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ISSUE BRIEF

# FGCU Seasonality Index

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## Introduction

Seasonality is an important feature of the Southwest Florida economy. The workforce region experiences a boost in population between October and April when the snowbird population makes its way down south to avoid the winter season. Local businesses adjust to account for this population influx, ramping up employment levels for the increased demand in goods and services.

In December 2018, the RERI introduced a seasonality index to assist in measuring how important seasonality was to the region. The index, which looked at the peak and trough within a 12-month period, was sufficient during a period of growth, but faced issues at the onset of the Covid-19 pandemic when employment everywhere suddenly dropped. To improve the index and better capture seasonal components of the economy, rather than cyclical and irregular components, in this issue brief, we introduce a new methodology for the FGCU Seasonality Index.

The new index is based on a Mean Seasonal Variation, which looks at the average absolute difference between an unseasoned and seasoned data point over a period. We first introduce the methodology for calculating the index and provide comparisons to the old methodology. Using Southwest Florida as an example, the comparisons illustrate that the trend since 2000 is more consistent under the new methodology, as well as showing that the ordinal rankings do not differ much for the region.

We conclude the issue brief by looking at seasonality in Southwest Florida to learn how seasonal the region is. The data shows that November through April are the most seasonal months for the region, while June through October exhibit much lower employment levels. The region has had a much higher seasonality index than the state since 2000, registering at 1.6 percent in 2021. This index was the third highest in the state for 2021, out of 24 workforce regions. Finally, when looking at seasonality by industry, the most seasonal industries included Agriculture, Forestry, Fishing and Hunting (19.6 percent), Arts, Entertainment, and Recreation (8.1 percent), and Educational Services (4.6 percent).

# Methodology

Prior to this issue brief, the FGCU Seasonality Index relied on a peak-trough method for estimating seasonality within a region. Calculation of the index was simple – over a period of time (typically a 12-month period), the peak-trough method would divide the lowest level of employment (the trough) by the highest level of employment (the peak) and multiply by 100 to obtain a percentage. The result represented the percent change between the highest and lowest employment level during that period.

The calculation was simple and easily digestible for a general audience but was not without its shortcomings. For one, the peak-trough method only looked at two months within a 12-month period and said nothing else regarding seasonality patterns for the other ten months. Moreover, the method did not address the cyclical or irregular components of employment.

To address these issues, a new methodology was proposed for the calculation of the FGCU Seasonality Index. The new index replaces the peak-trough method of determining seasonality with the calculation of the Mean Seasonal Variation (MSV). The MSV represents the average absolute difference between an unseasoned variable and seasoned variable over a length of time. In formal terms, the MSV is defined as follows:

