Exploration of Temporal-spatially varying Impacts on COVID-19 Cumulative Case in Texas using geographically weighted regression (GWR)

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Introduction

Content goes here: COVID-19, as a global social, environmental, and economic comprehensive crisis, extremely impacts on people's daily life and reshape people's routine behaviors, especially a pervasive sense of quarantine fatigue and panic attacks of getting infected are challenging human's fortitudes.

Texas
Texas is the second largest state in the U.S, owning one quarter of older Americans, as a pilot experiment study area, conveys demonstration impacts on other states.

significance
This research are expected to provide references for preventing and controlling COVID-19 and related infectious diseases, evidences for disease surveillance and response systems to facilitate the appropriate uptake and reuse of geographical data.

Literature Review

Texas undergone 5 stages of COVID-19 risk-based guidelines, including the first phase on April 4th, the second phase on May 18th, the third phase on June 3rd, the fourth phase on July 4th, the fifth phase on Dec 15th for Travis County.

There are 28 executive orders regarding containing the spread of COVID-19 from Executive Order 8 on March 19 to Executive Order 32 on October 7. There are 11 times of publishing PHDD During March 19, 2020 -January 15, 2021.

Some of the critiques are thought that non-controlling the virus expansion is mainly responsible for potential policy from the Trump Administration, who has done little to counter rampant misinformation about the pandemic and has made numerous incorrect statements about the virus's origins, spread, and deadness.

If the COVID-19 data has a spatial-temporal resolution to capture the trajectories, both approaches are adequate for the spread of COVID-19 recognition

Methodology

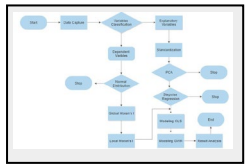
Data source
COVID-19 data (cumulative cases and new cases) as dependent variables are from the Centers for Disease Control and Prevention (CDC).
Explanatory variables:
- Demographical factors such as age structure, gender, and race from the 2019 U.S census tract data.
- Hospitalization (i.e., THB, BPC) from The Texas Department of State Health Services (DSHS)
- Economic data (e.g., annual income, unemployment) from the Texas Association of Counties
- the United States Environmental Protection Agency (AQI, PM2.5)
- National Weather Service (i.e., temperature, precipitation).

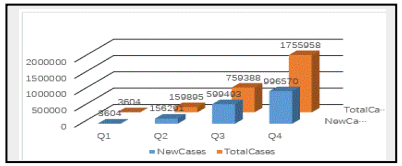
Quarterly data are real-time raw data at the end day of each quarter.

Data description
The number of NC and CC are classified four quarters. The trend is exhibited that the spread of COVID-19 is constantly and monotonically increasing without controlling.

This is temporal-study framework.

This is the spatial-study framework.





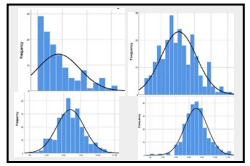
This is the number of NC and CC in four quarters. It means the spread of COVID-19 is monotonically increasing without controlling.

Results

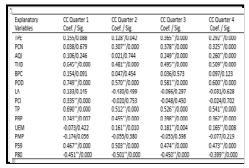
Normal Distribution
After logarithm transformation, quarterly CC within is qualified normal distribution except for the first quarter.

Correlation
The first quarter CC is positively significant to THB, POD, PCI, TP, PBP, and P59. It is negatively significant to P80. The second quarter CC is positively significant to TPE, PCN, THB, POD, TP, PBP, UEM, P59, and negatively significant to P80. The third quarter CC is positively significant to TPE, PCN, AQI, THB, POD, TP, PBP, UEM, P59. While it is negatively significant to P80. The last quarter CC is positively significant to TPE, PCN, AQI, THB, POD, TP, PBP, UEM, P59, and negatively significant to P80. As the result, the correlation from the second quarter to the fourth quarter is similar.

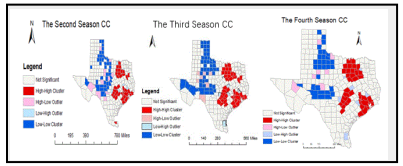
Spatial Autocorrelation
In the second season, HH is distributed in 39 counties, HL is distributed at 11 counties, LH is limited at 6 counties, LL is at 41 counties. In the third season, HH at 44 counties, HL is at 7 counties, LH is at 6 counties, LL is at 48 counties. In the fourth season, HH is in northern Texas of 37 counties, HL is at 7 counties, LH is at 7 counties, LL is distributed south and eastern of Texas of 31 counties.



This is four distribution charts. The top-left is skewed distribution, the other is normal distribution.



This is correlation table, showing the links between dependent variables and independent variables.



This is Local Moran's Model of CC .
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GWR result analysis

Spatial change of CC

In the last-three seasons, population and hospitalization has the largest effects on CC in northern Texas. The medical supply index is shown the change of spatial heterogeneity that areas of positive impacts are moved from eastern Texas to western and south Texas while areas of negative effects are decreased and moved.

Temporal change of CC factors
Population and hospitalization impact on COVID-19 within 3 quarters is relatively positive. Age structure impacts during 3 quarters are stably positive. Air quality impacts during three quarters are flexible. Economic impacts during three quarters are flexible. Natural supply and medical supply impacts in three quarters have fluctuated.

Findings
(1). The most important quarantine areas of COVID-19 in Texas are El Paso, Odessa, Midland, Lubbock, and Amarillo areas. (2). 20-59 population is the main source of Cumulative Case with a lower death rate, while over 80 population have lower infection rates and higher COVID death rates. (3). Race and gender is not important to controlling COVID-19 since they are not components of factors. (4). Economic, environmental, race, and natural condition factors directly facilitated COVID-19 CC change with spatial-temporal heterogeneity.

Discussion

The application of research might be limited to apply other states. There is no chronic disease data to supports this research. COVID-19 accelerated the decline of health in the USA.

Conclusion

Spatial-temporal Geostatistical Analysis on COVID-19 CC through GWR is beneficial to make appropriate and scientific judgments, target vulnerable communities, allot health care resources, reshape disease surveillance and response systems.

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