SL Analytics Academy

Quantitative Research Methods

Fundamental Approaches

Fundamental Approaches

Quantitative Research Methods

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The authors have the permission of OSL Risk Management (www.oslriskmanagement.com) and Real Option Valuations (www.realoptionsvaluation.com) to use figures, layouts and results from *Risk Simulator* and *BizStats* (advanced analytical software for quantitative research) to provide recommendations and support the methodologies described throughout this document.

Content:

Risk Simulator

www.oslriskmanagement.com/product/risk-simulator/
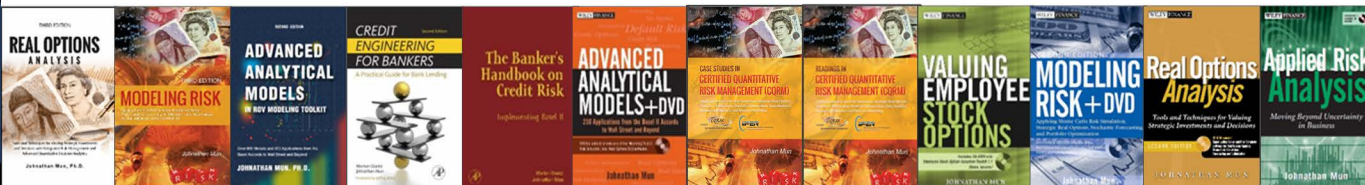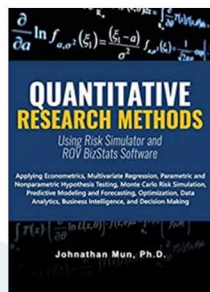
BizStats

https://oslriskmanagement.com/product/bizstats/

Fundamental Approaches

Quantitative Research Methods

* In this white paper, you can quickly explore different techniques and tools to enhance your quantitative research skills

* The goal is to define **what** type of quantitative methods, (including **when, how,** and **why**) can be used to analyse numerical data, find patterns, run Monte Carlo simulations, make predictions, test causal relationships, and generalize results to wider populations

* Using the right statistical tools and numerical methods increase the possibilities of completing a research degree or getting your research published

* Always keep your research goals clear and consistent when conducting quantitative research, which allows enhancing your storytelling

Want to be a Successful Researcher? Focus on Quantitative Methods to support your research questions

"Test and validate your hypotheses"