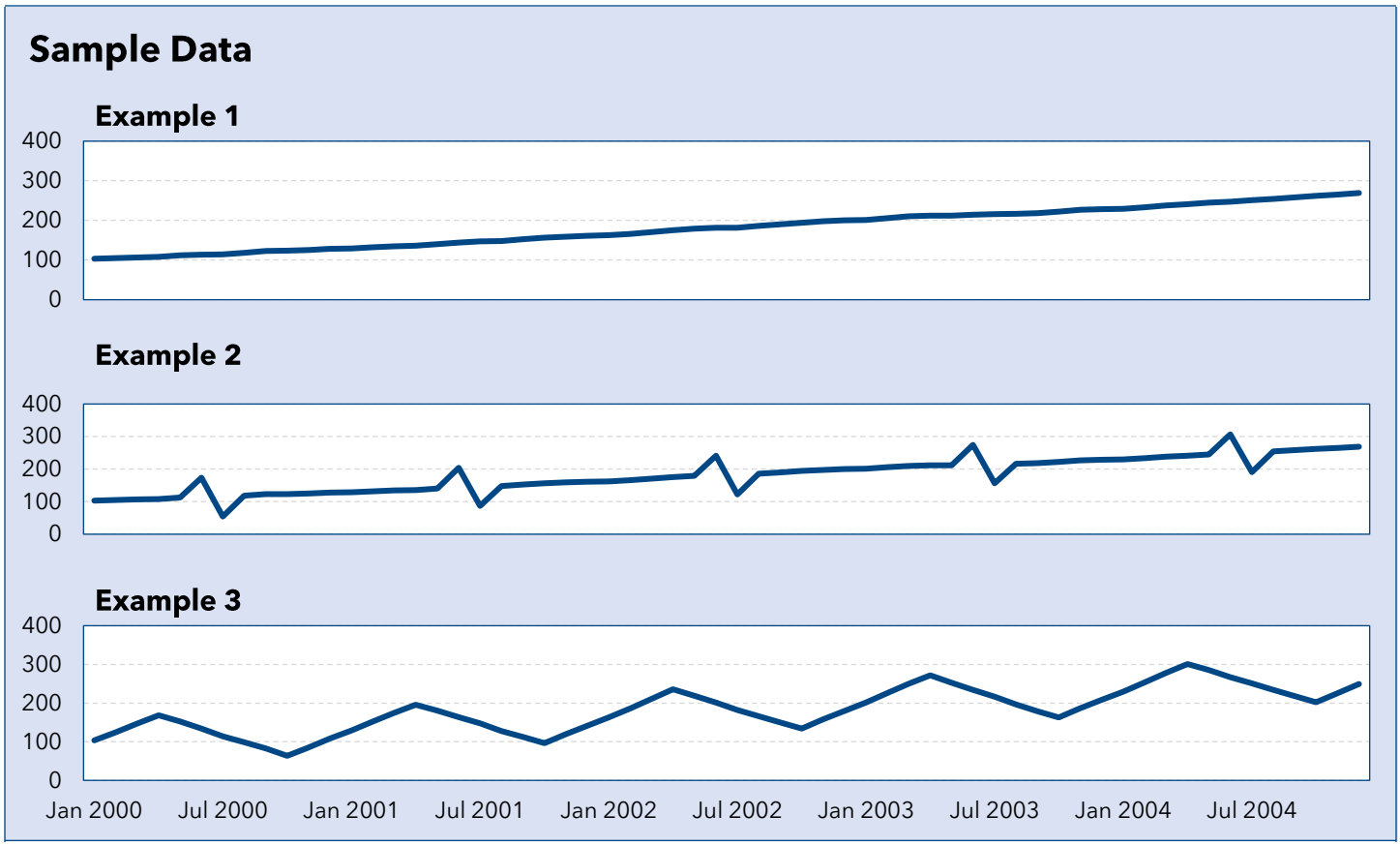
$$MSV = \left(\sum_{t=1}^{T}\left|\frac{U_t - S_t}{S_t}\right|\right)\Big/T$$

Where $U_t$ is the unseasoned variable in time $t$, $S_t$ is the seasoned variable in time $t$, and $T$ is the length of the period. For this issue brief, the primary variable used is monthly private employment, making $T = 12$.[1]

This method addresses the two shortcomings of the peak-trough method. First, the MSV incorporates all 12 months of data into the calculation instead of two. Second, the MSV looks to capture only variation caused by seasonal fluctuations in the economy by seasonally adjusting the data prior to taking the differences.

Data used in this issue brief is obtained from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW). Furthermore, data is seasonally adjusted using the U.S. Census Bureau X13 ARIMA-SEATS Seasonal Adjustment model.

[1] *The MSV is not limited to employment and can be applied to other variables that exhibit seasonal patterns (e.g. sales, tax revenues, airport passenger activity)*




# Index Comparison

The peak-though method relies only on two points in time, thus better measuring the volatility rather than the seasonality. The MSV method, in turn, is a comparison of seasoned and unseasoned data, thus measuring the extent to which the unseasoned data differs from the seasoned data.

To illustrate these differences, we simulated data (illustrated above) to learn the differences between both methods and why the MSV method is preferred over the peak-trough method. Example 1 illustrates an economy with little to no fluctuation over a period of time. Example 2 shows the same economy as Example, except it experiences a shock in employment during June and an equal drop in employment in July, before returning to normal. Finally, Example 3 depicts an economy with similar peaks and troughs as Example 2, but gradually increases and decreases over the 12-month period.

