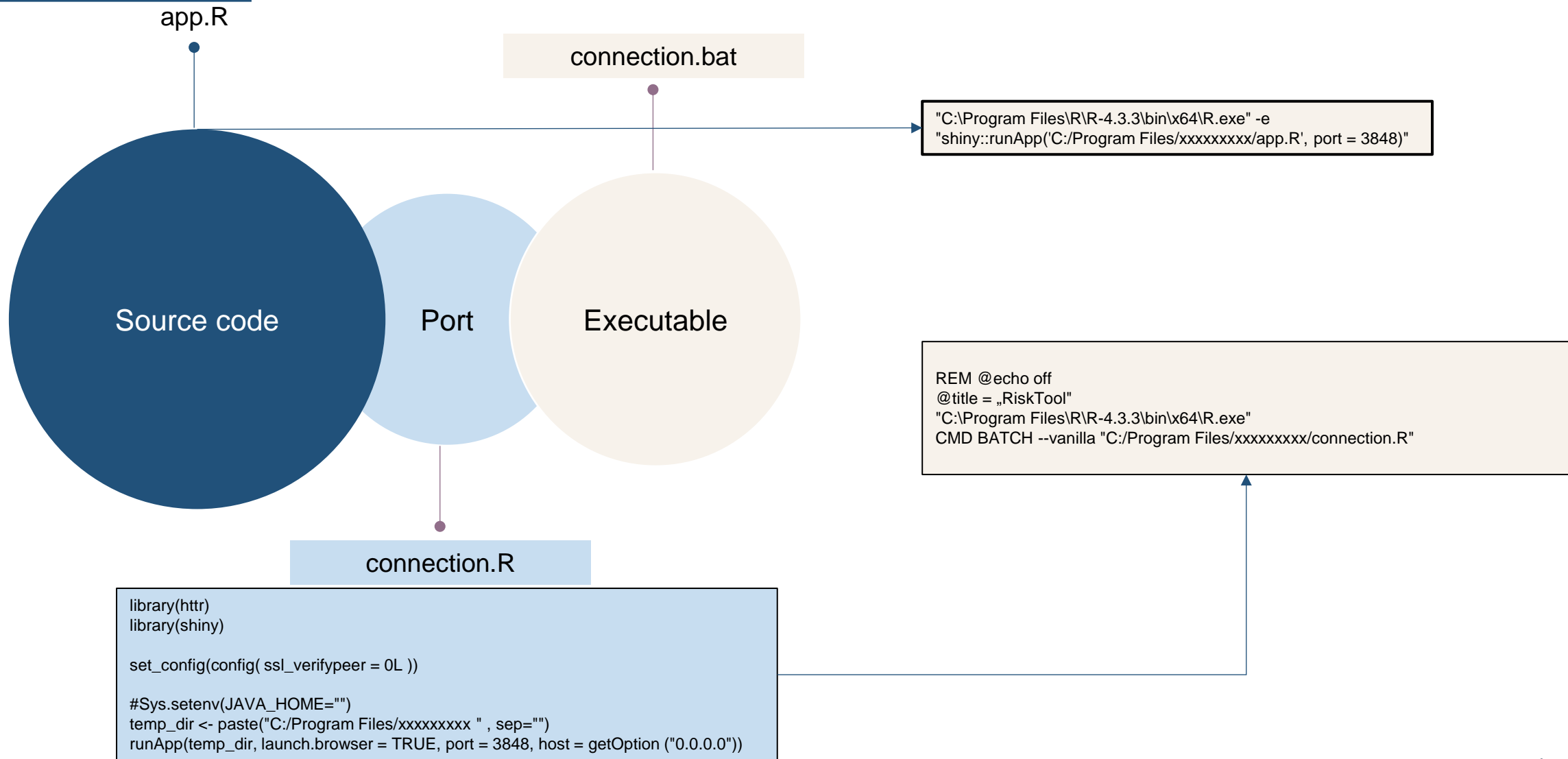
¹ SSRN link to **paper** describing details: <https://ssrn.com/abstract=4561635>

app.R (ui, server)

