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The Illinois Institute for Rural Affairs (IIRA) has been publishing a steady stream of research on Covid-19 for the use of stakeholders such as community economic developers and healthcare practitioners. Most of these publications provide absolute and relative changes in the growth of the virus over time, statistics stakeholders view as important when they examine changes to Covid-19 numbers in their communities. However, caution should be exercised in the use of these statistics when one is interested in the differential growth of the virus in communities. For example, during June 1, 2020 to June 14, 2020, the number of Covid-19 cases in Pike County increased by 100%, and in Cook County by 8%. In absolute numbers, these represent one new case for Pike County, and 6,411 cases for Cook County. In general, absolute numbers overstate the growth of the virus in larger geographies and understate the growth in smaller communities. In contrast, percentage measures tend to overstate the growth of Covid-19 in smaller regions and understate the growth of the virus in larger regions. The shift method that is used in this paper to assess changes in number of Covid-19 cases in Illinois is touted as a remedy for issues with absolute and percentage change metrics.

The Shift Method
This method has been designed to measure the relative size of the change of a variable compared with a benchmark, for example, a growth norm. To calibrate Covid-19 shift

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1 Professor, Illinois Institute for Rural Affairs, Western Illinois University.
2 IIRA has published ten papers on the topic since April 4, 2020; see http://www.iira.org/2020-2021-publications/
3 Inferred from discussions with a convenience sample of stakeholders.
indices for Illinois counties, we categorize counties as metro and nonmetro, and for each of these regions, define the following variables:

(i) Actual change of Covid-19 cases in county \( i \) (\( \Delta V \)):

\[
V_{i,t} = \text{number of cases of Covid} - 19 \text{ for county } i \text{ at time } t;
\]
\[
\Delta V_i = V_{i,t} - V_{i,t-1}.
\]

If \( \Delta V_i < 0 \), the \( i \)th county experienced a decline in Covid-19 cases,
\( \Delta V_i = 0 \), the \( i \)th county experienced no change in Covid-19 cases,
\( \Delta V_i > 0 \), the \( i \)th county experienced an increase in Covid-19 cases.

(ii) Total growth rate (\( K \)) for the region:

\[
K = \frac{\sum_{i=1}^{m} V_{i,t}}{\sum_{t=1}^{m} V_{i,t-1}}, \text{ where } \sum_{i=1}^{m} V_{i,t} \text{ number of cases of Covid-19 for all counties in the region at time period } t; \text{ the denominator is the sum of Covid-19 cases in the region at time } t-1.
\]

(iii) Expected value (\( E(V) \) and \( E(\Delta V) \)):

The expected value of Covid-19 cases at time period \( t \) for a county in the region is the product of the actual value of Covid-19 cases at time \( t-1 \) and the rate of change for all the counties in the region (\( K \)):

\[
E(V_{i,t}) = K V_{i,t-1}.
\]

The expected change in the value of Covid-19 is the difference between \( E(V_{i,t}) \) and \( V_{i,t-1} \); formally:

\[
E(\Delta V_i) = E(V_{i,t}) - V_{i,t-1}
= V_{i,t-1}(K - 1)
\]

(iv) Net Shift in Covid-19 cases for county \( i \) (\( N \)):

It is the difference between actual and expected change in number of Covid-19 cases:

\[
N_i = \Delta V_i - E(\Delta V_i)
\]
Percentage net shift is the relative increase or decrease in Covid-19 cases for a particular county (see Table 1).

To calibrate net shift metrics for Illinois, we classify each of the 102 counties as metro or nonmetro, calculate change norms (see the metrics for $K$ above), and compute net shift scores. In all, 61 counties were classified as nonmetro, and 41 as metro.

**Results**

During the period June 1, 2020 to June 14, 2020, the total absolute increase in Covid-19 cases for the metro region was 10,857; nonmetro counties witnessed 334 new cases. The percentage increase for the metro was 9%, 12% for the nonmetro. Table 1 shows the expected number of Covid-19 cases for the counties. In the metro region, 13 counties registered less-than-expected number of cases; these counties are containing the spread. Of the remaining 28 metro counties with more than expected number of Covid-19 cases, Winnebago, St. Clair, Peoria, and Kane counties register the most deviation from the expected number of cases; deviations range from a low 10% for Kane and a high 25% for Winnebago. Figure 1 shows the distribution of variation in percentage net shift across metro counties, only counties with ±2% net shift scores are shown.

Figure 1. Variation in Percentage Net Shift: Metro Counties

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7 The median net shift score of 2% was used to choose counties for display.
In the nonmetro, some of the not-so-ideal cases, that is, counties with more Covid-19 cases than predicted by the net-shift analysis, had outbreaks in long-term care facilities\(^8\) (for example, Morgan, and McDonough; see Figure 2). In general, the virus growth in a majority of the nonmetro counties (84%) is contained; Randolph County is a case in point, the county’s actual number of Covid-19 cases were 21% lower than the expected number.

**Figure 2. Variation in Percentage Net Shift: Nonmetro Counties with Higher than Expected Number of Covid-19 Cases**

![Percentage Net Shift Graph]

**Conclusion**
This paper was designed to alert economic development practitioners about pitfalls in comparing communities’ Covid-19 cases using absolute and/or relative measures of change; the net shift method is recommended for such comparisons. Net shift computations involve measuring the relative size of increases or decreases in Covid-19 cases in counties vis-à-vis the regional norm.

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Table 1: Covid-19 Cases: Absolute Change and Net Shift from June 1, 2020 to June 14, 2020

<table>
<thead>
<tr>
<th>Metro County</th>
<th>No. of Cases: June 1, 2020</th>
<th>No. of Cases: June 14, 2020</th>
<th>Actual Change (Δvi)</th>
<th>Expected Change (E(Δvi))</th>
<th>Net Shift (Ni)</th>
<th>Scaled Ni %(^9)</th>
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</table>

\(^9\) Ni % = \(\frac{\sum_{Region} |\Delta V_i - E(\Delta V)|}{S} \times 100\), where, \(S = \sum_{Region} |\Delta V_i - E(\Delta V)|\)
<table>
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<th>Nonmetro County</th>
<th>No. of Cases: June 1, 2020</th>
<th>No. of Cases: June 14, 2020</th>
<th>Actual Change ($\Delta v_i$)</th>
<th>Expected Change ($E(\Delta v_i)$)</th>
<th>Net Shift ($N_i$)</th>
<th>$N_i$ %</th>
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<td>No. of Cases: June 1, 2020</td>
<td>No. of Cases: June 14, 2020</td>
<td>Actual Change (Δvi)</td>
<td>Expected Change (E(Δvi))</td>
<td>Net Shift (Ni)</td>
<td>Ni %</td>
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