Data Literacy Contributes to Critical Thinking: FRED for the Classroom

Kathy Cosgrove
Mary Suiter
Scott Wolla

Federal Reserve Bank of St. Louis

The authors make the case that data literacy is a key component to critical thinking in the world today. They describe the Federal Reserve Economic Data (FRED) database and how it can be used. They provide a classroom lesson that uses FRED to help students gain an understanding of inflation and price stability.

Keywords: Data Literacy, Critical Thinking, Data, Inflation, Economics, Personal Finance

Introduction

The goals of this article are to illustrate the link between data literacy and critical thinking, to introduce the reader to Federal Reserve Economic Data (FRED), and to provide a lesson for using FRED in a high school classroom.

Data Literacy and Critical Thinking

Information reaches us quickly and often with an inherent bias or agenda. The Internet and multiple media formats—including television, laptops, smartphones, iPads, and so on—bombard us with a nearly endless combination of commentary and facts. We need to recognize and analyze the appropriate information to make informed decisions.

Many researchers and institutions have described the ability to recognize and analyze data. “Data literacy” is described in the National Science Foundation’s Thinking with Data project (National Science Foundation [NSF], 2009) as the ability to ask and answer questions by collecting and making sense of the data encountered in daily life. Bloom’s revised taxonomy (Leslie Wilson, 2009) correlates data literacy with the top three levels of cognition: analysis, evaluation, and creation. Edward Glaser provides a more formal definition of critical thinking in general in his influential 1941 study (italics added): “to comprehend and use language with accuracy, clarity, and discrimination, to interpret data, to appraise evidence and evaluate arguments...to put to test the conclusions and generalizations at which one arrives...and to render accurate judgments about specific things and qualities in everyday life.”

Data literacy is clearly a complementary aspect of critical thinking as outlined by Glaser, Bloom, and others. It contributes to critical thinking by requiring individuals to understand data and use the data to answer questions, evaluate alternatives, and make judgments. As Lauren B. Resnick and Megan Williams Hall (1998) observe, “What we know now is that just as facts do
not constitute true knowledge and thinking power, so thinking processes cannot proceed without something to think about.” Increasingly, in learning environments that prepare students for the modern world, data provide the substance—*something to think about*—but critical-thinking skills enable the learner to interpret the data in useful ways.

Data literacy contributes to the development of informed citizens in a democratic society. Nearly every public issue under discussion—from reducing the budget deficit to health care reform, Social Security, and inflation—depends on data, analysis, evaluation, and inference. In other words, society’s participants need to be able to think critically about data and information, support arguments, make legitimate projections, and suggest reasonable policies (Steen, 1999). People also need these skills for the basic personal and societal aspects of their daily lives: which telephone service to choose, whether to buy a house or rent, how to save and invest, what car to buy, and so on.

George W. Cobb and David S. Moore (1997) point out that, in most mathematics, “context is part of the irrelevant detail...[but] in data analysis, context provides meaning.” Data literacy requires cross-curricular contributions; students’ personal and societal decisions take place outside mathematics classes. And, social studies, including economics, is a curricular area that offers context and data for analyzing important problems (P. Vahey et al., 2010).

**Federal Reserve Economic Data**

Although much information and data—economic and otherwise—are available on the Internet, it often can be challenging to find reliable, easy-to-use data sources for the classroom. FRED (Federal Reserve Economic Data) is a freely available database provided by the Federal Reserve Bank of St. Louis. The database offers a wide range of easily accessed data for students and teachers to examine and manipulate. The FRED database is well known among economists, aggregating 44,000 time series from a variety of regional, national, and international data sources. These sources include the Bureau of Labor Statistics, the Department of Commerce, the Bureau of Economic Analysis, the Federal Reserve Board, the Organisation for Economic Co-operation and Development, the International Monetary Fund, and other government entities. The date released by the U.S. government are in the public domain, so there is no charge for their use and no permission is required to include this information in FRED. Some series are from commercial or international sources, so, while they are free on FRED and can be used in the classroom, publishing them in another resource requires the permission of the owner. All of the data are extracted from the originating agencies to avoid errors. The database is updated every business day.