Prof. Dr. Johnathan Mun
PhD, MS, MBA, BS, CQRM, FRM, CFC, MIFC

Linkedin

ResearchGate
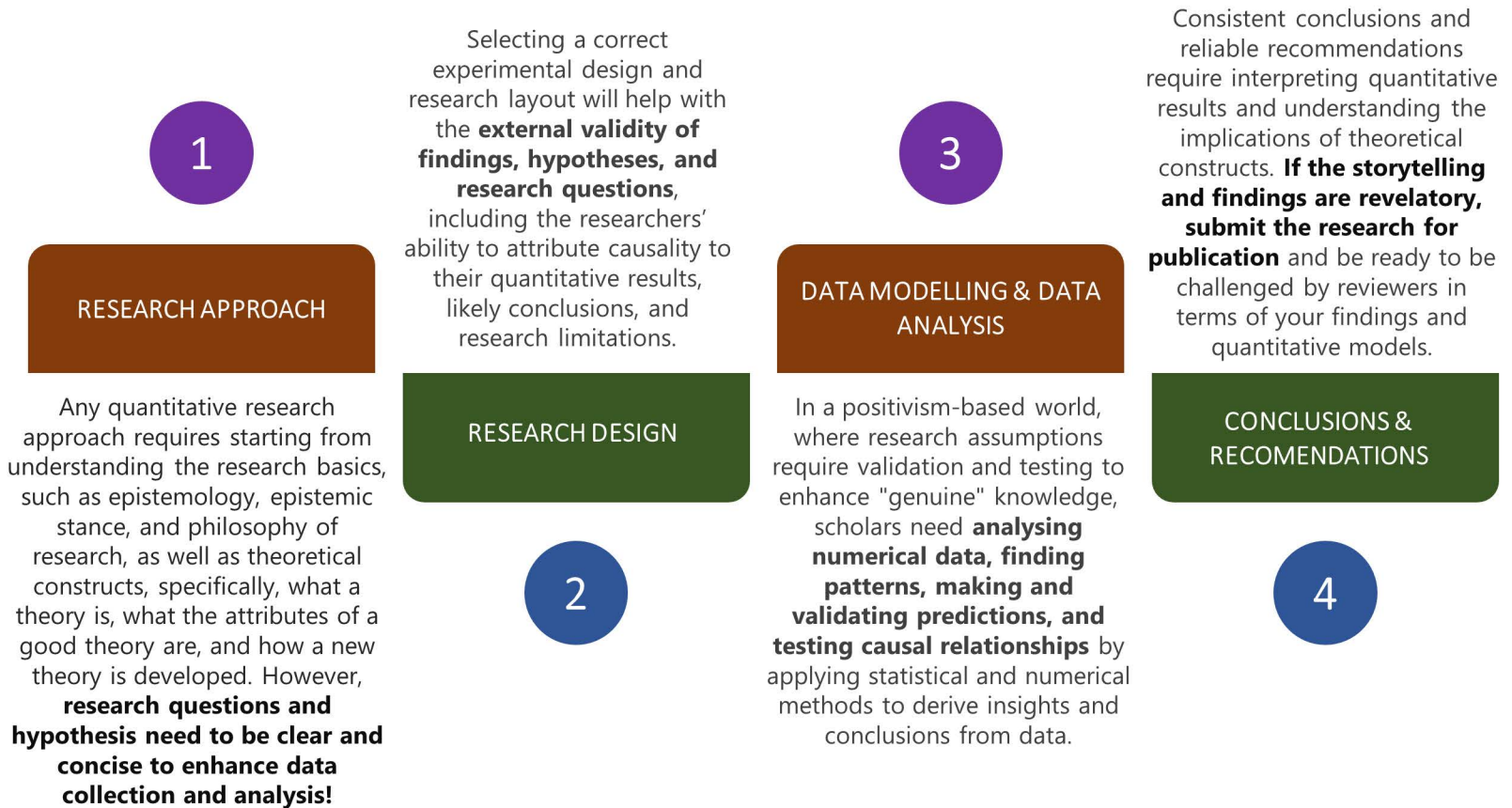
Free Master Class
...ly Statistical and
...cal Methods

* CEO, Real Options Valuation, Inc.
* Chair, IIPER International
* Director of OSL Risk Management (UK)
* Full professor at the U.S. Naval Postgraduate School.
* Author | Inventor | Risk Specialist | Researcher

Some useful references for Quantitative Research Methods

Quantitative Research Process
| From Theory and Questions to Conclusions

1

RESEARCH APPROACH

Any quantitative research approach requires starting from understanding the research basics, such as epistemology, epistemic stance, and philosophy of research, as well as theoretical constructs, specifically, what a theory is, what the attributes of a good theory are, and how a new theory is developed. However, **research questions and hypothesis need to be clear and concise to enhance data collection and analysis!**

Selecting a correct experimental design and research layout will help with the **external validity of findings, hypotheses, and research questions**, including the researchers' ability to attribute causality to their quantitative results, likely conclusions, and research limitations.

RESEARCH DESIGN

2

3

DATA MODELLING & DATA ANALYSIS

In a positivism-based world, where research assumptions require validation and testing to enhance "genuine" knowledge, scholars need **analysing numerical data, finding patterns, making and validating predictions, and testing causal relationships** by applying statistical and numerical methods to derive insights and conclusions from data.

Consistent conclusions and reliable recommendations require interpreting quantitative results and understanding the implications of theoretical constructs. **If the storytelling and findings are revelatory, submit the research for publication** and be ready to be challenged by reviewers in terms of your findings and quantitative models.

