

## Cross-Sectional Data

**Cross-sectional data** are measurements created at approximately the same period of time.

DEFINITION

For example, consider the life expectancy at birth in 2020 for selected countries given in Table 2.5.2.<sup>85</sup>

Country	Life Expectancy
Afghanistan	66
Australia	84
Botswana	70
Egypt	73
Guatemala	75
Japan	85
Kenya	67
Sierra Leone	56
Spain	84
Sri Lanka	78
Sweden	83
United Kingdom	82
United States	79

The data in table 2.5.2 represents cross-sectional measurements since the measurements were made in the same time period (2020). People in Japan are expected to live on average until age 85—about 6 years longer than the average for Americans. Developed countries such as Australia and the United States generally have higher life expectancies than developing countries such as Sierra Leone and Kenya. But according to the World Health Organization, life expectancies in developing countries are on the rise due to medical interventions based on advanced technology and drugs. In fact, developing countries are expected to experience a massive increase in their elderly populations over the next 25 years. Most of the statistical methods developed in this text are devoted to cross-sectional data.

## 2.5 Exercises

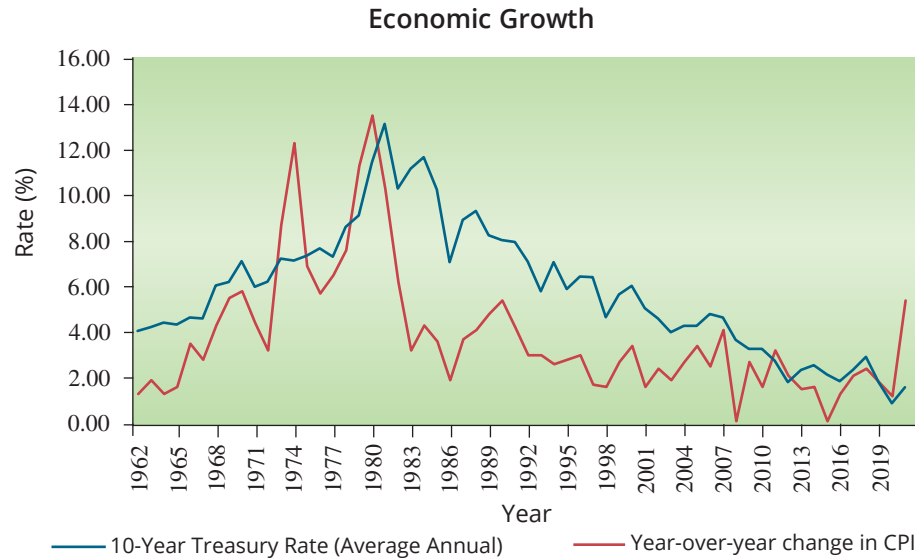
### Basic Concepts

1. What are time series measurements?
2. What problems are associated with the concept of population when studying time series data?
3. What is a stationary process?
4. What is a nonstationary process?

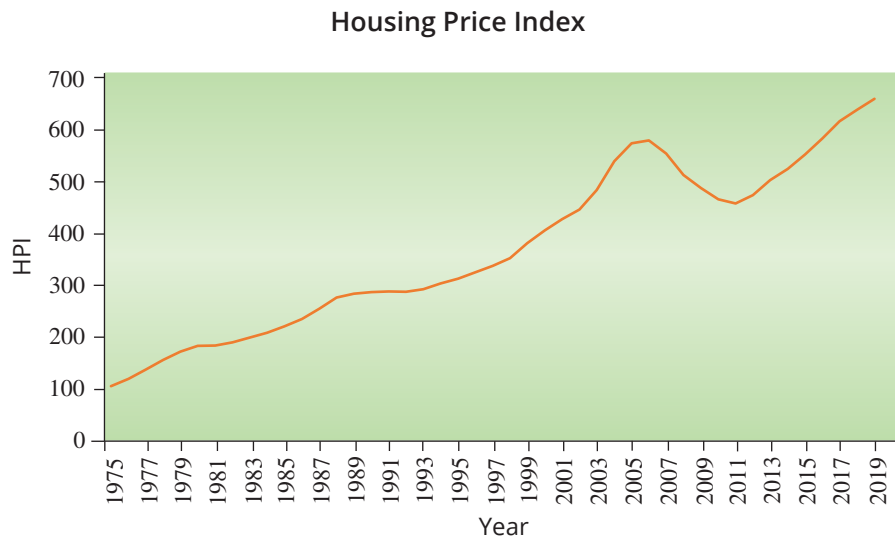
5. What is a trend? If a time series has an ‘upward trend,’ what does this mean?
6. What is cross-sectional data?
7. What is the difference between cross-sectional data and time series data?

