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# Outlier Detection for Temporal Data

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*SYNTHESIS LECTURES ON  
DATA MINING AND KNOWLEDGE DISCOVERY*

Jiawei Han, Eric Gilbert, Wei Wang, Johannes Gehrke, Robert Grossman, Series Editors

# Outlier Detection For Temporal Data Jing Gao

**R Sandford**



## **Outlier Detection For Temporal Data Jing Gao:**

Outlier Detection for Temporal Data Manish Gupta, Jing Gao, Charu Aggarwal, Jiawei Han, 2022-06-01 Outlier or anomaly detection is a very broad field which has been studied in the context of a large number of research areas like statistics data mining sensor networks environmental science distributed systems spatio temporal mining etc Initial research in outlier detection focused on time series based outliers in statistics Since then outlier detection has been studied on a large variety of data types including high dimensional data uncertain data stream data network data time series data spatial data and spatio temporal data While there have been many tutorials and surveys for general outlier detection we focus on outlier detection for temporal data in this book A large number of applications generate temporal datasets For example in our everyday life various kinds of records like credit personnel financial judicial medical etc are all temporal This stresses the need for an organized and detailed study of outliers with respect to such temporal data In the past decade there has been a lot of research on various forms of temporal data including consecutive data snapshots series of data snapshots and data streams Besides the initial work on time series researchers have focused on rich forms of data including multiple data streams spatio temporal data network data community distribution data etc Compared to general outlier detection techniques for temporal outlier detection are very different In this book we will present an organized picture of both recent and past research in temporal outlier detection We start with the basics and then ramp up the reader to the main ideas in state of the art outlier detection techniques We motivate the importance of temporal outlier detection and brief the challenges beyond usual outlier detection Then we list down a taxonomy of proposed techniques for temporal outlier detection Such techniques broadly include statistical techniques like AR models Markov models histograms neural networks distance and density based approaches grouping based approaches clustering community detection network based approaches and spatio temporal outlier detection approaches We summarize by presenting a wide collection of applications where temporal outlier detection techniques have been applied to discover interesting outliers Table of Contents Preface Acknowledgments Figure Credits Introduction and Challenges Outlier Detection for Time Series and Data Sequences Outlier Detection for Data Streams Outlier Detection for Distributed Data Streams Outlier Detection for Spatio Temporal Data Outlier Detection for Temporal Network Data Applications of Outlier Detection for Temporal Data Conclusions and Research Directions Bibliography Authors Biographies

Exploratory Causal Analysis with Time Series Data James M. McCracken, 2022-06-01 Many scientific disciplines rely on observational data of systems for which it is difficult or impossible to implement controlled experiments Data analysis techniques are required for identifying causal information and relationships directly from such observational data This need has led to the development of many different time series causality approaches and tools including transfer entropy convergent cross mapping CCM and Granger causality statistics A practicing analyst can explore the literature to find many proposals for identifying drivers and causal connections in time series data sets Exploratory causal analysis ECA

provides a framework for exploring potential causal structures in time series data sets and is characterized by a myopic goal to determine which data series from a given set of series might be seen as the primary driver In this work ECA is used on several synthetic and empirical data sets and it is found that all of the tested time series causality tools agree with each other and intuitive notions of causality for many simple systems but can provide conflicting causal inferences for more complicated systems It is proposed that such disagreements between different time series causality tools during ECA might provide deeper insight into the data than could be found otherwise

**Mining Latent Entity Structures** Chi Wang, Jiawei Han, 2022-05-31 The big data era is characterized by an explosion of information in the form of digital data collections ranging from scientific knowledge to social media news and everyone's daily life Examples of such collections include scientific publications enterprise logs news articles social media and general web pages Valuable knowledge about multi-typed entities is often hidden in the unstructured or loosely structured interconnected data Mining latent structures around entities uncovers hidden knowledge such as implicit topics phrases entity roles and relationships In this monograph we investigate the principles and methodologies of mining latent entity structures from massive unstructured and interconnected data We propose a text rich information network model for modeling data in many different domains This leads to a series of new principles and powerful methodologies for mining latent structures including 1 latent topical hierarchy 2 quality topical phrases 3 entity roles in hierarchical topical communities and 4 entity relations This book also introduces applications enabled by the mined structures and points out some promising research directions