The average annual employment for all three examples would be the same if calculated. However, all three examples yield different indices for the peak-trough method and the MSV method (shown in the table below). In Example 1, the peak-trough method suggests that there is seasonality in the dataset, while the MSV method shows no seasonal variation at all. The peak-trough method also suggests that the data in Example 2 is more seasonal than Example 3, while the MSV method suggests the opposite. By construction, we know that Example 3 has a more seasonal pattern than Example 2. Lastly, we observe that the peak-trough method does exhibit higher variability.

# Index Comparison

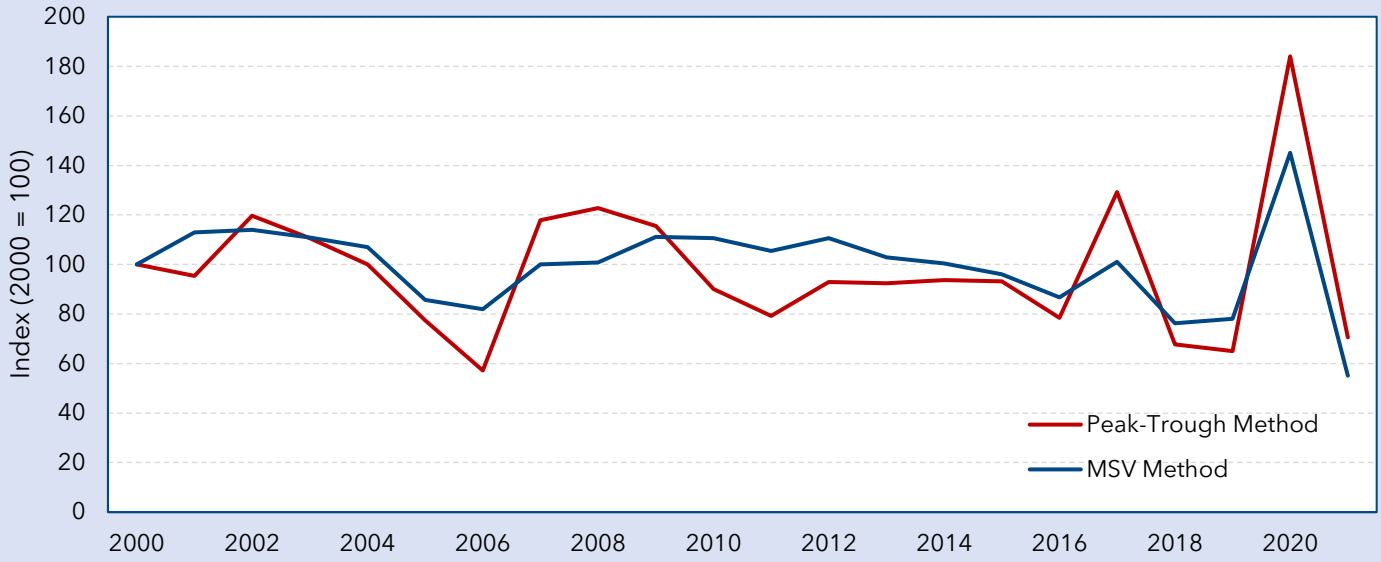
Peak-Trough vs. MSV

| Example/Method | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| Example 1 | | | | | |
| Peak-Trough | 0.19 | 0.20 | 0.19 | 0.12 | 0.15 |
| MSV | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Example 2 | | | | | |
| Peak-Trough | 0.69 | 0.57 | 0.50 | 0.43 | 0.38 |
| MSV | 0.09 | 0.07 | 0.06 | 0.05 | 0.04 |
| Example 3 | | | | | |
| Peak-Trough | 0.62 | 0.51 | 0.43 | 0.40 | 0.33 |
| MSV | 0.26 | 0.21 | 0.16 | 0.14 | 0.12 |

