



وهزارهتی خوێندنی باڵا و توێژینهوهی زانستی

**Ministry of Higher Education &  
Scientific Research**

<b>PhD Research Program</b>		به‌نامه‌ی توێژینه‌وه‌ی بۆ به‌ده‌سته‌هینانی بروانه‌ی دکتۆرا
<b>1. Title of PhD research proposal</b>		ناونیشان‌ی پرۆپۆزەلی توێژینه‌وه‌ی پێشنیازکراو
		<i>Stochastic Processes Modelling and Statistical Analysis with Application</i>
<b>2. General information</b>		زانباری گشتی
Name and surname of the supervisor 1	<i>Khwazbeen S. Fatah</i>	ناوی سیانی سه‌رپه‌رشتیار 1
Scientific title	<i>Assist. Prof.</i>	پله‌ی زانستی سه‌رپه‌رشتیار 1
E-mail	<i>Khwazbeen.fatah@su.edu.krd</i>	ئیمێلی سه‌رپه‌رشتیار 1
Mobil	<i>07503018989</i>	ژماره‌ی مۆبایل
Department	<i>Mathematics</i>	ناوی به‌شی زانستی
College / faculty	<i>College of science</i>	کۆلیژ / فاکه‌لتی / سکول
University's name	<i>Salahaddin University</i>	ناوی زانکۆی میلاکی سه‌رپه‌رشتیار
Name and surname of the supervisor 2		ناوی سیانی سه‌رپه‌رشتیار 2 (نه‌گه‌ر هه‌یه)
Scientific title		پله‌ی زانستی سه‌رپه‌رشتیاری 2
E-mail		ئیمێلی سه‌رپه‌رشتیار 2
Mobil		ژماره‌ی مۆبایل
Department		ناوی به‌شی زانستی
College / faculty		کۆلیژ / فاکه‌لتی / سکول
university's name		ناوی زانکۆ
<b>3. Summary (Abstract) of PhD research proposal</b>		
This should be no longer than 200 words and not less than 75 words.		

ئەبستراكتى توۋزىنەھى پېشنىيازكراو. لە 200 وشە زياتر نەبىت و لە 75 وشە كەمتر نەبىت.

The theory of stochastic processes has developed very rapidly and has found application in a large number of fields such as physical system; finance and economy; information theory of communication and control; operations research; biology; astronomy and so on. Recently, the Markov chain model, which is a discrete time parameter stochastic process in which the future state of the system is dependent only on the present state and is independent of the previous states, has been widely used for predicting parameters indifferent fields of study; this model is used to predict parameters depending on the probability of transition.

In this research proposal, the classic Markov Chain model is introduced and then the approach with random transition matrices will be explored. Such chains are a development on classic Markov chains where the transition matrix is taken to be random. The intuition for this is that it may be interested in modeling phenomena as where the homogeneity assumption of classic Markov chains is invalid. Hence, it is proceeded to explore theoretical properties of such chains with a focus on their asymptotic behavior. Finally the attempt is to predict the oil prices in future and the focus will be on oil prices in Kurdistan Region of Iraq. In addition, various tests will be carried out to confirm the significance of the model.

#### 4. Introduction

پېشەكە

To be completed by the primary supervisor: an overview of the proposed research project, focusing on the background of the project and rationale for the research.

لېرەدا سەرپەرشتىبارى سەرەكى پوختەپەك دەربارەى پرۆژەى توۋزىنەھى كە دەنوسىت، تىپادا باكگراوندى پرۆژەكە باس دەكات و روونى دەكاتەھە كە بۆچى ئاراستەكردنى ئەم توۋزىنەھىە گرنەگە.

Markov chains are among the most well known and established probabilistic models. They

have long been developed, studied and applied to real world problems.

Just as the probability theory is regarded as the study of mathematical models of random phenomena, the theory of stochastic processes plays an important role in the investigation of random phenomena depending on time. A random phenomenon that arises through a process which is developing in time and controlled by some probability law is called a stochastic process. Thus, stochastic processes can be referred to as the dynamic part of the probability theory. Markov chains are among the most well

known and established probabilistic models. They have long been developed, studied and applied to real world problems. A finite Markov chain is a discrete time parameter stochastic process in which the future state of the system is dependent only on the present state and is independent of the previous states. The behavior of a Markov chain model largely depends on the transition probabilities which can be represented by the probability matrix which enables the prediction of parameters be easily obtained. [1]; [2]; [3].

The Markov chain was first proposed by Andreyev Markov (1856-1922) [5]. A stochastic process is said to include the Markov chain if it fulfills the properties of Markov (Markovian properties). The properties of Markov stated that the probability of a future event, with known past events and present events, is not dependent on past events and only depends on the present events. The Markov chain is generally classified into two, namely the Markov chain with discrete parameter index and the Markov chain with continuous parameter index. The Markov chain is said to be a discrete parameter index if the shift state occurs with a fixed discrete time interval. Whereas, the Markov chain is said to be a continuous parameter index if the shift state occurs with a continuous time interval [6]. Data which is a time series data that indicates the movement of state in a fixed discrete time interval can be represented by Markov chain model.

## 5. Research objectives

Clarify the research objectives and planned methodology to meet the challenges of the project. Include details of the research plan and relate to the previous work carried out by others.

لێرەدا سەرپەرشتیار دەبێت ئامانجەکانی توێژینەوه که روونبکاتەوه و باس له میتۆدهکانی رووبەر و بوونەوهی ئەو تەحەدیاتانە دەکات که لهکاتی توێژینەوه دا دێته ریگای، ههروهها گرنگه که پلانی توێژینەوه که بیهستیتەوه بهو کارانهی که پیشتر لهو بواره دا ئه‌نجام دراون.