CONCLUSIONS & RECOMENDATIONS

4
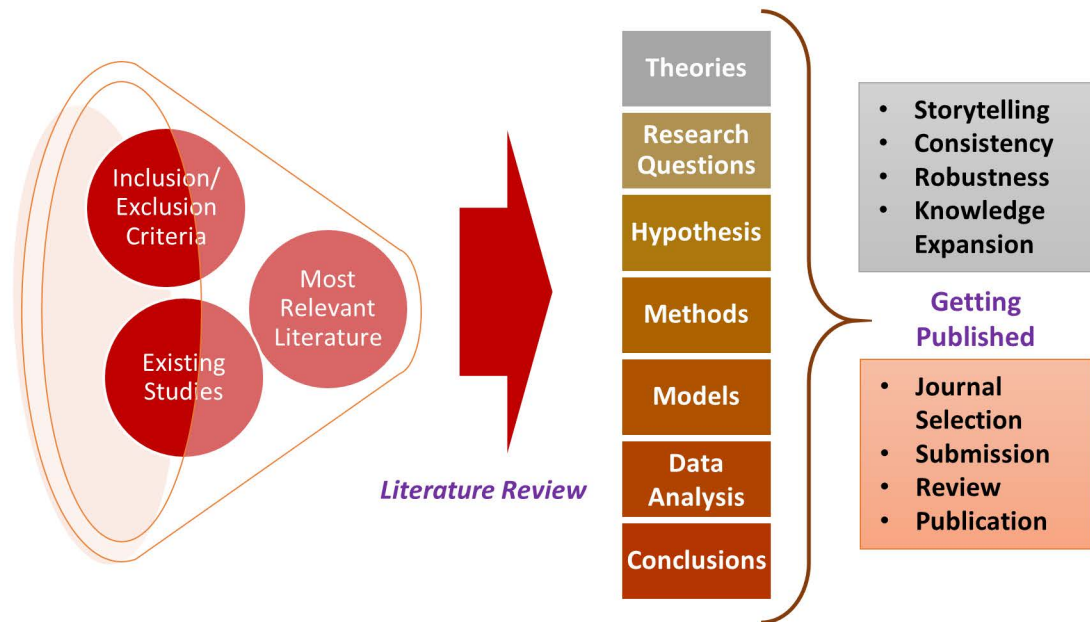
QUANTITATIVE RESEARCH PROCESS

1

RESEARCH APROACH

Intersection between philosophy, designs, and methods

- ✓ Selecting an appropriate *research approach* requires conducting thoroughly literature reviews to position your potential study within the current literature and supporting theories

- ✓ *Literature reviews* (conventional and/or systematic) are essential to support your questions and analysis (your purpose), as well as your broad assumptions and detailed quantitative methods for data collection and analysis

- ✓ *Quantitative research* is a way to challenge the conventional view of the "*absolute truth of knowledge"* (*Phillips & Burbules, 2000*)

Phillips, D. C., & Burbules, N. C. (2000). *Postpositivism and educational research*. Lanham, MD: Rowman & Littlefield.

Inclusion/ Exclusion Criteria

Most Relevant Literature

Existing Studies

Literature Review

| Theories |
| Research Questions |
| Hypothesis |
| Methods |
| Models |
| Data Analysis |
| Conclusions |

- • **Storytelling**
- • **Consistency**
- • **Robustness**
- • **Knowledge Expansion**