*Source: Simulated data generated using R.*

**FGCU Seasonality Index**

Peak-trough method vs. mean Seasonal variation method




*Source: RERI Analysis of QCEW data obtained from the U.S. Bureau of Labor Statistics*
*Prepared by the Regional Economic Research Institute*

# Southwest Florida Index Comparison

A comparison of the seasonality index in Southwest Florida using both the peak-trough method and the MSV method can be found in the graph above. Both series were indexed to the 2000 value to see how they compare over time. As expected, the MSV method exhibited less volatility than the peak-trough method over the 21-year period. This was especially true during the recessionary periods of the late 2000s and beginning of 2020.

We also use both methods to look at how Southwest Florida ranked between 2018 and 2021 in the table below. Between 2018 and 2020, the Southwest Florida workforce region was ranked in the top five for most seasonal economies in the state, regardless of the method used. Both rankings saw a dip in seasonality in 2021, with the peak-trough method showing a slightly larger decline.

**FGCU Seasonality Index**

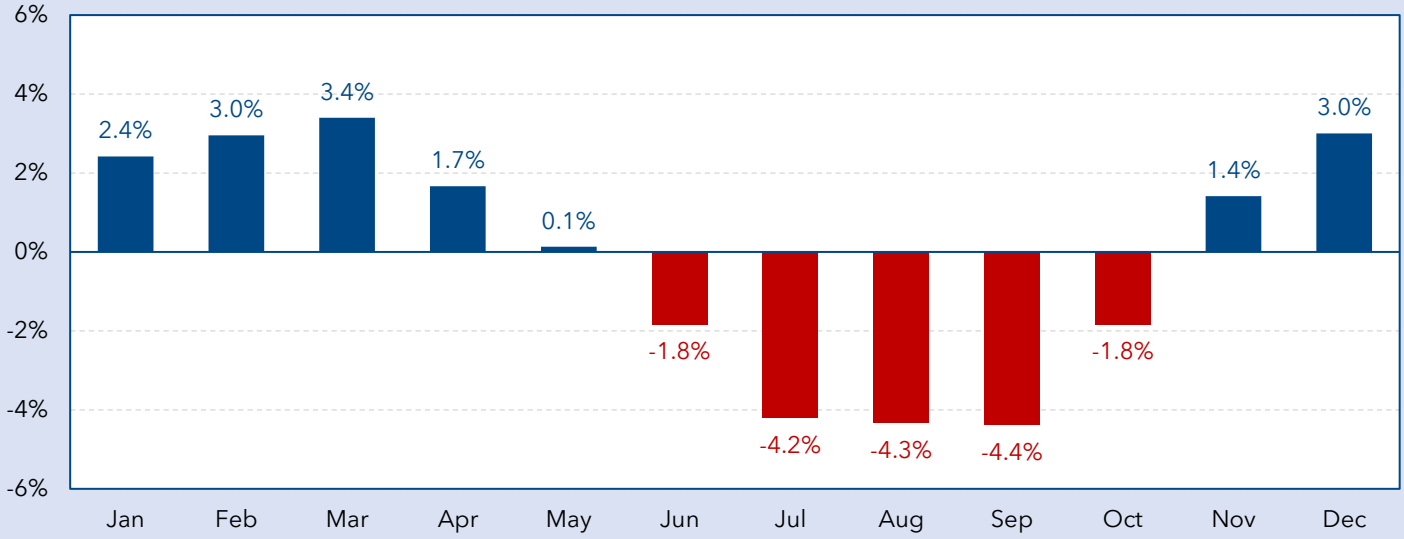
Peak-Trough vs. MSV

| Method | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|
| Peak-Trough | 5th | 3rd | 3rd | 8th |
| MSV | 3rd | 2nd | 1st | 3rd |

*Source: RERI Analysis of QCEW data obtained from the U.S. Bureau of Labor Statistics*

