

# Preface

Mathematics has long played a major role in human history and is at times confused with philosophy. As the only truly universal language, mathematics is found in a wide variety of subjects such as art, business, economics, encryption, music, science, and technology. The field also develops creativity, logic, problem solving, and reasoning which, in turn, spurs development in numerous ways. The laws of mathematics have been discovered and employed over aeons by great thinkers such as Einstein, Euler, Gauss, Nash, Newton, Pythagoras, and Ramanujan who have implemented applied and/or theoretical (pure) mathematics into their different contributions.

Mathematical literacy drives economic growth and international business today is a large component of that growth. In an era of global hypercompetition, the continued development and use of mathematics in international business holds increasing importance at the regional, national, local, and corporate levels. Therefore, the purpose of this publication is to examine some different areas and applications of mathematics within the field of international business that we trust will spur additional research for future benefit to all concerned. Some chapters covered in this book involve unique topics such as drug trafficking and encryption which may not normally be considered in international business; however, the reader will be able to see the connection using a holistic perspective of this publication.

Chapter 1 uses an applied mathematics approach to embed algorithmic measures into cultural theory in research on International Business. The specialized area is concerned with adaptation of multinational enterprise (MNE) cross-borders in which how dynamic functions can strengthen the argument by producing robust models. The chapter contributes to the extant literature by offering a set of mechanisms that can be used by MNEs in adapting to a new or complex environment where culture can be diverse and policy choice is challenging. The mechanism by driving an adaptive approach, in particular, addresses a research issue that is persistent in cultural transition studies. The issue is distinguished from the standard economic model in that individual or rational actors have a fixed set of independent preferences (i.e., decision choice based on price, benefit, or rules of the game), uninfluenced by the behaviour of others or the social settings within which they operate. The current study addresses the issue by demonstrating that a range of socio-cultural factors can influence behavior.

Chapter 2 examines the relationship between team work quality and the speed of new product development (NPD). Previous research has consistently demonstrated that team work quality plays an important role in predicting the speed of NPD. However, the examination of the fundamental mechanisms behind this relationship has received less attention than it deserves. Drawing on the resource-based view and internal market orientation theories, this study examines mediating effect of internal market orientation in the relationship between teamwork quality and speed of NPD. A total of 149 team members drawn from the telecom companies in the Kingdom of Saudi Arabia participated in this study. Partial least squares

path modelling was employed to test mediating effect of internal market orientation in the relationship between teamwork quality and NPD speed, and the findings suggest a positive relationship between teamwork quality and NPD speed.

Chapter 3 covers foreign direct investment, corruption, and crime. Drug trafficking could be associated with the corrupt structures of governments and any anti-drug enforcement policy would be compromised. Simultaneously, it is perceived that the flow of foreign direct investment, which is inversely related with drug trafficking, drives the economy and the host government faces a dilemma between encouraging foreign direct investment or allowing drug trafficking. In this work, a theoretical model of this stylized fact is made. It is found that the host government sets a strict enforcement policy if the corruption level is low; otherwise, a lax policy would be set. Once the enforcement policy has been set, an increase in the corruption level reduces the enforcement level. Additionally, an increase in the demand for drugs may reduce or increase the enforcement level depending of the size of corruption level compared with the market size for foreign investors. However, with an international specific policy, an increase in demand of drugs reduces unequivocally the optimal enforcement level.

Chapter 4 builds and explains the Gravity Model for the trade flows of Albania and 15 of its trade partners for the period of 2001-2016, both theoretically and empirically. The theoretical development of the subject gives an overview of the economic thought over the years regarding the concept of free trade, its benefits and threats, the Central European Free Trade Agreement (CEFTA), and the Gravity Model in order to be able to explain and interpret the patterns of trade between countries. The econometrical analysis illustrates the impact of Gross Domestic Product (GDP) of partner countries, the distance between them, and CEFTA has on the trade flows of Albania. The Gravity Model built in this study supports the theoretical approach and shows how GDP has positively affected trade flows, while distance has negatively affected trade flows. The impact of CEFTA is insignificant.

Chapter 5 develops an integrated rough model for third party logistics service provider selection. Logistics is a key factor for companies to sustain their businesses, to gain a competitive advantage in the market, and to speed up the transportation process. Companies can perform their own logistic activities using their own core competencies; however, they can face huge logistics costs. To avoid these logistics operating costs, companies need to cooperate with third party logistics service providers (3PL) to perform logistics activities. This study proposes an integrated rough MCDM model including Rough SWARA and Rough COPRAS methods to identify the best 3PL for a Turkish textile company. These two rough methods were not previously utilised in solving any decision making problems in the extant literature. Thus, the contribution of this study is to develop a new rough integrated model to solve the 3PL service provider selection problem.

Chapter 6 investigates the relationship between research and development (R&D) expenditures and economic growth in 19 OECD countries with both the Emirmahmutoglu and Köse (2011) Causality test and the Dimitrescu and Hurlin (2012) Panel Causality test based on Rolling Windows Regression for the selected member nations during the period 1996-2015. The results concluded that for all panel there is a causality from economic growth to R&D expenditures. In this study, the relationship between variables was investigated using different mathematical techniques like rolling windows. According to the results of the Dimitrescu and Hurlin Panel Causality Test based on Rolling Window Regression, which is applied differently from other studies in the extant literature, there was a causality from economic growth to R&D expenditures in 2010. In 2011, there was causality from R&D expenditures to economic growth for all panels.