Getting Published

- • **Journal Selection**
- • **Submission**
- • **Review**
- • **Publication**

Quantitative research allows testing theories by examining the relationship among variables, using data and numerical methods or statistical procedures. Although **Qualitative research**, focused on open-end questions and responses, also helps to understand problems attribute to complex situations, many scholars are embracing **Mixed methods research** to provide additional insights beyond quantitative or qualitative research alone. However, note that the quantitative approach is the dominant form of research mainly because it provides protection against bias, which is increased when using mixed methods research. *It's time to boost your quantitative research skills!*
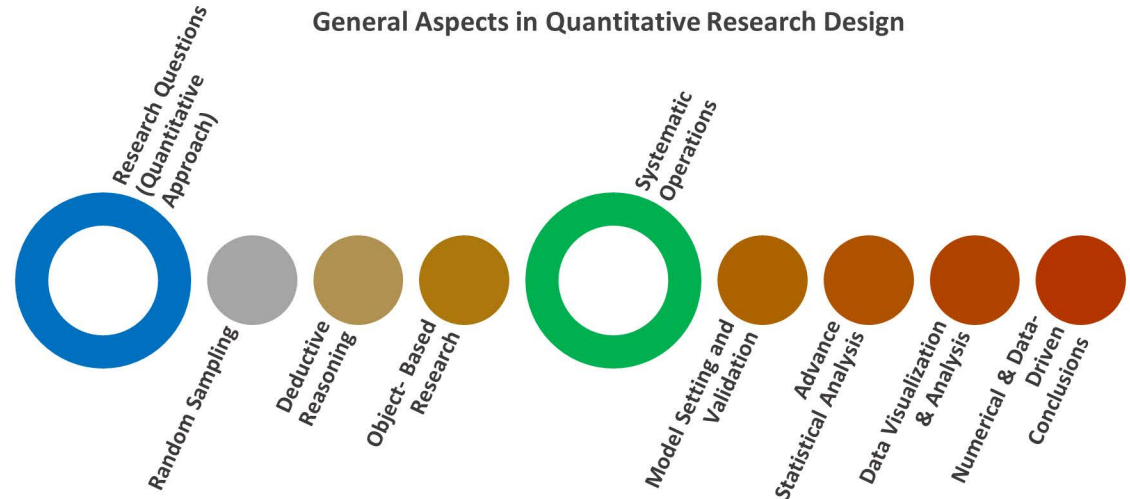
RESEARCH DESIGN

Strategies of investigation "inquiry"

- ✓ Because of computer and software developments, research designs have improved scholars' capabilities for data analysis, complex modelling, and new procedures for conducting quantitative research.

- ✓ Researchers need to understand how forms of data collection, analysis, and interpretation enhance their proposed study. Therefore, they need to be able to interpret statistical results, implement numerical methods, and make sense of themes and patterns that emerge from data and numerical methods.

"The right methodology increases the validity of research. Consequently, your findings will have credibility, replicability and transparency"
Prof. Dr. Johnathan Mun

General Aspects in Quantitative Research Design

- Research Questions (Quantitative Approach)
- Random Sampling
- Deductive Reasoning
- Object- Based Research
- Systematic Operations
- Model Setting and Validation
- Advance Statistical Analysis
- Data Visualization & Analysis
- Numerical & Data- Driven Conclusions

Quantitative Research Designs invoke a postpositivist worldview and include different approaches like true experiments, quasi-experiments, applied behavioural analysis, causal-comparative research, correlational design, and applications of numerical methods, among other. A good quantitative researcher needs to understand equation modelling, regression analysis, Monte Carlo simulations, optimizations, decision analytics, and experiment designs, to name a few, as well as how to use time-series, cross-sectional, and transversal data approaches to examine the development of ideas, models, and trends.

RESEARCH DESIGN AND STRATEGIES

3

DATA MODELLING & DATA ANALYSIS

Producing trustworthy conclusions

- ✓ In *Quantitative methods*, researchers need to have the skills to develop models, and therefore, to collect, process, analyse, and interpret the findings of a study

- ✓ Do not forget to include, at least, descriptive analysis of data for the considered variables (means, standard deviations, ranges, etc), and identify outliers and missing data and their correction

- ✓ Parametric and non-parametric statistical tests, precision, accuracy, and sensitivities, among other indicators provide strength to the research questions and hypothesis in your analysis