## Average Seasonal Difference

Southwest Florida
2000 to 2021



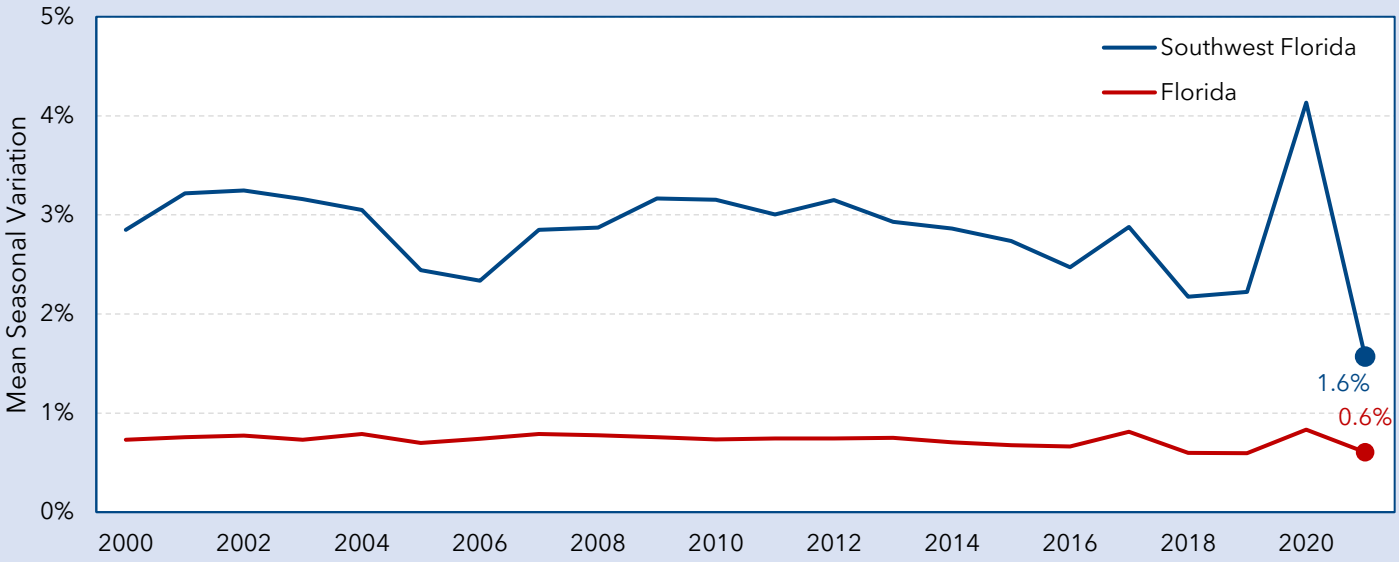

*Source: RERI Analysis of QCEW data obtained from the U.S. Bureau of Labor Statistics*
*Prepared by the Regional Economic Research Institute*

# Southwest Florida Seasonality by Month

The chart above shows the average percent differences between the observed value and the seasonal values, by month, in Southwest Florida from 2000 to 2021. November through April tend to be the months considered "in season" for the region, and employment data backs this up. On the other hand, June through October tend to be the off season months for the region, when firms shutdown and temporarily cut back on employment as demand for goods and services decline.

**FGCU Seasonality Index**

Southwest Florida




*Source: RERI Analysis of QCEW data obtained from the U.S. Bureau of Labor Statistics*
*Prepared by the Regional Economic Research Institute*

# Southwest Florida Seasonality

Using the new methodology, we compare seasonality in Southwest Florida to the state overall. Southwest Florida had an index of 1.6 percent in 2021, compared to 0.6 percent for the state. Historically, the region has trended above the state since 2000.