The overall aim of this project is to study stochastic processes, specifically the classic Markov Chain and one with random transition matrices to predict the next future state of oil prices in Kurdistan Region (KR) of Iraq. In order to achieve this aim, a data set must be created by recording the current state of the oil prices and its state transitions. This data set can be created with the help of seniors and authorities in KR. This includes collecting data from the Ministry of Natural Resources and then predicting the future state of the oil prices. One of the methods for solving the problem of prediction is to make use of the Markov chain concept. A Markov chain is a memory less system in which the future state does not depend on the past states but only the current state. By implementing the Markov chain concept in the prediction, it becomes possible to predict the next state of the oil prices. Finally, by using different test statistics the aim is to decide on the goodness of fit for the proposed model.

The aim is to predict the model of fluctuating these prices and then to produce accurate forecast for future prices based on a description of history patterns in crude oil prices.

## 6. Methodology and data collection

In this section the supervisor should describe the methodology of the proposed research

لیرهدا سهر پهرشتیار باس له میتودهکانی ئەنجامدانی توێژینهوهکه و شیوازی کوکردنهوهی داتاگان دهکات.

To ensure the achievement of the research goal, the workflow is planned with two stages. In the first one, a theoretical approach would be taken, describing the problem of interest. A literature review would follow highlighting the most important background.

The second stage is to provide the short overview of methodology applied to solve the problems covered in the study. The performance evaluation can be carried out by different methods such as;

- mathematical analysis with numerical procedures;
- building the system and then measure its performance;
- using simulation techniques.

## 7. Scope and limit to the research

Details of anticipated problems and proposed resolutions

لیرهدا باس لهو بهر بهستانه دهکریت که دهشیت بینه ریگای ئەنجامدانی توێژینهوهکه، ههروهها باس له چارهسهری ئەو بهر بهستانهش دهکریت.

The project will focus on the context data which can be used to predict the future state of oil prices in KR of Iraq in which oil production is new industry and the processing of raw materials my face many problems. Therefore, the basic goals of this project are (1) record the current state of the oil prices and its state transitions and (2) predict the future prices using an appropriate prediction model.

## 8. Duration and timeline

لیرهدا باس له کاتی پنیویست بو ئەنجامدانی توێژینهوهکه دهکریت

The duration for this project is expected to be within 2-3 years time in which 3-4 month will

be on introduction and review then the rest will be dedicated for achieving the goal.

## 9. Conclusions

The project supervisor summaries the research objectives and clarify their expected findings; include why the research has scientific value.

لیره‌دا سه‌ر په‌ر شتیار باس له گرنگی ئامانج و دهر ئه‌نجامه چاوه‌ر وانکراوه‌کانی توئیزینه‌وه‌که ده‌کات، هه‌روه‌ها روونی ده‌کاته‌وه که بۆچی ئاکامه‌کانی ئه‌م توئیزینه‌وه‌یه به‌های زانستی هه‌یه.

The objective of this research is to study Stochastic Processes and the most widely used model Markov chain to develop the forecasting model for oil price. The data of oil prices in KR will be used to develop the model and then to test the significance for the model. For this purpose, different criterions will be used to measure the accuracy of the proposed model. The primary focus of this thesis will be on investigation for the existing prediction models and then to propose a solution based on the best existing model and then test it with an implementation for the proposed model.

## 10. References

سه‌ر چاوه‌کان

- [1] Frank, B., (2016) *Applied Probability and Stochastic Processes*, Taylor & Francis Group.
- [2] Randolph, N., (1995), *Probability, Stochastic Processes, and Queuing Theory: The Mathematics of Computer Performance Modeling*, 1st Edition, Springer.
- [3] Hillier, F and Lieberman, G., (2016) *Introduction to Operations Research*, Lehigh Edition McGraw-Hill, New York, NY, USA.
- [4] Kozicka, M. (2019), A novel approach to stochastic input-output modelling, 53, ( 4) DOI : <https://doi.org/10.1051/ro/2018046>
- [5] Sujatmoko and Bambang 2012 Analisa Kehandalan Stokastik Rantai Markov untuk Simulasi Data Curah Hujan Harian pada Das Kampar. Jurnal Sains dan Teknologi 11 (1), ISSN 1412-66257.
- [6] Ross S M 1996. Stochastic Processes Second Edition. University of California, Berkeley, United States of America.

## 11. General notes :



ھەر زانیارییهکی گشتی دیکه که سەرپهرشتیار به گرنگی بزانییت

12.

پهسهندکردنی پرۆپۆزهل له لایهن لیژنه‌ی زانستی بهش

ژماره‌ی کۆنوسی کۆبوونهوه:

ریکهوتی کۆبوونهوه:

پهسهند نهکرا

بریار:  پهسهند کرا

ناوی سیانی و واژووی لیژنه‌ی زانستی بهش

واژوو:

ناوی سه‌رۆکی لیژنه زانستی بهش

مۆری بهش

13.

پهسهندکردنی پرۆپۆزهل له لایهن نهنجومه‌نی کۆلیژ/فاکهلتی

ژماره‌ی کۆنوسی کۆبوونهوه:

ریکهوتی کۆبوونهوه:

پهسهند نهکرا

بریار:  پهسهند کرا

ناو واژووی راگری کۆلیژ

مۆری کۆلیژ

تیبینی: تکایه فورمه‌که ته‌نها به یه‌ک زمان (زمانی توژیینهوه) پر بکریتهوه.