2020 MCM
Problem A: The 2019 Novel Coronavirus Outbreak

Background

On 31 December 2019, human cases of pneumonia of unknown etiology were reported in Wuhan, China. A novel coronavirus, named 2019-nCoV was identified as the causative virus for the acute respiratory disease by Chinese Center for Disease Control and Prevention (China CDC) on 7 January 2020. Compared with SARS, 2019-nCoV has weak infectivity, but a good affinity with human respiratory tract cells, indicating certain infectivity for humans. Moreover, 2019-nCoV can be transmitted from person to person.

The first patient with unexplained pneumonia was discovered on December 12, 2019, and the number of infected patients is growing exponentially with the development of virus nucleic acid detection kit. As of 5:00 pm on February 3, 2020, China has officially announced 17,332 cases of viral pneumonia, 21,558 suspected cases, and 361 deaths. Meanwhile, nearly 150 cases were confirmed outside of China all over the world. On the recommendation of the Emergency Committee, the World Health Organization (WHO) Director-General declared the outbreak of novel coronavirus a Public Health Emergency of International Concern (PHEIC) on Jan. 31, 2020. The Chinese government is taking decisive measures to prevent the spread of pneumonia.

The outbreak and response of 2019-nCoV is accompanied by a large-scale information epidemic, shortened by "infodemic". That is, the excessive information that is currently indistinguishable from true and false on the Internet makes it difficult for people to find trustworthy sources and reliable guides when needed. At this critical moment, government officials and the public are in urgent needs of appropriate guidance.

As a team of consultant for epidemics hired by China CDC, your tasks are:

Task 1: Based on current epidemiological reports, establish a reasonable and effective model to predict the number of both domestic and global infections in the next two weeks.

Task 2: Based on the traditional transportation during the Chinese New Year and the current epidemic situation, analyze the effectiveness of the measures taken by the Chinese government, especially those imposed on travel restrictions and extended holidays. For example, how many possible infections have been reduced through various protective measures? At the same time, what are the negative effects and losses of these measures? Please quantify your solution.

Task 3: Based on your model built in Task 1, predict the development of the epidemic under the influence of various factors in the next two months. Possible examples of factors: emergence of effective treatment programs or drugs, presence of secondary infections, returning after Spring Festival, mutations in the virus… Estimate whether WHO will terminate PHEIC earlier (usually WHO will reconvene every 3 months to review the PHEIC status and modify, extend or terminate the temporary recommendations).

Task 4: Write a blog for the public on the utility, predictions, and recommendations based on your modeling on this issue.

Your submission should consist of:
· One-page Summary Sheet,
· One-page blog,
· Your solution of no more than 20 pages, for a maximum of 22 pages with your summary and blog.
· Note: Reference list and any appendices do not count toward the 22-page limit and should appear after your completed solution.