# Seasonality by Workforce Region

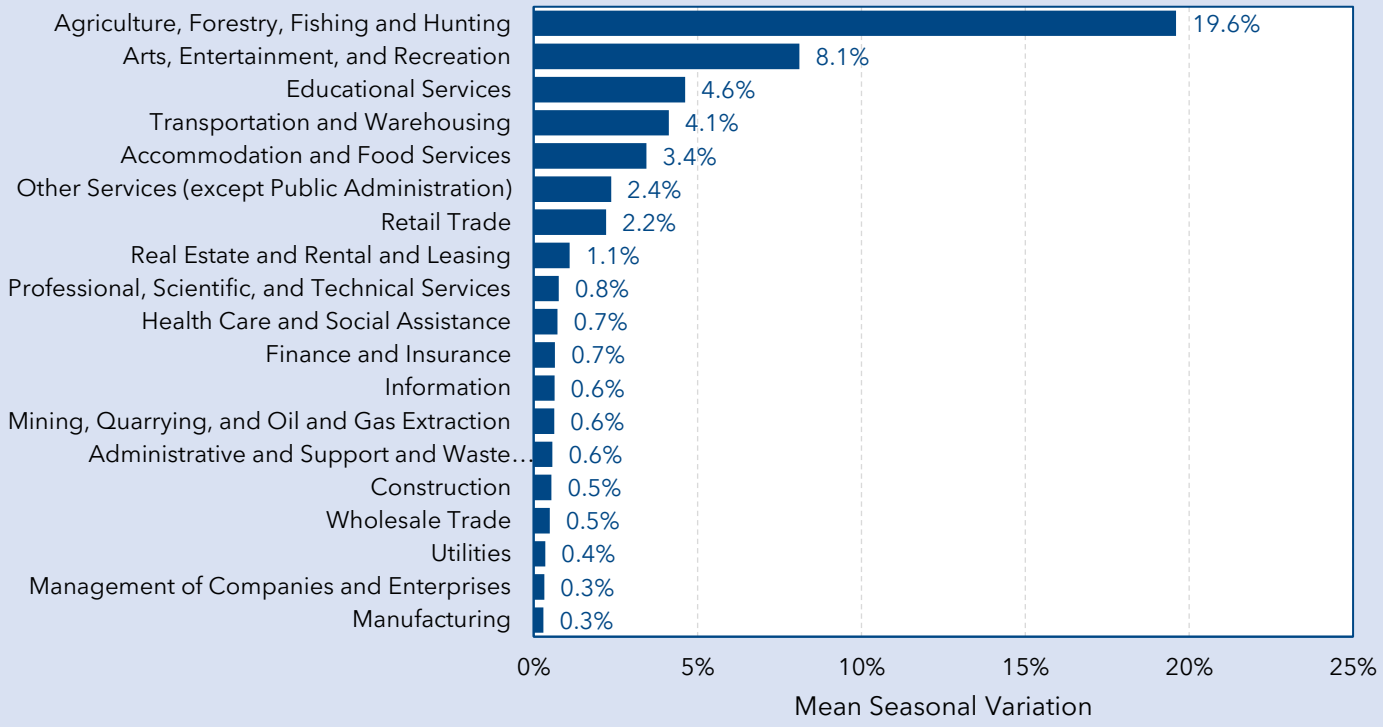
The region also experiences more seasonal fluctuations than all but two of the Florida workforce regions. Only the Heartland workforce region (1.7 percent in 2021) and the Okaloosa Walton workforce region (1.6 percent) had a higher index than Southwest Florida.

**FGCU Seasonality Index**
2021

| Rank | Workforce Region | MSV |
|---|---|---|
| 1 | Heartland | 1.7% |
| 2 | Okaloosa Walton | 1.6% |
| **3** | **Southwest Florida** | **1.6%** |
| 4 | Gulf Coast | 1.4% |
| 5 | Suncoast | 1.2% |
| 6 | Research Coast | 1.0% |
| 7 | Capital Region | 0.9% |
| 8 | Palm Beach County | 0.9% |
| 9 | Polk | 0.8% |
| 10 | Tampa Bay | 0.8% |
| 11 | North Central Florida | 0.8% |
| 12 | Florida Crown | 0.7% |
| 13 | Northeast Florida | 0.6% |
| 14 | South Florida | 0.6% |
| 15 | Flagler Volusia | 0.6% |
| 16 | Broward | 0.5% |
| 17 | Citrus Levy Marion | 0.5% |
| 18 | North Florida | 0.5% |
| 19 | Central Florida | 0.5% |
| 20 | Pasco Hernando | 0.5% |
| 21 | Escarosa | 0.5% |
| 22 | Chipola | 0.4% |
| 23 | Pinellas | 0.3% |
| 24 | Brevard | 0.3% |