## Exercises

8. Consider the following graph of long-term interest rates (10-year treasury notes) and inflation rates reported as the year over year change in the consumer price index:<sup>86</sup>



- a. Are the long-term interest rates presented above time series or cross-sectional data?
  - b. Are the inflation rates (change in CPI) presented above time series or cross-sectional data?
  - c. For each of parts **a.** and **b.**, if the data is time series data, does it appear to be stationary or nonstationary?
9. The Housing Price Index (HPI) is calibrated using appraisal values and sales prices for mortgages bought or guaranteed by Fannie Mae and Freddie Mac. The HPI values reflect the base year being used (annual appreciations are the same), with the index value having a base of 100 when first recorded in 1975.<sup>87</sup>



### Data

The data set is available on [stat.hawkeslearning.com](http://stat.hawkeslearning.com) under **Discovering Statistics and Data, Fourth Edition > Data Sets > Long Term Interest Rates.**

### Data

The data set is available on [stat.hawkeslearning.com](http://stat.hawkeslearning.com) under **Discovering Statistics and Data, Fourth Edition > Data Sets > Housing Price Index.**

- a. Is the data time series or cross-sectional?  
 b. If the data is time series data, does it appear to be stationary or nonstationary?

10. The following table shows the annual average crude oil price from 1946 through 2023.<sup>88</sup> Prices are adjusted for inflation to February 2023 prices using the Consumer Price Index (CPI-U) as presented by the Bureau of Labor Statistics. Inflation adjusted prices were at an all-time high in 1980, reaching \$136.79 dollars per barrel. Crude oil prices reached an all-time low in 1998 (lower than the price in 1946!) when the price per barrel dipped to \$21.99. Using the data in the table, discuss if the data set contains time series or cross-sectional data. Also, discuss the data and make some inferences. That is, can you explain some of the fluctuations in the oil prices? [Note: The nominal price is the actual price (in dollars) in the specified year.]

Annual Average Domestic Crude Oil Prices (\$ per Barrel)								
Year	Nominal	Inflation Adjusted Price (Feb 2023)	Year	Nominal	Inflation Adjusted Price (Feb 2023)	Year	Nominal	Inflation Adjusted Price (Feb 2023)
1946	\$1.63	\$24.73	1972	\$3.60	\$25.90	1998	\$11.91	\$21.99
1947	\$2.16	\$29.06	1973	\$4.75	\$31.92	1999	\$16.56	\$29.83
1948	\$2.77	\$34.67	1974	\$9.35	\$56.96	2000	\$27.39	\$47.83
1949	\$2.77	\$35.00	1975	\$12.21	\$68.22	2001	\$23.00	\$39.09
1950	\$2.77	\$34.64	1976	\$13.10	\$69.27	2002	\$22.81	\$38.12
1951	\$2.77	\$32.11	1977	\$14.40	\$71.45	2003	\$27.69	\$45.29
1952	\$2.77	\$31.39	1978	\$14.95	\$68.99	2004	\$37.66	\$59.93
1953	\$2.92	\$32.77	1979	\$25.10	\$103.06	2005	\$50.04	\$77.01
1954	\$2.99	\$33.50	1980	\$37.42	\$136.79	2006	\$58.30	\$86.98
1955	\$2.93	\$32.86	1981	\$35.75	\$118.45	2007	\$64.20	\$92.98
1956	\$2.94	\$32.56	1982	\$31.83	\$99.30	2008	\$91.48	\$127.41
1957	\$3.14	\$33.60	1983	\$29.08	\$87.86	2009	\$53.48	\$74.86
1958	\$3.00	\$31.27	1984	\$28.75	\$83.28	2010	\$71.21	\$98.24
1959	\$3.00	\$30.96	1985	\$26.92	\$75.28	2011		
1960	\$2.91	\$29.63	1986	\$14.44	\$39.62	(Partial)	\$87.04	\$116.42
1961	\$2.85	\$28.68	1987	\$17.75	\$46.99	2012	\$86.46	\$113.31
1962	\$2.85	\$28.34	1988	\$14.87	\$37.88	2013	\$91.17	\$117.73
1963	\$2.91	\$28.61	1989	\$18.33	\$44.62	2014	\$85.60	\$108.73
1964	\$3.00	\$29.10	1990	\$23.19	\$53.24	2015	\$41.85	\$53.12
1965	\$3.01	\$28.72	1991	\$20.20	\$44.62	2016	\$36.34	\$45.50
1966	\$3.10	\$28.74	1992	\$19.25	\$41.27	2017	\$43.97	\$53.96
1967	\$3.12	\$28.15	1993	\$16.75	\$34.90	2018	\$57.77	\$69.20
1968	\$3.18	\$27.46	1994	\$15.66	\$31.78	2019	\$50.01	\$58.84
1969	\$3.32	\$27.24	1995	\$16.75	\$33.07	2020	\$32.25	\$37.45
1970	\$3.39	\$26.28	1996	\$20.46	\$39.22	2021	\$60.84	\$67.41
1971	\$3.60	\$26.75	1997	\$18.64	\$34.94	2022	\$87.40	\$89.90
						2023		
						(Partial)	\$70.58	\$70.78

