The Consumer Price Index

Columbus City Council Compensation Review Commission
Bill LaFayette, Ph.D., owner, Regionomics® LLC
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The City Charter ties officials' compensation to the Consumer Price Index (CPI). This is a summary of the CPI, what it measures, how it is calculated, and which CPI should be used to benchmark compensation.

Purpose and Calculation of the CPI

The CPI is one of a number of alternative ways to measure inflation, which is a process of continuously rising prices – in other words, continuously declining value of money. In inflation, a dollar doesn't buy as much as it did before. The whole point of cost-of-living pay increases is to give workers the same purchasing power as they had before inflation hit. The CPI is designed to measure inflation and how much the dollar's purchasing power has changed between two specific periods.

The CPI is constructed by measuring the price of a pre-defined basket of goods and services at a particular time and place. It is based on the prices of 211 items in 38 places, meaning that 8,018 prices are collected each month to construct the index. The prices of the items are weighted to approximate the purchasing patterns of a typical household. The U.S. Bureau of Labor Statistics (BLS) surveys consumers' purchases to figure out what the correct weights should be. The result is the Consumer Expenditure Survey, which is useful in its own right.

A price index shows the path of price changes over time. The price level at a specific date (called the base date) is set to a particular value. This is usually 100 and it is 100 in the CPI, but it doesn't have to be. The date chosen as the base date is also arbitrary. The index value in each following month is based on the change in the value of the basket relative to the base month. Say, for example, the price of the basket at the base date is $1,000. The price index is 100.0 (by definition). If the price of the basket the following month is $1,002, the index is calculated as the current month's price divided by the base date price times the initial value of the index:

$$1{,}002 / 1{,}000 \times 100 = 100.2.$$

One year later, say the price of the basket has increased to $1,050. The index is

$$1{,}050 / 1{,}000 \times 100 = 105.0.$$

In other words, you need $1,050 to buy the same things that $1,000 got you the year before.

The inflation rate is easy to calculate from the CPI. Inflation is typically measured from one year to the next or from one month to the next. (Monthly inflation rates are usually converted to annualized rates.) The inflation rate is calculated as the percentage change in the price index between the first and second date. If the index value at the first date is I_1 and the index value at the second date is I_2, this is:

$$(I_2 - I_1) / I_1 = I_2 / I_1 - 1.$$

In the example above, the change in the price index is 105.0/100.0 – 1 = 5.0 percent. In other words, the purchasing power of the dollar has fallen by 5 percent. You can leave workers in the same position as they was last year by increasing their wages by 5 percent.

Actual values of the CPI are as follows:

- March 2013: 232.773

- March 2014: 236.293
- March 2015: 236.119

So the inflation rates are as follows:

- March 2013 to March 2014: 236.293 / 232.773 – 1 = 1.5%
- March 2014 – March 2015: 236.119 / 236.293 – 1 = -0.07%

Average inflation for a year is calculated the same way, using the average CPI for each year rather than that for a particular month.

Types of CPIs

There are 10,614 different CPIs. They fall into several major groups. One dimension is according to the type of consumer. The two primary categories are Consumer Price Indices for All Urban Consumers (CPI-U), which is the most commonly-used category, and Consumer Price Indices for Urban Wage and Clerical Workers (CPI-W). The difference between these two categories is the weighting of the items in the basket. CPI-W is designed to reflect the purchasing pattern of a lower-income household.

A second dimension is according to the breadth of the basket. Some indices are based on all items; others track various subsets of the basket. These include indices tracking specific categories of groups of goods and services (e.g., food, energy, services, and healthcare) and a large number of very specific items. Other categories exclude groups of items. The most common of these is All Items Less Food and Energy. This is called the "core CPI." Prices of food and energy are especially volatile, so excluding those removes some of the noise and allows policymakers and analysts to see the underlying path of inflation more clearly.

Indices can be measured as their calculated value or on a seasonally-adjusted basis. Seasonal adjustment takes account of price changes that recur regularly at specific times during the year. One example is the usual price increase in gasoline in late spring as refiners switch from winter blend to summer blend. Gasoline price increases at this point mean less than they do at other times during the year. Seasonal adjustment is a statistical technique that removes the impact of a recurring change in prices.

Price indices also vary according to their geographical coverage. The broadest indices are U.S. city average. Other indices refer to broad regions of the country – Northeast, Midwest, South, and West – and to 25 metro areas (not including Columbus). A series of indices also track price changes by the size of the metro area. These are in four size classes. Size Class A is a population of 1.5 million or more; Size Class D is a population of less than 50,000. Regions are intersected with region size (e.g., Midwest Metros, Size Class A.