Design of experiments provide a standard research layout for master's theses, doctoral dissertations, and academic journal articles

Experimental Design (Research Layout)

Computing **distributional statistics,** including skewness and kurtosis of your data, helps to detect outliers and potential biases in your dataset

Descriptive Statistics

Counting rules, permutations, **dependent and independent probability events**, and Bayesian probability help to analyse uncertainty in research studies

Basic Probability and Probability Rules

In **Simulation-based research**, selecting a statistical distribution (i.e., normal, Gamma, Weibull, Poisson) helps to describe the probability that a variate takes on a value less than or equal to a number, for example.

Probability Distributions

Quantitative Methods focus on carefully measuring (numerically or experimentally) variables (independent or dependent) and inputs or outputs to answer theory-guided research questions and hypotheses. Note that the meaning of the finding and results come from reporting and extensively analysing the descriptive statistics, statistical significance tests (t test, F-test, Chi-Square, and so on), effect sizes, confidence intervals, and goodness of fit, among other indicators, to support inferences being applied to the population and the consistency of the results.
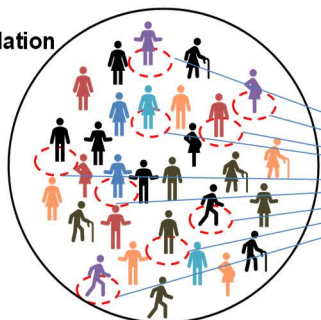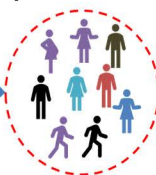
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**DATA MODELLING &
DATA ANALYSIS**

Producing trustworthy conclusions

- ✓ In Quantitative Research, *Hypothesis testing* assesses the likelihood of a hypothesis or research question by analysing data
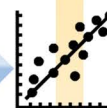- ✓ Scholars test a hypothesis by examining a random sample of the population being analysed

Population

Sample

Research requires **confidence intervals and *p-value* approaches** to test and validate a hypothesis. However, what a hypothesis actually means (predictive statements) needs to be clearly stated through a literature review and theoretical support

Hypothesis Testing

Parametric and Nonparametric Statistics

Multivariate Analysis and Regression Models mostly assume underlying statistical distributions in the data (parametric tests). However, when the parametric conditions of validity are not met, researchers need to use nonparametric approaches to interpret their findings

Any researcher should be able to say if the results are valid, if the results and the conclusions are reliable, or if the data being used to derive the results are trustworthy; **reliability and validity** help to evaluate research quality

Validity and Reliability

Forecasting and Predictive Modelling

Predictive modelling also supports quantitative researchers in running or developing mathematical and statistical processes (Markov chains, ARIMA models, neural networks, regression models, fuzzy logic, GARCH models, etc.) to predict future events or outcomes by analysing patterns and trends

QUANTITATIVE METHODS APPLIED TO RESEARCH

3

DATA MODELLING & DATA ANALYSIS

Producing trustworthy conclusions

- ✓ Understanding **Quantitative methods** not only helps you to determine the relationship between independent and dependent variables, but also provides you with computational techniques and numerical methods to explain a particular phenomenon
- ✓ Quantitative research deals with numbers, logic, and objective statements, which help in replicating the study (reliability)
- ✓ Generalizing of concepts, expanding knowledge, predicting future results, or investigating causal relationships are essential in quantitative research

In Quantitative Research, Monte Carlo simulation helps scholars to use randomness in complex models, risk management studies, uncertainty analysis, and stochastic problems, including correlation assumptions

Monte Carlo Simulation

Robustness and Decision Support

Advanced decision analytics, such as tornado analysis, dynamic sensitivity analysis, nonparametric bootstrap simulations, and decision trees enhance research robustness and managerial applications

Finding the best combination and permutation of decision variables, subject to constraints to optimise a decision problem, requires running static, dynamic, or stochastic optimizations to determine the best or most effective use of a situation or resource