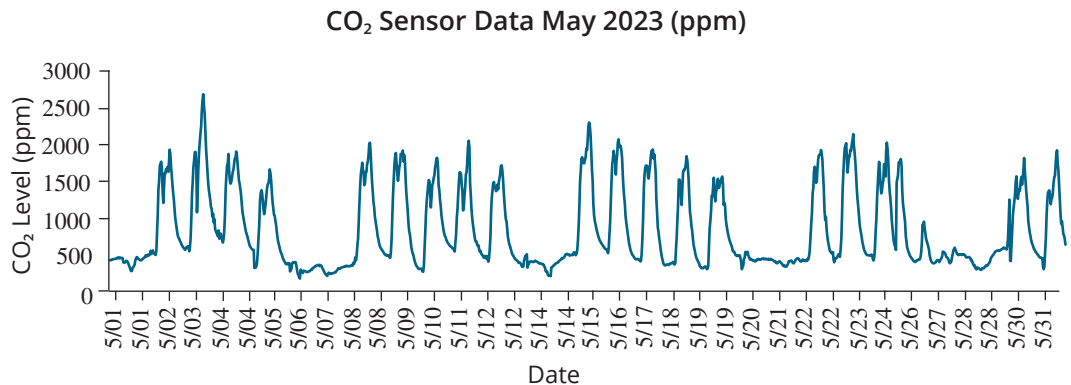
### Data

The data set is available on [stat.hawkeslearning.com](https://stat.hawkeslearning.com) under **Discovering Statistics and Data, Fourth Edition > Data Sets > Domestic Crude Oil Prices.**

## Data

The data set is available on [stat.hawkeslearning.com](http://stat.hawkeslearning.com) under **Discovering Statistics and Data, Fourth Edition > Data Sets > CO<sub>2</sub> Sensor Data**.

11. The data depicted below is one month of CO<sub>2</sub> sensor data measured in parts per million (ppm) levels at an office complex. Is this data stationary or non-stationary? What is the level of measurement of the data?



## CR Chapter Review

### Key Terms and Ideas

- Big Data
- Volume
- Variety
- Velocity
- Veracity
- Scale
- Measurement
- Level of Measurement
- Ratio Data
- Interval Data
- Ordinal Data
- Nominal Data
- Fuzzy Concepts
- Confounding Variable
- Peer Review
- The Scientific Method
- Experimental Design
- Controlled Experiment
- Control Group
- Experimental Group
- Treatment
- Explanatory Variable
- Response Variable
- Completely Randomized Design
- Before and After Study
- The Placebo Effect
- Double-Blind Study
- Single-Blind Study
- Observational Study
- Simpson's Paradox
- Surveys
- Bias
- Structured Data
- Unstructured Data
- Qualitative Data
- Quantitative Data
- Discrete Data
- Continuous Data
- Time Series Data
- Stationary Process
- Nonstationary Process
- Trend
- Cross-Sectional Data