Finally, there is a series of 28 national-level "chained" CPIs that are designed to address a problem with the traditional CPI, discussed in the next section.

Problems with the CPI

As discussed above, the market basket used to calculate the CPI is based on the purchase patterns of a typical consumer. People in different places, different ages, different household types, and different income levels spend very differently. The CPI for wage-earners and clerical workers takes a stab at addressing this problem, but that is the only reflection of this problem.

One problem arises from changes in quality of the underlying goods. The CPI basket includes a television, but at some point that television changed from black and white to color, and at some point it changed from a one with a picture tube to a high-definition flat screen. The pace of change in technology-dependent goods, such as computers, is even faster. Each change may have resulted in a price increase, but households probably wouldn't see it that way because the new good delivers more satisfaction than the old. People have experimented with ways to address this problem, but these fixes have been difficult to implement, so none has been. This means that you have to be careful when looking at price changes over long periods, even four years. There is no practical way to fix the problem. You just have to be aware of it.

A second problem is that purchasing patterns shift over time. Tastes change, new goods appear, and expenditure shares change. This means that the weights on the prices used to calculate the CPI become less relevant over time. The results of the Consumer Expenditure Survey are used to recalibrate the basket every two years.

Substitutions also happen much more dynamically as the price of goods and services shift relative to one another. If the price of margarine goes up and the price of butter comes down, people switch from margarine to butter. If the price of movies goes up, fewer people go to movies and more people go bowling. The fact that the price of margarine and movies went up influences people's buying patterns, but once the shift has been made, the higher prices of those items become irrelevant. This means that the CPI with a fixed basket overstates the actual financial impact of changing prices on households.

The chained CPI is a response to the second and third of these three problems. The chained CPI is calculated like the traditional CPI except the weights on the goods and services change every month based on the results of the monthly Consumer Expenditure Survey. Because the chained CPI includes the impact of households' attempts to minimize the impact of rising prices, you expect the chained CPI inflation rate to be lower than the traditional CPI inflation rate, and it generally is. The chained inflation rate from March 2013 to March 2014 is 1.4 percent rather than 1.5 percent. The chained rate from March 2014 to March 2015 is a negative 0.4 percent rather than a negative 0.007 percent.

The chained CPI sounds like a solution to these problems. The Simpson-Bowles Commission on Deficit Reduction recommended the use of the chained CPI in setting Social Security benefits – although it was more because the chained CPI's measured inflation rate is lower than because this is a theoretically better measure. There is a potentially serious practical problem with using the chained CPI to set compensation, though. The chained CPI values come out with all the others – about three weeks after the end of the month to which they refer. But because the Consumer Expenditure Survey only comes out with a three-quarter lag, the index values for the past year or so are preliminary and are revised a couple times before they are final. On the other hand, the traditional CPI values are final on their first release – unlike most other BLS stats.

Which CPI Should Be Used to Benchmark Compensation?

As noted earlier, there are a number of different measures of price changes, but the CPI probably is the best for this purpose. The problem arises in benchmarking pay increases to no more than a four-year average of inflation. This is unwise because it makes the pay escalation unresponsive to changes in inflation. It is what economists call "sticky." If inflation increases, the wage adjustments increase much more slowly and the officials wind up losing purchasing power. If inflation declines, the average

overstates current inflation. (However, the fact that four-year inflation is a ceiling means that there is no problem in declining inflation, as will be demonstrated shortly.)

Which of the 10,614 CPI values should be used? It is better to use an all-items index rather than one excluding food and energy (the core CPI). Core inflation is more stable, but in real life officials do have to buy food and energy, so is unfair not to reflect this. The chained CPI is at least theoretically better, but you have to be comfortable with ambiguity. The rate for the past year (one-quarter of your wage adjustment) is likely to change. You have to decide how to handle this. Do you retroactively adjust people's pay for the incorrect initial rate, or do you leave it alone? In any case, using the chained CPI, requires formally setting a date on which the CPI values are retrieved to avoid any conflict later on. This is not an important consideration with the traditional CPI because those values don't change once they are issued. An annual-average inflation rate requires the use of the non-seasonally-adjusted CPI because annual averages are not defined for seasonally-adjusted series. In any case, measuring inflation year-over-year – even at a particular month – should be done with the unadjusted numbers.