- Recommended packages: shinydashboard, shiny, shinyjs, shinyBS, DT, DBI
- Basis: **shinydashboard::dashboardPage**
 - **dashboardSidebar** for navigation
 - **dashboardBody** for dashboard and incident intake
 - **actionButton(s)** for initiating calculations, submit data, save data, send emails,...
- **shiny::reactiveValues** used to dynamically steer new cases
- **DBI::dbConnect** used to establish databases or connect to existing databases to save data, using **DBI::dbGetQuery** to query databases using SQL queries
- **Shiny::modalDialog** used for pop-up windows and details on submitted cases, that are presented as **DT::dataTableOutput**
- **Shinydashboard::renderValueBox** and **Shinydashboard::renderPlot** used for dashboard charts and boxes



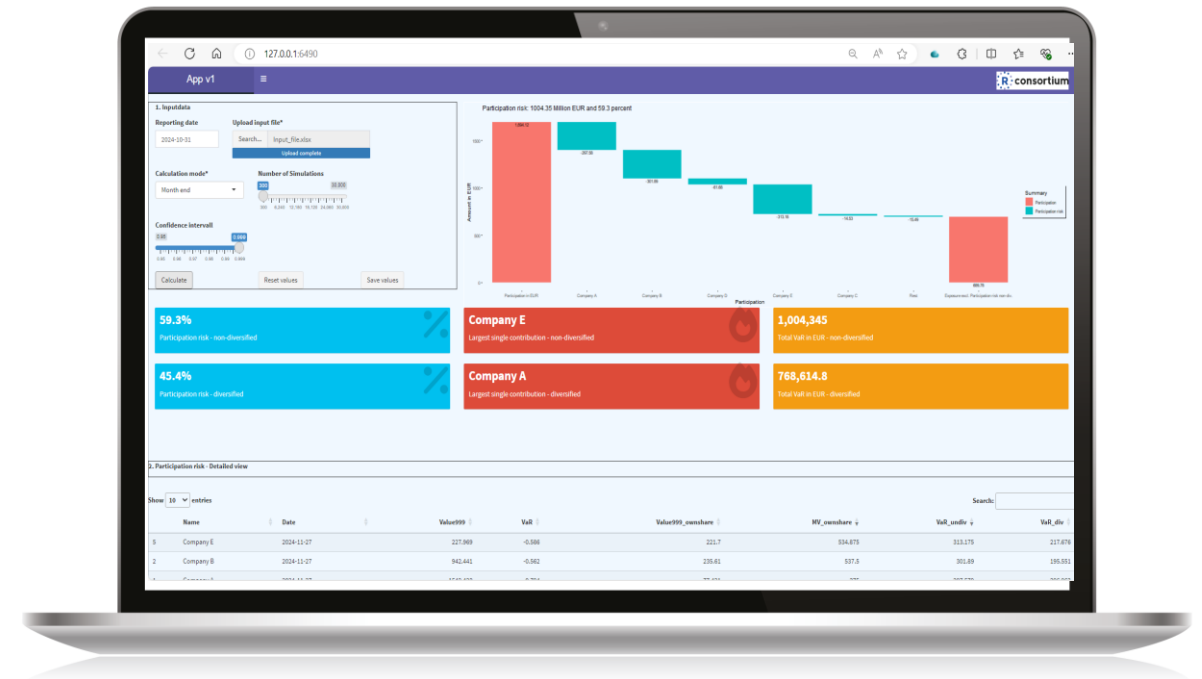
Connection files



Case Study¹: Quantification of participation risk

Functionality included in the tool

- Fully integrated model for risk quantification
- Dashboard
- Embedded database (.db)
- Training and governance-related materials
- Download-to-Excel function

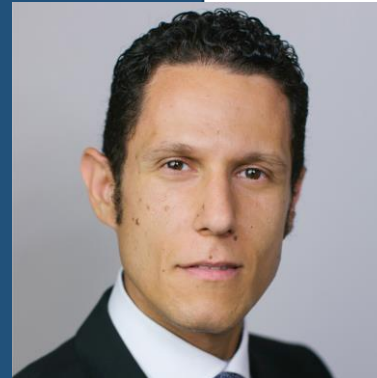


¹ Application available on GitHub: <https://github.com/GoranLovric/RiskWebinar2024>

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