The most commonly cited benefit of the FRED database is that it compiles its data from numerous sources to provide users with a convenient “one-stop shop.” Users can find series on the same topic from several different sources, allowing for interesting comparisons and critical analysis. Other notable features of FRED include free user accounts allowing users to save data series and graphs; updates when new data are released; and the ability to construct customized graphs of any time series contained in FRED and combine several different series (e.g., to use gross domestic product [GDP] and consumption to determine the percent consumption expenditures contribute to GDP).

The powerful FRED tool, originally designed for professional economists, is now used by a much broader audience. To help bridge this gap, the Economic Education Department is now taking further steps to make FRED accessible to high school social studies, economics, and
personal finance teachers, and their students, by creating several new resources designed specifically for these audiences. These tools are available via a new website, *Page One Economics*. The site contains a subset, or “starter set” of the 50 most fundamental data series contained in the larger FRED database. This subset—also referred to as “Top Economic Indicators”—makes it easier for students to locate and use the appropriate data series. In addition, the new website includes brief tutorials for students on how to use FRED, as well as “Data Practice Using FRED” lessons with accompanying video tutorials geared toward undergraduate introductory economics students and high school Advanced Placement (AP) economics students. The step-by-step lessons take students through the process of using FRED to find particular economic indicators, create charts, and view data, while helping them learn about basic economic concepts, such as measures of inflation, employment and unemployment, and debts and deficits. The lesson plan on inflation and price stability included in this article was originally a Data Practice Using Fred lesson, but has been modified slightly to be age appropriate for high school students.

Another component of the *Page One Economics* website is an economic information newsletter covering current economic issues and basic economic concepts. A classroom edition is available for high school teachers and students, providing economic data to accompany the newsletter essay and questions designed to develop critical-thinking skills in economics. The answers to the questions are provided so that teachers have a ready-made lesson to supplement their curriculum. There is also a “For Further Discussion” section with additional suggestions for discussion and/or other related activities. The newsletter is available free via e-mail or RSS feed. The new site “went live” in early 2012.

**Lesson Plan: What FRED Says about Price Stability**

Understanding inflation is not intuitive. It is a concept that requires instruction and refining. Students often understand the basic meaning of inflation as rising prices but have difficulty understanding the complexities. While students, for example, might realize the individual effects of inflation, it is easy for them to overlook the importance of price stability for the broader economy. It often is difficult for students and others to make distinctions between the changes in the prices of individual goods such as gasoline and the broader measure of inflation. Finally, while students may realize that inflation can cause problems, they may not recognize the harmful effects that might result from deflation, a falling price level. In the following lesson, students use critical-thinking skills to address the topics inflation, disinflation, and deflation.

**Materials Required for the Lesson**

- Computer with Internet access
- Activity 1, *What FRED Says about Price Stability*, one copy per student (see Appendix D).
- Visuals 1, 2, and 3 (see Appendices A, B, and C).

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¹ *Liber8* is the predecessor to the *Page One* newsletter.
Instructional Procedures

1. Show students a balloon. Inflate the balloon and tie the end shut. Ask: What does the word “inflation” mean? (Answers will vary.) After discussing, tell students that the dictionary defines inflation as the act of inflating: to cause to expand or distend with air or gas. Ask:
   - What other items, besides balloons, can be inflated? (Students might mention bicycle and car tires, water toys, or air mattresses.)
   - Show students a one-dollar bill. Ask: Can a one-dollar bill be inflated? (Not in the same way—filling with air.)

2. Show students Visual 1 (see Appendix A). Tell the students that economists define inflation as a rise in the general or average price level of all goods and services in an economy. Ask:
   - What is actually rising if inflation is happening? (Average price level is rising.)
   - If prices are rising, but my one-dollar bill still has a one on it, what is happening to the purchasing power of my dollar? (It is decreasing; one dollar no longer buys as much as it could before the prices went up.)

3. Using a pin, poke a small hole in the balloon, letting the air out slowly. Ask:
   - How would you define deflation? (To deflate is to release air from something, to depress or reduce.)
   - Show students a one-dollar bill. Ask: Can a one-dollar bill be deflated? (Not in the same way—filling with air.)

4. Show students Visual 1. Tell the students that economists define deflation as a decrease in the general or average price level of all goods and services in an economy. Ask:
   - What is actually decreasing if deflation is happening? (Average price level is falling.)
   - If prices are falling, but my one-dollar bill still has a one on it, what is happening to the purchasing power of my dollar? (It is increasing; one dollar buys more than before the prices went down.)