*Multidimensional Mining of Massive Text Data* Chao Zhang, Jiawei Han, 2022-06-01 Unstructured text as one of the most important data forms plays a crucial role in data driven decision making in domains ranging from social networking and information retrieval to scientific research and healthcare informatics In many emerging applications people's information need from text data is becoming multidimensional they demand useful insights along multiple aspects from a text corpus However acquiring such multidimensional knowledge from massive text data remains a challenging task This book presents data mining techniques that turn unstructured text data into multidimensional knowledge We investigate two core questions 1 How does one identify task relevant text data with declarative queries in multiple dimensions 2 How does one distill knowledge from text data in a multidimensional space To address the above questions we develop a text cube framework First we develop a cube construction module that organizes unstructured data into a cube structure by discovering latent multidimensional and multi granular structure from the unstructured text corpus and allocating documents into the structure Second we develop a cube exploitation module that models multiple dimensions in the cube space thereby distilling from user selected data multidimensional knowledge Together these two modules constitute an integrated pipeline leveraging the cube structure users can perform multidimensional multigranular data selection with declarative queries and with cube exploitation algorithms users can extract multidimensional patterns from the selected data for decision making The proposed

framework has two distinctive advantages when turning text data into multidimensional knowledge flexibility and label efficiency First it enables acquiring multidimensional knowledge flexibly as the cube structure allows users to easily identify task relevant data along multiple dimensions at varied granularities and further distill multidimensional knowledge Second the algorithms for cube construction and exploitation require little supervision this makes the framework appealing for many applications where labeled data are expensive to obtain

*Probabilistic Approaches to Recommendations* Nicola Barbieri, Giuseppe Manco, Ettore Ritacco, 2022-05-31 The importance of accurate recommender systems has been widely recognized by academia and industry and recommendation is rapidly becoming one of the most successful applications of data mining and machine learning Understanding and predicting the choices and preferences of users is a challenging task real world scenarios involve users behaving in complex situations where prior beliefs specific tendencies and reciprocal influences jointly contribute to determining the preferences of users toward huge amounts of information services and products Probabilistic modeling represents a robust formal mathematical framework to model these assumptions and study their effects in the recommendation process This book starts with a brief summary of the recommendation problem and its challenges and a review of some widely used techniques Next we introduce and discuss probabilistic approaches for modeling preference data We focus our attention on methods based on latent factors such as mixture models probabilistic matrix factorization and topic models for explicit and implicit preference data These methods represent a significant advance in the research and technology of recommendation The resulting models allow us to identify complex patterns in preference data which can be exploited to predict future purchases effectively The extreme sparsity of preference data poses serious challenges to the modeling of user preferences especially in the cases where few observations are available Bayesian inference techniques elegantly address the need for regularization and their integration with latent factor modeling helps to boost the performances of the basic techniques We summarize the strengths and weakness of several approaches by considering two different but related evaluation perspectives namely rating prediction and recommendation accuracy Furthermore we describe how probabilistic methods based on latent factors enable the exploitation of preference patterns in novel applications beyond rating prediction or recommendation accuracy We finally discuss the application of probabilistic techniques in two additional scenarios characterized by the availability of side information besides preference data In summary the book categorizes the myriad probabilistic approaches to recommendations and provides guidelines for their adoption in real world situations

**Machine Learning and Knowledge Discovery in Databases** Peter A. Flach, Tijl De Bie, Nello Cristianini, 2012-09-11 This two volume set LNAI 7523 and LNAI 7524 constitutes the refereed proceedings of the European Conference on Machine Learning and Knowledge Discovery in Databases ECML PKDD 2012 held in Bristol UK in September 2012 The 105 revised research papers presented together with 5 invited talks were carefully reviewed and selected from 443 submissions The final sections of the proceedings are devoted to Demo and Nectar papers The Demo track

includes 10 papers from 19 submissions and the Nectar track includes 4 papers from 14 submissions The papers grouped in topical sections on association rules and frequent patterns Bayesian learning and graphical models classification dimensionality reduction feature selection and extraction distance based methods and kernels ensemble methods graph and tree mining large scale distributed and parallel mining and learning multi relational mining and learning multi task learning natural language processing online learning and data streams privacy and security rankings and recommendations reinforcement learning and planning rule mining and subgroup discovery semi supervised and transductive learning sensor data sequence and string mining social network mining spatial and geographical data mining statistical methods and evaluation time series and temporal data mining and transfer learning      **Advances in Knowledge Discovery and Data Mining** ,2005      **Spatial and Temporal Data Mining with Applications to Earth Science Data** Haibin Cheng,2008      **Data Mining, Intrusion Detection, Information Assurance, and Data Networks Security ...** ,2007      **Current Index to Statistics, Applications, Methods and Theory** ,1999 The Current Index to Statistics CIS is a bibliographic index of publications in statistics probability and related fields      **KDD ...** ,2003      **中国数学** ,2005      *Chinese Journal of Numerical Mathematics and Applications* ,2001      **Notices of the American Mathematical Society** American Mathematical Society,1990      **Advances in Web-age Information Management** ,2004      *Mathematical Reviews* ,2005      *Optics Design and Precision Manufacturing Technologies* Guo Fan Jin,Wing Bun Lee,Chi Fai Cheung,Suet To,2007-12-06 Selected peer reviewed papers from the Asia Pacific Conference on Optics Manufacture 2007 11 13 January 2007 Hong Kong P R China      Wuhan daxue xuebao xinxi kexue ban ,2005      **CRREL Bibliography** ,1998      **Geological Abstracts** ,1988

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