**FIN305 Risk Management for Business – Group Project**
**(Worth 30% of the Total Grade)**
**----------This is a provisional version, subject to moderation----------**

## Learning Outcomes:

- *Undertake a critical analysis of risk from the viewpoint of the individual transaction, the business model and the organization.*
- *Describe and evaluate the effectiveness of a variety of approaches to risk financing, risk transfer and risk control, and the factors driving the corporate demand for such approaches.*
- *Identify and discuss the nature of various financial risks (such as market risk, interest rate risk, credit risk, liquidity risk, and operational risk) and recommend risk management solutions in the context of financial institutions.*
- *Identify, research and make appropriate use of source material relevant to organizational risk management, and use appropriate references to, and compile a bibliography of, such material.*

## Project Background

When measuring financial risk, value at risk (VaR) is commonly adopted within a firm or portfolio over a specific period. One problem is that one needs to know the joint distribution before applying various methods of VaR. However, the joint distribution of two or more assets is often unknown and complex. In practice, copula is applied to allow the joint distribution to consist of different margins and dependent structures.
Another feature in financial markets is heteroscedasticity, i.e. time-varying volatility, which is often fitted by GARCH-type models. A combination of GARCH and copula is frequently considered when computing VaR and has been shown to substantially outperform the traditional method in terms of the forecasting accuracy.

## Project Content

*Select a portfolio consisting of at least two risk factors of **equal weights**. The selection is flexible but a detailed justification for the selection of the portfolio is expected to provide in the main text, i.e. why the chosen portfolio is worth investigating? Some examples may be:*

- *Returns of stock indices: CAC 40, DAX 40, FTSE 100, Nikkei 225, S&P 500…: studies of the transmission of return and volatility shocks from one market to another and the cross-market correlations are crucially relevant in finance;*
- *Returns of individual stocks from a certain industry. Please see the classification outlined at the end of this document.*
- *Other portfolios as you wish*

The time span of the portfolio should be sufficiently long to cover at least 2 of the 3 disasters: 1) global financial crisis in 2007-2009; 2) European sovereign debt crisis in 2010-2012; 3) the Covid-19 in 2019-2020. Data of stock prices can be easily downloaded from Yahoo Finance.

In the project, you are expected to explain and implement the risk management related methodologies that are discussed in the module to real-world finance data. Details are given below:

- *Estimating a GARCH-type model with the capacity to capture the evolution of volatility of each individual component of the portfolio over the specified time horizon; an appropriate choice of volatility models needs to be discussed in detail*
- *Filtering the returns by fitting the GARCH model above to get the residuals and standardize the residuals by the corresponding standard deviations to obtain the standardized residuals. Deducing the marginal distributions of each standardized residuals within the portfolio and then applying the Gaussian copula to link the marginal distributions together into a multivariate distribution*
- *Implementing the Monte Carlo simulation approach to find estimates of the portfolio VaR (hint: do not forget to reintroduce the heteroscedasticity observed in the original returns using again the GARCH model to get the simulated returns.)*

  *Bonus marks (5-10 marks) will be awarded during the marking process if the following efforts are demonstrated in the project: a) the use of the t-copula and a thorough comparison between the normal- and t-copula; b) implementation of backtesting procedures by comparing daily losses with daily VaR estimates. The latter is to evaluate the performance of the GARCH-copula approached adopted in the project.*

  *See "Lecture 3: Volatility" and "Lecture 5: Market Risk - Dependence of Asset Returns" and cite relevant literature when needed*

**How to create groups**

Each project group shall include 3-4 students. Students are free to choose their group members till 20 October, 2021.

**Project Outputs**

**Report (100 Marks).** The project report should include the following sections: An introduction, a literature review of the methodology, a very detailed explanation of the methodology, implementation of the methodology on data, discussion, references and Appendix (source code of the implementation). Moreover, it must contain a minimum of 2000 words and a maximum of 4000 words (references, tables and appendix are not

counted). Furthermore, each group must fill in and sign the group contribution form together with the submission (the form is attached at the end of this document).

**Assessment**

The final mark will be based on the instructor's evaluation of the report using the following criteria:

- *The literature review is critical and extensive*
- *The methodology is explained with sufficient details (all the necessary formulas are given with clear explanations and numerical examples are provided)*
- *The construction of portfolio is well justified.*
- *The source for the data is clearly specified along with clear explanations on the features of the data (a descriptive statistics of the data is also present)*
- *Numerical results are very clear and interpreted for the reader*
- *Figures and tables (created by the authors of the report) are also used to explain the numerical results*
- *The conclusion section summarizes the ideas of the methodology explained along with important numerical results*
- *References are listed alphabetically by the last name of authors and follows a standard (Harvard referencing style is recommended)*
- *The source code is included and is written neatly and commented*

Table 1 shows how the overall mark of a hypothetical student is calculated for the group project.

**Table 1 Student mark summary for the group project**

Suppose you had a 4-member group. The group earned an 80 on the report. The default assumption is each person contributed 25%. The grades will be adjusted by the percentage above or below the presumed percentage as follows:

| **Individual Name:** | **%Contribution (X)** | **Grade** 80+80*(X-25%) |
|---|---|---|
| **Joe** | **25%** | 80 |
| **Jane** | **25%** | 80 |
| **Mike** | **35%** | 80+80*10%=88 |
| **Sue** | **15%** | 80+80*(-10%)=72 |
| | **100%** | |

Note: In case that you cannot reach a consensus, I will meet with all members of a group at one time. I hope that I will not have to do this because I am not privy to the group's actual contributions and would prefer you coming to a consensus by yourselves. The module leader reserves the rights to make special adjustments for individual marks in extreme cases.