As mentioned earlier, there is no CPI for Columbus, but there are for Cincinnati and Cleveland. These should not be used for Columbus, though, because the demographics, economies, and purchasing patterns in Cincinnati and Cleveland are different from those in Columbus. The best CPI is probably the CPI-U, Midwest, Size Class A, All Items. This is not a perfect solution because Columbus is demographically different from many Midwestern cities, but this CPI does incorporate the purchasing behavior of Midwesterners, and it does include Columbus information to a greater extent than the national index.

Using the values of this CPI to obtain the inflation rates for the last four years yields the following:

Year	CPI-U, Midwest Size A	Inflation
2010	208.575	
2011	215.155	3.15%
2012	219.409	1.98%
2013	222.562	1.44%
2014	225.658	1.39%

The four-year average is 1.99 percent, much more than the 2014 average of 1.39 percent. This is no problem in setting compensation because the 1.99 percent is a ceiling and the 1.39 percent increase can be used to adjust pay. However, if the annual inflation rates had been reversed so that 3.15 percent had been the 2014 increase, the pay increase would have been limited to 1.99 percent and officials would lose purchasing power.

Using the national average for large regions nationwide instead of in the Midwest yields the following:

Year	CPI-U, All U.S. Cities, Size A	Inflation
2010	218.056	
2011	224.939	3.16%
2012	229.594	2.07%
2013	232.957	1.46%
2014	236.736	1.62%

The four-year average is a somewhat higher 2.08 percent. Notice the particularly large difference between the 2014 averages.

An important mathematical point is that a geometric average should be used to calculate the four-year average inflation rather than the traditional arithmetic average (i.e., the four inflation rates summed and divided by four). The geometric average is:

$$[(1+0.0315) \times (1+0.0198) \times (1+0.0144) \times (1+0.0139)]^{0.25} - 1.$$

The 0.25 exponent means to take the fourth root of the term in brackets. The difference between the arithmetic and geometric averages is generally not great except when some changes are negative; a one-percent decrease is not the same as a one-percent increase. Negative inflation over a year is rare, but it does happen, as in the March 2014 to March 2015 case. The inflation rate in 2009 was negative as well.

The two following attachments are first, BLS guidance for using the CPI for wage escalation, and second, a step-by-step guide for downloading CPI values from the BLS website.

Source: http://stats.bls.gov/cpi/cpi1998d.htm. Retrieved 30 April 2015.

How to Use the Consumer Price Index for Escalation

The Consumer Price Index (CPI) measures the average change in the prices paid for a market basket of goods and services. These items are purchased for consumption by the two groups covered by the index: All Urban Consumers (CPI-U) and Urban Wage Earners and Clerical Workers, (CPI-W).

Escalation agreements often use the CPI—the most widely used measure of price change—to adjust payments for changes in prices. The most frequently used escalation applications are in private sector collective bargaining agreements, rental contracts, insurance policies with automatic inflation protection, and alimony and child support payments.

The following are general guidelines to consider when developing an escalation agreement using the CPI:

Define the base payment. Define clearly the base payment (rent, wage rate, alimony, child support, or other value) that is subject to escalation.

Identify which CPI series will be used. Identify precisely which CPI index series will be used to escalate the base payment. This should include the population coverage (CPI-U or CPI-W), area coverage (U.S. City Average, West Region, Chicago, etc.), series title (all items, rent of primary residence, etc.), and index base period (1982-84=100).

Specify reference period. Specify a reference period from which changes in the CPI will be measured. This is usually a single month (the CPI does not correspond to a specific day or week of the month) or an annual average. There is about a two-week lag from the reference month to the date on which the index is released (that is, the CPI for May is released in mid-June). The CPI's for most metropolitan areas are not published as frequently as are the data for the U.S. City Average and the four regions. Indexes for the U.S. City Average, the four regions, three city-size classes, ten region-by-size classes, and three major metropolitan areas (Chicago, Los Angeles, and New York) are published monthly. Indexes for the remaining 23 published metropolitan areas are available only on a bimonthly or semiannual basis. Contact BLS for information on the frequency of publication for the 26 metropolitan areas.

State frequency of adjustment. Adjustments are usually made at fixed intervals, such as quarterly, semiannually, or, most often, annually

Determine adjustment formula. Determine the formula for the adjustment calculation. Usually the change in payments is directly proportional to the percent change in the CPI index between two specified periods. Consider whether to make an allowance for a "cap" that places an upper limit on the increase in wages, rents, etc., or a "floor" that promises a minimum increase regardless of the percent change (up or down) in the CPI.