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Chapter 7 demonstrates how the notion of ‘proof’ can be used to resolve issues of valuation in finance and how the method of simultaneous equations can be applied to determine the value of shares in two firms that hold an investment of shares in one another at the same time. The reader will be introduced to the notion of proof by arbitrage as it was first pioneered in modern finance by Modigliani and Miller (1958) and then its application in providing guidance to practitioners of valuation is explored.

Chapter 8 proposes a model as applied to a Turkish textile company using Fuzzy SWARA (Step-wise Weight Assessment Ratio Analysis) and Fuzzy ARAS (Additive Ratio Assessment) methods to solve the supplier selection problem. As the performance of suppliers directly or indirectly affects the performance of the companies with which they engage, working with the most suitable supplier has become the key to success for companies. When solving the supplier selection problem, many different criteria involving qualitative and quantitative criteria are considered. Therefore, the supplier selection problem is considered an MCDM problem. These criteria can include uncertain and imprecise data. Additionally, the judgments of many managers are considered in supplier selection problems. Thus, in this study, a fuzzy group integrated model including Fuzzy SWARA and Fuzzy ARAS is proposed to select the best supplier. This study contributes to the extant literature since these two methods were not used in the past to solve any problems together.

Chapter 9 introduces the PSK method for solving fully intuitionistic fuzzy assignment problems with some software tools. The Assignment Problem (AP) is a particular case of a linear programming problem which deals with the allocation of various resources for various activities on a 1-to-1 basis. It does so in such a manner that the profit or sale involved in the process is maximum and cost or time is minimum. Generally, the profit/sale/cost/time is called the parameter of the AP and this is not a crisp number due to some uncontrollable factors. They can also involve uncertainty and hesitation. Therefore, to solve the AP under an intuitionistic fuzzy environment in this chapter, the author proposes the PSK (P.Senthil Kumar) method. Numerous theorems which are related to intuitionistic fuzzy assignment problem is proposed and is proved by PSK. By using the PSK method, the real-life related fully intuitionistic fuzzy assignment problems are solved. The proposed results are verified by both LINGO 17.0 and TORA software packages. In addition to verifying the efficiency and realism of the proposed method, the computer code based on LINGO 17.0 is presented. Results, discussion, comparative study and the advantages of the PSK method are given. The chapter ends with the conclusion and future studies.

Chapter 10 estimates the probability of default and its design of experiment via the Merton Model which is the critical model for financial economics to measure the default of a firm. It was the first structural model because it uses the market value of the firm for estimating the default of the firm. The firm will be in default only when the values of the firm goes down to a threshold value (the debt of the firm), and if it occurs the owner will put the firm to the debt holders. The effects of parameters-asset value  $V$ , firms debt  $D$ , interest rate  $r$ , the volatility  $\sigma$  and period  $T$  on the probability of default was investigated. To estimate the probability of default of a firm, the Black Scholes Model for European call options is used. The aim is to determine which parameter effects more or less on Probability of Default. The experiment is based on the orthogonal array L27 in which the five factors (parameters) are varied at three levels. The Taguchi L27 orthogonal method, ANOM, and ANOVA are used to examine the effect of these parameters on the probability of default. It also provides the best combination where the probability of default is minimum.

Chapter 11 studies real options and their suitability in assessing international digital investment. Firms have experienced extreme competition because of changes in technological and global issues. Globalization of manufacturing has arisen through a faster transfer of materials, complex payment systems, and compression of product life cycle. Eventually, firms need the integration of technologies to meet the increasingly sophisticated customers' needs. Among the technologies, artificial intelligence has attracted much of the attention as it has been foreseen to have a major impact on all industries. Real options approach may be applied to make informed decisions concerning digital technologies investments. Therefore, firms could decide to defer the option of investing in artificial intelligence for the sake of finding a more favorable future environment. This study provides an adequate tool to reduce uncertainty in deciding whether to implement artificial intelligence in their companies. This tool comprises the strategic perspective of the investment in digital technologies which makes it suitable to be incorporated as a part of the set of strategic tools.

Chapter 12 designs a neural network model for forecasting time series. Artificial neural networks are highly flexible and efficient tools in the approximation of time series patterns. In recent years, more than 5,000 studies oriented to the use of neural networks in the prognosis of time series have been evidenced in the extant literature. However, the methodology used for its specification and construction still involves a lot of trial and error, or is inherited from econometric and statistical procedures that do not fit perfectly to the characteristics of the time series. This is especially true when they present non-linear behavior; moreover, it is not designed for working with neural networks. The objective of this chapter is to present a five-step guide for the specification, design, and validation of a neural network model for forecasting time series.

Chapter 13 concludes the book by examining encryption techniques. Encryption is the process of converting confidential private data into unreadable form and securing information in the file from unauthorized access using various encryption algorithms. We live in the information age where the exchange of private information has become the integral part of our day-to-day activities. Billions of e-mails and business data are sent throughout the world through Internet daily. The success of the information age is to keep private secure data from unauthorized access and key to access the private and secure data for authorized users. Encryption in this information age plays a vital role in the protecting the confidential data from unauthorized access. In last few decades, the computer network has created a revolution in the use of information. Authorized users access their data or send their private data from anywhere in the world; hence, it has become very important to secure the private data not only where it is stored, but also to maintain high level of confidentiality while transmission of this private data from one machine to another.

As the current century in the new millennium speeds along at an increasingly faster pace, the need for further development of applied and pure mathematics in international business continues to gain importance. We trust this work will assist in that effort and appreciate any constructive feedback on this publication.

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