5. Explain that, when considering the health of the economy, economists want to know what is happening to the price of goods and services from one time period to another. People produce and consume thousands of different products each year. The prices of some of these products may be increasing by a little or a lot during a year. Some prices may be decreasing a little or a lot. Other prices may not change at all from one year to the next. Ask students the following and allow some time for them to work with a partner to identify possibilities: Given all of the possible price changes, how would you determine whether the economy is experiencing inflation or deflation from one time period to another? (Accept a variety of answers.)

6. Discuss student suggestions. Help them identify positive and negative aspects of their suggestions.

7. Explain that inflation is measured using the consumer price index (CPI). Read the definition of CPI from Visual 2 (see Appendix B). Ask:
   - What is being compared in the process of measuring inflation? (The cost of a market basket at two points in time.)
   - How does this correspond with the ideas generated by the class? (Answers will vary.)

8. Tell the students to imagine that the market basket is a literal basket, like the one on Visual 2. Point out that the basket had a cost of $100 in year one and $103 in year two. Ask:
   - What happened to the price level? (The price level went up.)
Is this inflation or deflation? (Inflation, because the price level is rising.)

The cost of the market basket includes all of the things in the basket. Do you think that just because the cost of the entire basket went up, the cost of everything in the basket went up as well? (Answers will vary. Suggest to students that the prices of the items in the basket may have varied greatly. Some may have gone up a little; others may have increased a lot, while others may have fallen in price.)

Tell students that the inflation rate is just a calculation showing the percentage change in the price level. Show students the formula and work through the mathematics with them. What is the inflation rate? (3 percent)

If we were speaking of deflation, how would this have looked differently? (The cost for year two would have been less than the cost in year one. So, year one may still be $100, but year two may have been $98. In this case, the inflation rate is 2 percent, if there is 2 percent deflation.)

Suppose that a friend said the following, “We are suffering from deflation because the prices of iPads and flat screen televisions are decreasing.” How would you respond? (Although these prices are decreasing, that doesn’t mean that the economy is experiencing deflation. Other prices may be increasing at the same time.)

9. Read the definition of disinflation with students from Visual 1. Ask:
   - If inflation is a rising price level, and deflation is a falling price level, how is it different from disinflation? (Disinflation is a smaller inflation rate than the prior period.)
   - Using our examples, if the inflation rate from year one to year two was 3 percent, what would the inflation rate need to be for year three to show disinflation? (1 percent or 2 percent. Any number greater than 0 and less than 3 would be acceptable.)

10. Ask: What is a recession? (Answers will vary.) Read the definition of recession from Visual 1. Ask:
   - What kinds of events do you associate with recessions? (Answers will vary. Students might associate people losing their jobs with recession.)
   - What do you think typically happens to price level during recessions? (Answers will vary. Tell students that a recession is a decline in economic activity. Tell students that when economic activity slows, businesses often have to reduce their prices to sell their goods and services. As a result, the inflation rate decreases [disinflation] or can even be negative [deflation] during a recession.)

11. Distribute Activity 1 (see Appendix D) and give students time to work individually or in groups. Answers for Activity 1 are located below the closure section at the end of this lesson. When students are finished, show the first graph on Visual 3 (see Appendix C) and discuss the following:
   - What is the trend in the CPI for the past 60 years? (Gradually rising.)
   - What part of the line seems unusual? (2008-2009 shows the line dropping.)
   - Do you see a pattern to what happens to the price level during recessions, as indicated by the gray bars? (The line flattens during and/or shortly after the recession bars.)
Why would a recession cause price levels to flatten or even drop? (*The decrease in economic activity puts less upward pressure on prices. In some cases it might even put downward pressure on prices.*)

12. Show students the second graph on Visual 3. Remind the students that this graph uses the same data, but shows them as a percent change from a year ago so it is easier to see changes in the number, rather than long-term trends. This graph is specifically about the inflation rate, the percent change. Ask:
   - Can you see examples of inflation on the graph? In what years? (*Inflation exists in nearly all years on the chart. Significant increases in inflation are evident in the early 1950s, 1970s, and 1980s.*)
   - Can you see examples of disinflation on the graph? In what years? (*Disinflation is evident just after the inflationary periods mentioned above [1950s, 1970s and 1980s]. More recently, the early 1990s and 2008-2009 show disinflation.*)
   - Can you see examples of deflation on the graph? In what years? (*Deflation is evident in the late 1940s, mid-1950s, and in 2008-2009.*)
   - What is the relationship between the inflation rate and recessions, as indicated by the recession (gray) bars? (*The inflation rate tends to decrease during and after recessions.*)
   - Are there periods when the inflation rate is more stable than others? In what years? (*Inflation remained relatively stable in the early 1960s and in the 1990s.*)