Mathematical Programming and Optimization

Software Support

Nowadays research dimensions are quite diverse, and selecting the right software can facilitate data management, model setting, data analysis, hypothesis testing, and numerical reports to support your findings and conclusions

Risk Simulator   *BizStats*

Risk Simulator (RS) is a powerful Excel add-in that offers a large number of integrated quantitative methods for regression analysis, Monte Carlo simulation, forecasting, statistical analysis, decision trees, data science, and optimization (*all-in-one tool*). RS also contains **BizStats**, a quantitative research tool for applied statistics comprising over 500 algorithms and over 200 analytical tools with predefined examples to support scholars and universities. Get your **Free Trial Version** here: www.oslriskmanagement.com/product/risk-simulator/

4

CONCLUSIONS & RECOMENDATIONS

Persistence is essential to get research findings out there!

- ✓ *Quantitative Methods* provide emphasis on how quantitative results leads to conclusions and recommendations
- ✓ Researchers draws conclusions from the data, models and results to support research questions and hypotheses
- ✓ Do not forget to acknowledge the research implications of the findings (practice and future research), and discuss their theoretical and practical implications, limitations, and related recommendations

General Process to get your quantitative research published

Mastering **Quantitative Methods** strongly increases the possibilities of completing an academic degree or getting research published. Having consistent and well-supported quantitative results and conclusions, directly linked to your hypothesis and research questions, helps to tell a good story. Effective storytelling is the number one tip for getting published. Choose the right journal and note that a journal is an external auditor to review your research project.

Quantitative Research Methods
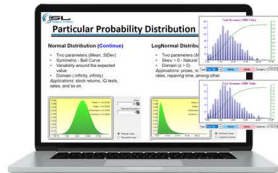## Enhancing Your Research Skills

Find more about Quantitative Methods Applied to Research in this Free Masterclass: **OSL Analytics Academy**

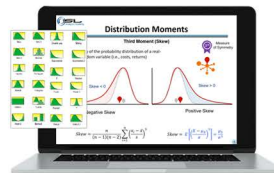**20** Units to **MAXIMIZE YOUR RESEARCH POTENTIAL**

Unit 1-2
General Overview in Quantitative Research

Unit 3-5
Experimental Design and Statistics

Unit 6-8
Probability Theory and Distributions Analysis

Unit 9-10
Hypothesis Testing and BizStats

Unit 11-13
Parametric and Nonparametric Analysis

Unit 14
Validity and Reliability

Unit 15-16
Forecasting and Predictive Modelling

Unit 17-19
Monte Carlo Simulation and Advance Analytics

Unit 20
Optimization

Learn to perform quantitative research using:
Econometrics, Multivariate Regression, Parametric and Nonparametric Analysis, Hypothesis Testing, Monte Carlo Risk Simulation, Predictive Modelling and Forecasting, Optimization, Data Analytics, Business Intelligence, and Decision Modelling for Graduate, Doctoral, Postgraduate Research Students, Scholars, and Professionals

Quantitative
Research Methods
Enhancing Your Research Skills

Testimonials

" Clearly organized training in "Quantitative Research Methods", which covers a large number of numerical and statistical methods applied to research. Hands-on **BizStats** and Risk Simulator definitely provide a plus to get useful analysis and conclusions from the data. "

⭐⭐⭐⭐⭐

Associate Professor
Dr Luis Enrique Pedauga

" Outstanding training! Full range of flexible methodologies to conduct quantitative research. Dr Mun emphasizes multiple objective measurements and statistical methods to formally test hypotheses, run simulations and make predictions. "

⭐⭐⭐⭐⭐

Lecturer in Accounting and Finance
Dr. Rexford Attah-Boakye

" A step-by-step approach to help scholars and professionals to implement quantitative methods into research. The software applications used during the course are powerful tools to analyse data, study our variables, validate our models, and support our findings. "

⭐⭐⭐⭐⭐

Research Fellow European Commission
Dr Agustin Velazquez

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Risk Simulator with BizStats

