**Appendix**

**Formula for Poisson regression models**

*Calculating the change in outcome at NPIs, unadjusted for seasonality*

Where is the outcome variable at time , represents the elapsed time in weeks since the start of the study, is a dummy variable indicating the implementation of massive NPIs, and is the center time.

*Calculating the change in outcome at NPIs, adjusted for seasonality*

Where are two sine/cosine pairs of Fourier terms used to adjust the seasonality.

*Counterfactual model*

**Sample R code for Poisson regression models, using HIV tests as an example**

# Load packages

library(tsModel)

library(tidyverse)

library(sandwich)

library(dplyr)

# Centre time

list2$time\_c <- list2$n - 163 # Time centered at the first week of NPIs

list2$time\_e <- list2$n - 212 # Time centered at the end of 2020

# Poisson regression model of HIV tests adjusting for seasonality

model\_tests <- glm(x ~ NPIs + n + NPIs:time\_c + harmonic(month, 2, 52),family = poisson, list2)

summary(model\_tests)

# Calculated the impact of COVID-19 NPIs at the end of 2020 adjusting for seasonality

model\_tests\_end <- glm(x ~ NPIs + n + NPIs:time\_e + harmonic(month, 2, 52),family = poisson, list2)

summary(model\_tests\_end)

# Look at residuals for autocorrelation

acf(residuals(model\_tests, type = "deviance"))

pacf(residuals(model\_tests, type = "deviance"))

acf(residuals(model\_tests\_end, type = "deviance"))

pacf(residuals(model\_tests\_end, type = "deviance"))

# Calculated R square

nullmod <- glm(x ~ 1, data=list2, poisson(link='log'))

R2\_adjusted <- as.numeric(round((1-logLik(model\_tests) / logLik(nullmod)),3))

R2\_adjusted

# Calculate Newey-West standard errors, with the lag taking the optimal value calculated

est <- exp(c(coef(model\_tests)["NPIs:time\_c"], coef(model\_tests)["NPIs"], coef(model\_tests)["n"]))

se1 <- sqrt(diag(NeweyWest(model\_tests, prewhite = F)))["NPIs:time\_c"]

se2 <- sqrt(diag(NeweyWest(model\_tests, prewhite = F)))["NPIs"]

se3 <- sqrt(diag(NeweyWest(model\_tests, prewhite = F)))["n"]

lb <- est \* exp(-1.96 \* c(se1, se2, se3))

ub <- est \* exp(1.96 \* c(se1, se2, se3))

table <- cbind(round(est, digits = 3), round(lb, digits = 3), round(ub, digits = 3))

table

# Calculate post-NPIs trend and confidence intervals

V <- NeweyWest(model\_tests, prewhite = F)

se <- sqrt(V["n", "n"] + V["NPIs:time\_c", "NPIs:time\_c"]+ 2 \* V["n", "NPIs:time\_c"])

slope\_post <- sum(coef(model\_tests)[c("n", "NPIs:time\_c")])

lower <- slope\_post - 1.96 \* se

upper <- slope\_post + 1.96 \* se

round(exp(cbind(slope\_post, lower, upper)),3)