14. Tell the following story to illustrate how price stability, or the lack of price stability, can affect purchasing decisions. Imagine you are saving for a new computer. You’ve checked your favorite online technology store for five consecutive days. Each day, the price of the computer you would like to purchase has increased by $10. Ask:
   - Based on this experience, what is your expectation of the price of the computer? (*You will likely expect the price to continue increasing.*)
   - How does your expectation affect your buying decision? (*You will most likely purchase the system sooner to avoid paying a higher price later.*)
   - If many people share your expectation, how might this affect the demand and ultimately the price of the good? (*Many people will likely purchase the good now rather than later, which will increase the demand and in turn, the price, in much the same way bidders at an auction increase the price of an item.*)
   - If people have similar expectations for the prices of goods and services to increase economy-wide, what may happen? (*Fearing higher prices, people will increase their purchases, putting upward pressure on prices, and thus causing inflation.*)

15. Now, imagine the same scenario, but this time the price of the computer you would like to buy is decreasing by $10 per day. Ask:
   - Based on this experience, what is your expectation of the price of the computer? (*You will likely expect the price to continue decreasing.*)
   - How does your expectation affect your buying decision? (*You will likely postpone your purchase, hoping to pay a lower price later.*)
If many people share your expectation, how might this affect the demand and ultimately the price of the good? (If many people postpone the purchase, businesses will have to lower the price to sell the good.)

If people have similar expectations for the prices of goods and services to increase economy-wide, what may happen? (People postponing their purchases will put downward pressure on prices.)

These scenarios demonstrate how consumers make decisions when price stability does not exist. When prices remain relatively stable for some time, how does your decision-making differ from that in the scenarios just discussed? (If the inflation rate remains low and stable, you will more likely make your purchasing decisions based on what you want, rather than based on your uncertainty about expected prices.)

Refer to Visual 3, Graph 2. While the danger to price stability in the 1970s and 1980s was a fear of inflation (circle the inflation spikes), the most recent threat to price stability has been deflation (circle the area in late 2008 and 2009 showing inflation dipping below 0).

18. Review the key concepts in the lesson by discussing the following:
   - What is inflation? (Inflation is a rise in the general, or average, price level of all the goods and services produced in an economy.)
   - What is deflation? (Deflation is a sustained decrease in the average price level of all the goods and services produced in the economy.)
   - What is disinflation? (Disinflation is a decrease in the inflation rate.)
   - What is price stability? (Price stability is the absence of inflation and deflation.)
   - Why is price stability important? (People will make purchasing decisions based on what they want rather than their uncertainty about expected prices.)
   - How can deflation be harmful to an economy? (During deflationary periods, consumers postpone spending, waiting for prices to drop further. If this behavior is widespread, firms will experience lower revenues and will have to lay off workers. Widespread layoffs would lead to less spending, lower revenues, falling prices, and more layoffs. This can lead to a self-reinforcing downward economic spiral that is hard to break.)


Answers for Activity 1

6. What is the general trend of the consumer price index? What does that trend indicate? (The line trends upward, which indicates a rising price level, or inflation.)
7. What is the noticeable exception to the trend? What does it indicate? (The line dips around 2008, indicating deflation.)
11. What are the gray bars? What happens to inflation during these periods? (The gray bars show when the economy was in recession; the line usually flattens to indicate disinflation, and even dips to indicate deflation during the latter part of recessions.)
12. What does this rate of inflation tell you about the price of any single item (e.g., a laptop computer)? (It doesn’t tell anything about the prices of the items in the basket, addressing only the inflation rate of the entire basket.)

13. What span of years shows inflation? (Students may pick a variety of years where the line slopes upward.)

14. What span of years show disinflation? (Students may pick a variety of years where the line slopes downward but stays above 0 percent inflation.)

15. What span of years show deflation? (On the graph, the late 1940s shows a period of deflation and 2008 shows deflation.)

