Omicron and vaccine-adjusted forecaster

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This is a method for simple post-hoc adjustment of a point forecaster of COVID-19 hospitalizations based on the proportion of (1) observed Omicron variant and (2) proportion of population vaccinated.

Consider the following mathematical model. Let $Y_{\ell,t}$ be the observed number of hospitalizations at location ℓ and on day t. We have a point forecaster $\hat{Y}^{(t)}_{\ell,t+\Delta}$ which predicts the number of hospitalizations at location ℓ and day $t+\Delta$ on the basis of data available as of day t. We expect that the relationship between $\widehat{Y}$ and Y depends on the proportion of cases of Omicron variant over all COVID cases, and the proportion of vaccinated residents: denote these by $O_{\ell,t}$ and $V_{\ell,t}$, respectively. We take a simple functional form for the conditional mean function $E[Y_{\ell,t+\Delta}|\widehat{Y}^t_{\ell,t+\Delta}, O_{\ell,t+\Delta}, V_{\ell,t+\Delta}]$: either

$$E[Y_{\ell,t+\Delta}|\widehat{Y}^t_{\ell,t+\Delta}, O_{\ell,t+\Delta}, V_{\ell,t+\Delta}] = (\beta_0 + \beta O_{\ell,t+\Delta}) \cdot \widehat{Y}^t_{\ell,t+\Delta}, \tag{1}$$

or

$$E[Y_{\ell,t+\Delta}|\widehat{Y}^t_{\ell,t+\Delta}, O_{\ell,t+\Delta}, V_{\ell,t+\Delta}] = (\beta_0 + \beta O_{\ell,t+\Delta} + \alpha V_{\ell,t+\Delta}) \cdot \widehat{Y}^t_{\ell,t+\Delta}, \tag{2}$$

or

$$E[Y_{\ell,t+\Delta}|\widehat{Y}^t_{\ell,t+\Delta}, O_{\ell,t+\Delta}, V_{\ell,t+\Delta}] = (\beta_0 + \beta O_{\ell,t+\Delta} + \alpha V_{\ell,t+\Delta} + \gamma O_{\ell,t+\Delta} \cdot V_{\ell,t+\Delta}) \cdot \widehat{Y}^t_{\ell,t+\Delta}. \tag{3}$$

We can use simple linear regression to estimate the coefficients.

There are two operational difficulties with this scheme. First, to be deployed today (call today t^*), we would need to have access to $O_{\ell,t^*+\Delta}$ and $V_{\ell,t^*+\Delta}$. In reality neither are available, so we will need to plug something in for them. Second, these adjust only point forecasts, but we want to adjust distributional forecasters.