**Appendix A**

## GROUP MEMBER CONTRIBUTION FORM

FIN305 – Group Assignment

The purpose of this document is to provide each group with an opportunity to reward or punish an individual's contribution to the group. All members of the group should discuss this form, fill in this form as directed, sign this form, and submit it with the report as the coversheet.

- **Option 1: We agree that all group members made a valuable contribution and therefore believe it is fair that each member receive the same grade for the group project.**

- **Option 2. We disagree that all group members made a valuable contribution. Please adjust our grades based on the following percentage of contribution.**

| **Individual Name (print):** | **%Contribution to the group project** |
|---|---|
| | **%** |
| | **%** |
| | **%** |
| | **%** |
| | **%** |
| | **%** |
| | **100%** |

## Signatures:

**1.**_____

**2.**_____

**3.**_____

**4.**_____

**Appendix B**

# Assessment Form for FIN305
# Group Coursework (For Tutor Use)

Group ID

| |
|---|
| |

| | Max Points | Marks |
|---|---|---|
| **Final Report** | | |
| ***Academic Content*** | | |
| Introduction and conclusion, putting in context | 5 | |
| Review of the relevant literature | 5 | |
| A clear description of the data employed | 5 | |
| Estimation of the GARCH-type model(s) | 15 | |
| Implementation of the Copula-GARCH model | 15 | |
| Estimation of portfolio VaR using the Monte Carlo simulation approach | 20 | |
| Interpretation of the numerical results | 20 | |
| A clear presentation of the source code | 5 | |
| ***Written Presentation*** | | |
| Clarity of presentation, ease of reading and style | 5 | |
| Demonstration of figures and tables, a good use of references | 5 | |
| **Reduction for Late Submission** | | |
| **Total Marks**<br>Please add up | **100** | |
| **Comments:** | | |

## Appendix c

| Consumer Discretionary | | Consumer Staples | | Energy | | Financials | | Health Care | |
|---|---|---|---|---|---|---|---|---|---|
| AMZN | Amazon.com Inc | AVP | Avon Products | BHI | Baker Huges | ALL | Allstate Corp | ABT | Abbott Laboratories |
| BBY | Best Buy Co. Inc. | BFB | Brown-Forman Corp. | CHK | Chesapeaks Energy | AXP | American Express | AMGN | Amgen Inc |
| DIS | Walt Disney | COST | Costco | CVX | Chevron Corporation | BAC | Bank of America | BSX | Boston Scientific |
| GPS | Gap (The) | EL | Estee Lauder Cos. | DVN | Devon Energy Corp | BK | The Bank of NY Mellon | GILD | Gilead Sciences |
| HD | The Home Depot | KMB | Kimberly-Clark | HAL | Halliburton Co. | C | Citigroup Inc. | HUM | Humana Inc. |
| IPG | Interpublic Group | KO | Coca-Cola | OXY | Occidental Petroleum | GS | Goldman Sachs Group | JNJ | Johnson & Johnson |
| MAR | Marriott Int'l. | PEP | Pepsi Co Inc. | SUN | Sunoco Inc. | JPM | JPMorgan Chase | MDT | Medtronic Inc |
| MCD | McDonald's | PG | Procter & Gamble | TE | TECO Energy | MS | Morgan Stanley | MRK | Merck |
| NWSA | News Corporation | UL | Unilever | WMB | Williams Cos. | TRV | Travellers | PFE | Pfizer |
| TWX | Time Warner Inc. | WMT | Wal-Mart | XOM | ExxonMobil | WFC | Wells Fargo | UNH | United Health Group |
| **Industrials** | | **Information Technology** | | **Materials** | | **Telecommunications Services** | | **Utilities** | |
| BA | Boeing | AAPL | Apple Inc. | AA | Alcoa | AMT | American Tower Corp A | AEP | American Electric Power |
| CAT | Caterpillar | CSCO | Cisco Systems | AKS | AK Steel Holding Corp | BT | BT Group plc (ADR) | CEG | Constellation Energy Group |
| CMI | Cummins Inc. | DELL | Dell Inc. | DD | DuPont | CTL | CenturyTel Inc | DUK | Duke Energy |
| GD | General Dynamics | EMC | EMC Corp. | DOW | Dow Chemical | FTR | Frontier Communications | ETR | Entergy Corp. |
| GE | General Electric | HPQ | Hewlett-Packard | FCX | Freeport-McMoran | Q | Qwest Communication Int | EXC | Exelon Corp. |
| HON | Honeywell Int'l Inc. | IBM | IBM | IP | International Paper | S | Sprint Nextel Corp | OKE | ONEOK |
| LUV | Southwest Airlines | INTC | Intel Corp. | NEM | Newmont Mining | T | AT & T | PCG | PG & E Corp. |
| MMM | Minnesota Mining & Mfg Co | MSFT | Microsoft | NUE | Nucor Corp. | TEF | Telefonica S.A. (ADR) | PEG | Public Serv. Enterprise Inc. |
| UPS | United Parcel Service | ORCL | Oracle Corp. | WY | Weyerhauser Co | VOD | Vodafone Group Plc (ADR) | PGN | Progress Energy, Inc. |
| UTX | United Technologies | XRX | Xerox Corp. | X | United States Steel Corp. | VZ | Verizon Communications | SO | The Southern Company |