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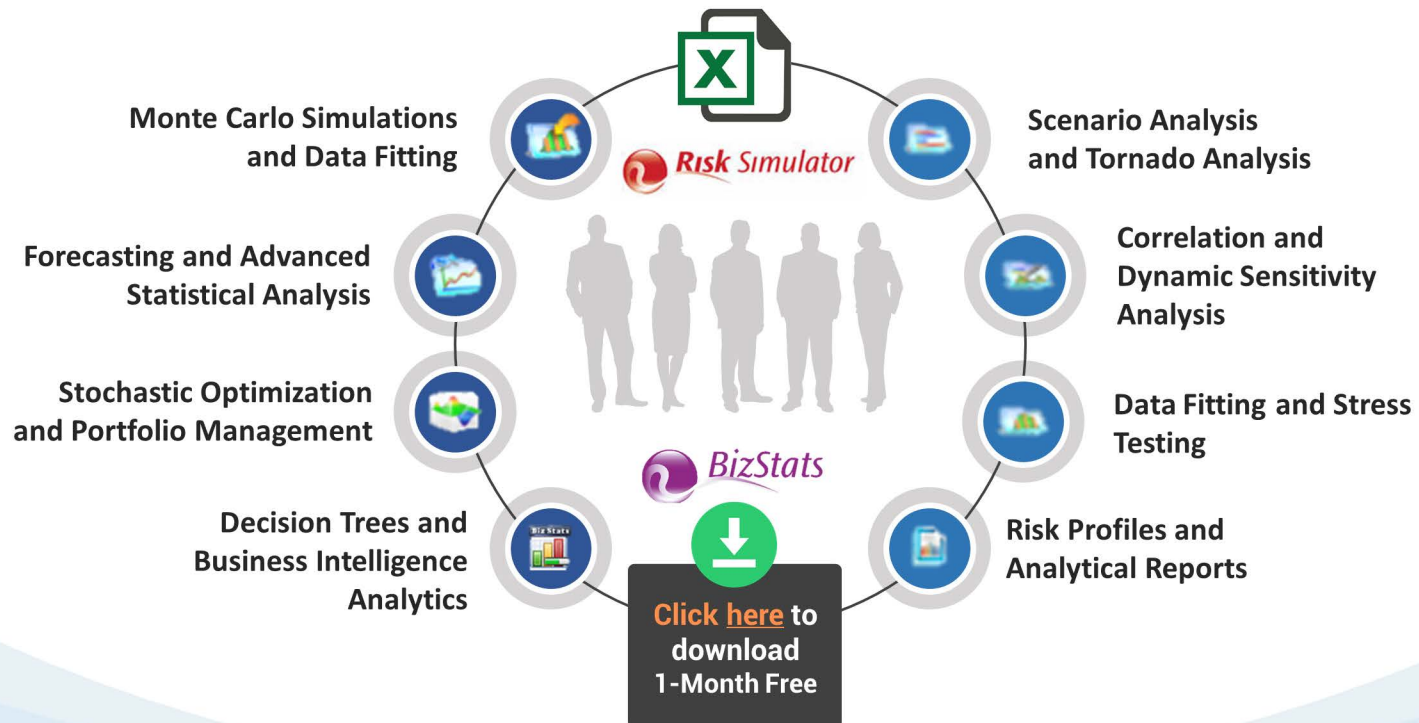
Integrate Quantitative Methods and apply statistical and numerical methods to research.

Quantitative Methods

Analytical Tools

Risk Simulator

BizStats

Monte Carlo Simulations and Data Fitting

Forecasting and Advanced Statistical Analysis

Stochastic Optimization and Portfolio Management

Decision Trees and Business Intelligence Analytics

Scenario Analysis and Tornado Analysis

Correlation and Dynamic Sensitivity Analysis

Data Fitting and Stress Testing

Risk Profiles and Analytical Reports

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