*Source: RERI Analysis of QCEW data obtained from the U.S. Bureau of Labor Statistics*

**FGCU Seasonality Index**
Southwest Florida
2021




*Source: RERI Analysis of QCEW data obtained from the U.S. Bureau of Labor Statistics*
*Prepared by the Regional Economic Research Institute*

# Most Seasonal Industries in Southwest Florida

The chart above shows the index for each industry in Southwest Florida. In 2021, Agriculture, Forestry, Fishing and Hunting had the highest index (measured at 19.6 percent), followed by arts, entertainment, and recreation (8.1 percent), educational services (4.6 percent) and transportation and warehousing (4.1 percent). Accommodation and food services (3.4 percent), other services (2.4 percent) and retail trade (2.2 percent) were the other industries with an index above the regional average in 2021.

# Appendix: Example Data

The R code shown below was used to generate the sample data for Examples 1 to 3.

```
library(dplyr)
library(tidyverse)
library(seasonal)

## Creating data
set.seed(16)
noise <- runif(60, 0, 5)
date <- c(seq(as.Date("2000/01/01"), as.Date("2004/12/01"), "months"))
seas_1 <- c(0, 0, 0, 0, 0, 60, -60, 0, 0, 0, 0, 0, 0, 0, 0, 0, 60, -60, 0, 0,
            0, 0, 0, 0, 0, 0, 0, 0, 60, -60, 0, 0, 0, 0, 0, 0, 0, 0, 0, 60,
            -60, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 60, -60, 0, 0, 0, 0, 0)
seas_2 <- c(0, 20, 40, 60, 40, 20, 0, -20, -40, -60, -40, -20, 0, 20, 40, 60,
            40, 20, 0, -20, -40, -60, -40, -20, 0, 20, 40, 60, 40, 20, 0, -20,
            -40, -60, -40, -20, 0, 20, 40, 60, 40, 20, 0, -20, -40, -60, -40,
            -20, 0, 20, 40, 60, 40, 20, 0, -20, -40, -60, -40, -20)

## Generating dataset
data <- data.frame(noise) %>%
  mutate(start = 100,
         date = date,
         cumulative_noise = cumsum(noise),
         example_1 = start + cumulative_noise,
         example_2 = example_1 + seas_1,
         example_3 = example_1 + seas_2) %>%
  select(date, example_1, example_2, example_3) %>%
  pivot_longer(!date, names_to = "example", values_to = "emp")


## Calculating Peak-Trough
peak_trough_calc <- data %>%
  mutate(year = lubridate::year(date)) %>%
  group_by(year, example) %>%
  summarise(min_emp = min(emp),
         max_emp = max(emp)) %>%
  mutate(peak_trough = 1 - (min_emp/max_emp)) %>%
  select(year, example, peak_trough)

## Calculating MSV
msv_calc <- data.frame()
for(i in 1:3){

  temp <- data %>%
    filter(example == paste0("example_", i))

  temp_ts <- ts(temp$emp, start = c(2000, 1), end = c(2004, 12), frequency = 12)
  m <- seas(temp_ts)

  temp <-cbind(temp, m$series$s12) %>%
    mutate(diff = emp - m$series$s12,
           seasonal_variation = abs(diff)/m$series$s12,
           year = lubridate::year(date)) %>%
    group_by(year, example) %>%
    mutate(msv = mean(seasonal_variation, na.rm = T)) %>%
    summarise(msv = mean(msv, na.rm = T))

  msv_calc <- bind_rows(msv_calc, temp)

}

## Binding datasets
agg_data <- data.frame()
agg_data <- left_join(peak_trough_calc, msv_calc, by = c("year", "example"))
```