Travel Volume Modelling for Infectious Disease Transmission Risks Assessment

**Summary**

In this report, I will introduce how to use travel volume modelling to evaluate the risks of infectious disease transmission. This technique is becoming more and more importance, and this is because of the connection between countries are globalizing the economy and transportation. Thus, the risk of transmission of a series of infectious diseases will become higher. Therefore, it is necessary to use traffic information for risk assessment. The main objective I want to goal in this project include: 1. taking other key factors into account, such as the susceptibility of different regions; 2. visualizing the results for ease of use by passengers. Therefore, in order to implement this topic, some data mining technics will be used, such as page rank and risk rank.

**Background**

Currently, because of international travel, the spread of COVID-19 has become the norm. This is because airborne, foodborne, and zoonotic infectious diseases transmitted during air travel, and this raise important public health concerns as air travel becomes more accessible and affordable. Likewise, the SARS outbreak in 2002 showed that air travel can play and important role in the rapid spread of new infections and may even lead to epidemics. Therefore, it is necessary to estimate the future infection risk through the flight volume in order to prevent the infection during travel.

In response to this situation, various countries and institutions have also developed corresponding risk assessment mechanisms. Since 2007, the European Center for Disease Control and Prevention has launched the Risk assessment guidelines for infectious diseases transmitted on aircraft(RAGIDA) (Karl Schendel et al, 2009). There is a series of algorithms behind the RAGIDA to support this project to be able to predict and prevent a range of infectious diseases such as anthrax and SRAS. Similarly, in China, some researchers have also developed a data-driven practical method for predicting the evolution of the new coronavirus pneumonia epidemic. Based on moving average prediction limit(MAPL), this project uses the previous SARS epidemic data to verify the practicability of the MAPL method for epidemic trend and risk prediction(Hao et al., 2020). The official data of COVID-19 from January 16, 2020 was tracked to establish the corresponding MAPL for timely epidemic prediction and risk assessment. The next paragraph will introduce some of the remaining problems.

**Problem identification**

Although several projects have now investigated this issue, there are still two issues that need to be addressed. The first problem is that some models only consider the effect of connectivity between regions on infection risk. However, the spread of the epidemic also depends on the susceptibility of countries and regions with different latitudes and longitudes, and the sensitivity of local people to certain infectious diseases. Moreover, when implementing the actual infectious disease risk prediction method, it is also necessary to evaluate the situation in different regions to predict the risk. Therefore, more factors need to be taken into our consideration. The second problem is that currently, there is a lack of visual implementation of these models. This is very necessary because infectious diseases affect every passenger. Moreover, in today’s convenient transportation environment, it is necessary to make it easy for everyone to obtain epidemic risks information. To solve these issues, I propose some objectives for the project.

**Objectives**

To implement this method, I will build a system that enable to do the following things:

* base on international air-travel volume, design and develop models for predicting the transmission of new infectious pathogens to and from different countries.
* build a user interface dashboard, which enable to update the travel data by the users.
* build an interactive visualization system that will use different data structures and graphic designs to help the users to explore the relationships, which would influent the transmission risks.

In order to achieve several objectives mentioned above, I will introduce the solution below.

**Proposed solution**

This project will be implemented in two parts. The first one is the risks assessment model. In this part, each region of the world is regarded as a node, and each node is connected by the air-travelling. In this way, the whole world can be seen as a network. Thus, the page rank algorithm can be used to evaluate the risks. The reason for using this algorithm is that it takes into account the influence that neighboring countries have on a country. The second part is the visualized dashboard. This would help user to explore the current data by various types of graphs, which could assist to discover insightful results. Moreover, it could also be a real-time epidemic risks map for users as a reference. More detailed steps will be explained in the next paragraph.

In order to implement this project, I will take following steps. First, relevant data needs to be collected, including demographic, healthcare, public health, disease dynamics, political domestic, political international and economic(Cadavid et al, 2021). Second, I will use the data as the evaluation criteria to evaluate the risks of different countries. Third, apply page rank algorithm to the graph network, and make iterations to build the model. Finally, I will build up and test the user interface dashboard.

In conclusion, this system will give corresponding risk prediction information based on the data of different infectious diseases given by the user and perform it to the user in a visual way.

**Reference**

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