Appendix A

Visual 1

**Inflation** is a rise in the general or average price level of all the goods and services produced in an economy.

**Deflation** is a sustained decrease in the average price level of all the goods and services produced in the economy.

**Disinflation** is a decrease in the inflation rate.

**Recession** is a decline in the rate of national economic activity, usually measured by a decline in real GDP for at least two consecutive quarters (i.e., six months).

**Price stability** is the absence of inflation and deflation.

Appendix B

Visual 2

**Consumer Price Index (CPI)**

A price index that measures the cost of a fixed basket of consumer goods and services and compares the cost of this basket in one time period with its cost in some base period. Changes in the CPI are used to measure inflation.

Cost in Year One = $100

Cost in Year Two = $103
Calculating the Inflation Rate

\[
\text{Inflation Rate} = \frac{\text{CPI later year} - \text{CPI earlier year}}{\text{CPI earlier year}} \times 100
\]

\[
\frac{103 - 100}{100} \times 100 = 3\%
\]

Appendix C
Visual 3

Graph 1: Consumer Price Index
http://research.stlouisfed.org/fredgraph.png?g=5jw

![Graph of Consumer Price Index](http://research.stlouisfed.org/fredgraph.png?g=5jw)
Appendix D
Activity 1

What FRED Says about Price Stability

The FRED database is a useful tool for accessing data and generating graphs. We will use FRED to create graphs that illustrate the concepts in our lesson.

1. The first step in this exercise is to find the Consumer Price Index for Urban Consumers (CPI-U). Start at the FRED website, http://research.stlouisfed.org/fred2.

2. As you follow along in this exercise, the red arrows and circles show you where to access the information. Click the Prices Category.

There are several measures of the CPI; one is the Consumer Price Index for All Urban Consumers: All Items (CPI-U: All Items). Other measures break out the components of CPI—products such as food, energy, housing, and medical care. To begin, we first look at the CPI-U: All Items. Then we will examine the energy component of the index and make some comparisons.

4. Choose the Consumer Price Index for All Urban Consumers: All Items, Seasonally Adjusted (SA). It is the first item on the list. Click the Series title to see the graph.
5. Notice that the data for CPI are an index. The number (on the left axis) represents a price level of a basket of goods purchased at different points in time.

6. What is the general trend of the consumer price index? What does that trend indicate?
7. What is the noticeable exception to the trend? What does it indicate?
8. So far we have seen only the change in the Consumer Price Index rise over time. Next, edit the CPI: All Items graph. After editing the graph, you will add the CPI for energy (CPI: Energy). CPI: Energy is a subset of the entire Consumer Price Index.
   • Start with Consumer Price Index for All Urban Consumers (which you just had up).
   • Click on the Edit Graph link.
9. That will bring up a graph to which series can be added, units can be changed, and time can be modified (e.g., 5 years, 1 year).

10. Graph settings are found below the graph; scroll down to find the units.
    • Change the display of the units to “Percent Change from Year Ago.”
    • Click Redraw Graph.
    This is a common way to describe inflation—the change year over year.
11. What are the gray bars? What happens to inflation during these periods?
12. What does this rate of inflation tell you about the price of any single item (e.g., a laptop computer)?
13. What span of years shows inflation?
14. What span of years show disinflation?
15. What span of years show deflation?

Measuring inflation is crucial to the Federal Open Market Committee’s mandate for price stability. And understanding inflation and how it is measured is key to being an informed citizen. We hope that you have found FRED to be a useful tool in your understanding of inflation and price stability.
References


Web-Based References


Author Bios

Kathy Cosgrove is a senior reference librarian at the Federal Reserve Bank of St. Louis, Homer Jones Memorial Library. She earned her M.A. in library science from the University of Missouri-Columbia. She assists bank staff including economists and analysts with economic research. She also works on economic education projects for the general public, teachers, and students. E-mail: Kathy.E.Cosgrove@stls.frb.org

Mary Suiter manages economic education programs at the St. Louis Federal Reserve. She earned her Ph.D. from the University of Missouri-St. Louis (UMSL). M.A from the University of Delaware, and B.S. in economics from the UMSL. Prior to joining the St. Louis Fed, she worked at the Center for Economic Education at UMSL.
Scott Wolla is an Economic Education Specialist at the Federal Reserve Bank of St. Louis. He earned his M.A. in economics for educators from the University of Delaware, and a B.S. in social studies education from Minnesota State University-Moorhead. Prior to joining St. Louis Fed, he taught history and economics in Minnesota for 14 years.