Provide for revisions. Provide a built-in method for handling situations that may arise because of major CPI revisions or changes in the CPI index base period. The Bureau always provides timely notification of upcoming revisions or changes in the index base.

The CPI and escalation: Some points to consider

The CPI is calculated for two population groups: All Urban Consumers (CPI-U) and Urban Wage Earners and Clerical Workers (CPI-W). The CPI-U represents about 88 percent of the total U.S. population and is based on the expenditures of all families living in urban areas. The CPI-W is a subset of the CPI-U and is based on the expenditures of families living in urban areas who meet additional requirements related to employment: more than one-half of the family's income is earned from clerical or hourly-wage occupations. The CPI-W represents about 29 percent of the total U.S. population. There can be small differences in movement of the two indexes over short periods of time because differences in the spending habits of the two population groups result in slightly different weighting. The long-term movements in the indexes are similar.

CPI-U and CPI-W indexes are calculated using measurement of price changes of goods and services with the same specifications and from the same retail outlets. The CPI-W is used for escalation primarily in blue-collar cost-of-living adjustments (COLAs). Because the CPI-U population coverage is more comprehensive, it is used in most other escalation agreements.

The 26 metropolitan areas for which BLS publishes separate index series are by-products of the U.S. City Average index. Metropolitan area indexes have a relatively small sample size and, therefore, are subject to substantially larger sampling errors. Metropolitan area and other subcomponents of the national indexes (regions, size-classes) often exhibit greater volatility than the national index. BLS recommends that users adopt the U.S. City Average CPI for use in escalator clauses.

The U.S. City Average CPIs are published on a seasonally adjusted basis as well as on an unadjusted basis. The purpose of seasonal adjustment is to remove the estimated effect of price changes that normally occur at the same time and in about the same magnitude every year (e.g., price movements due to the change in weather patterns, holidays, model change-overs, end-of-season sales, etc.). The primary use of seasonally adjusted data is for current economic analysis. In addition, the factors that are used to seasonally adjust the data are updated annually and seasonally adjusted data are subject to revision for up to 5 years after their original release. For these reasons, the use of seasonally adjusted data in escalation agreements is inappropriate.

Escalation agreements using the CPI usually involve changing the base payment by the percent change in the level of the CPI between the reference period and a subsequent period. This is calculated by first determining the index point change between the two periods and then determining the percent change. The following example illustrates the computation of a percent change:

CPI for current period:	232.945
Less CPI for previous period:	229.815
Equals index point change:	3.130
Divided by previous period CPI:	229.815
Equals:	0.0136
Result multiplied by 100:	0.0136 x 100
Equals percent change:	1.4%

The Bureau of Labor Statistics neither encourages nor discourages the use of price adjustment measures in contractual agreements. Also, while BLS can provide technical and statistical assistance to parties developing escalation agreements, we can neither develop specific wording for contracts nor mediate legal or interpretive disputes which might arise between the parties to the agreement.

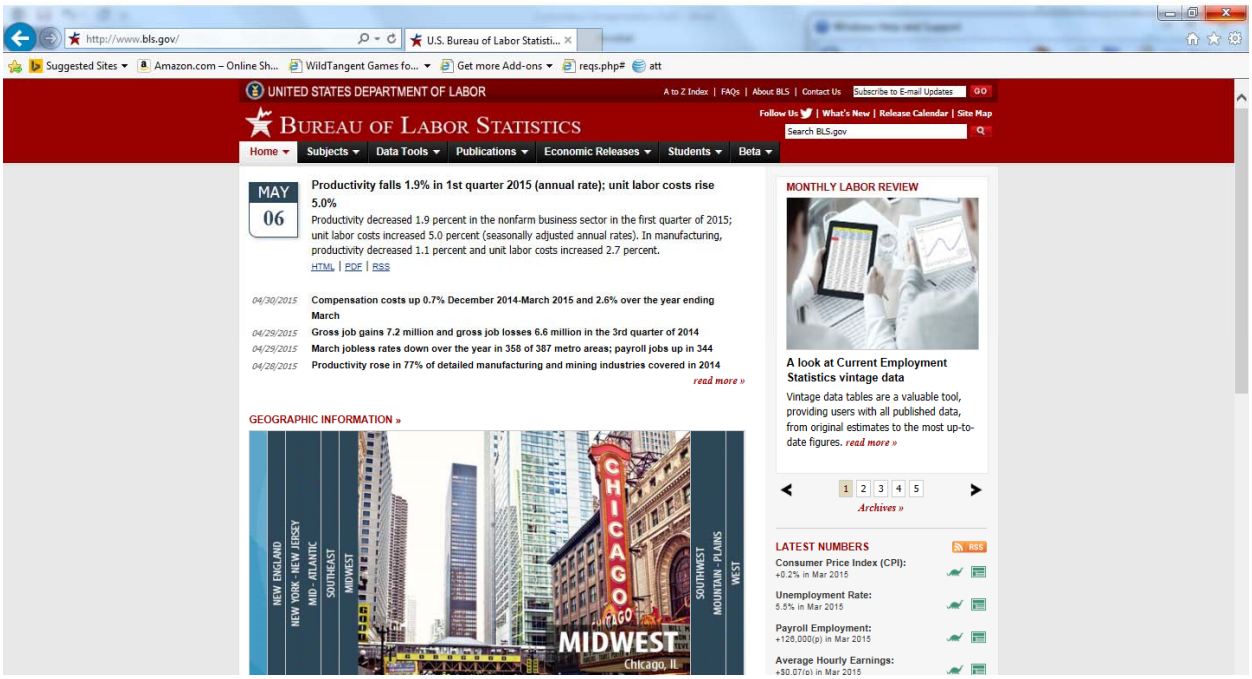
For any additional information about the CPI, please call (202) 691-7000, or write to:

Bureau of Labor Statistics Office of Prices and Living Conditions 2 Massachusetts Avenue, NE., Room 3615 Washington, DC 20212-0001

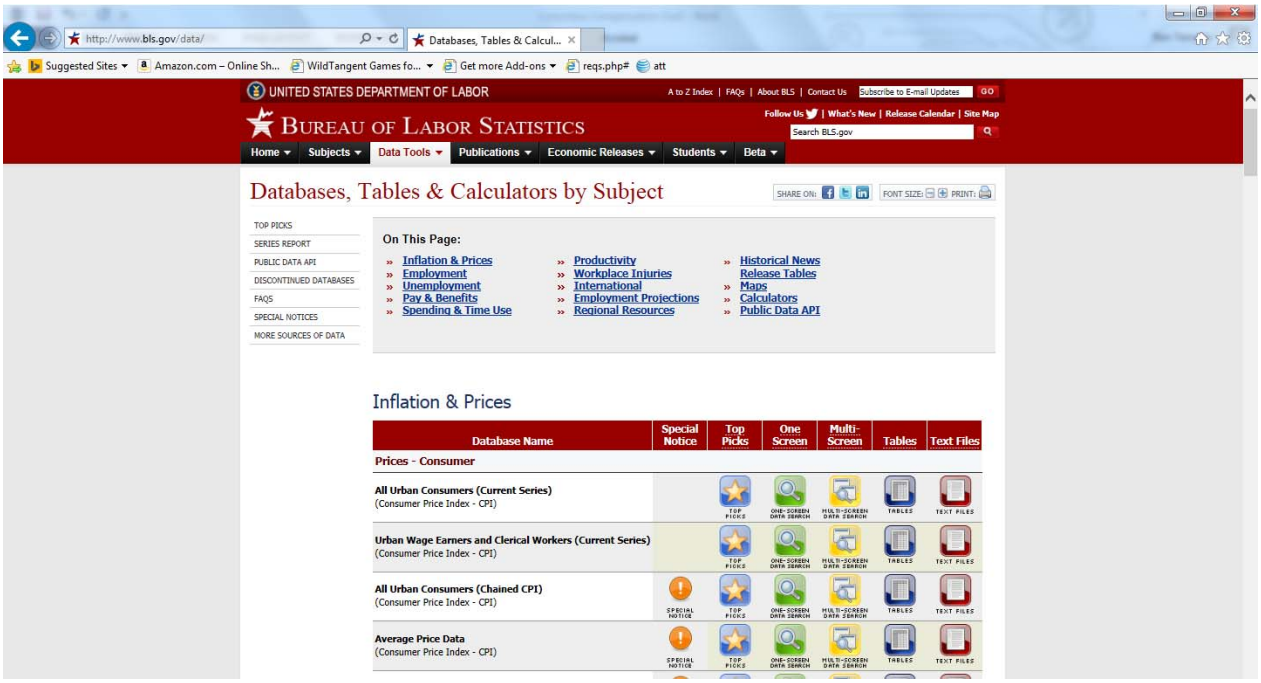
Last Modified Date: September 25, 2013

Retrieving CPI Values from the BLS Website

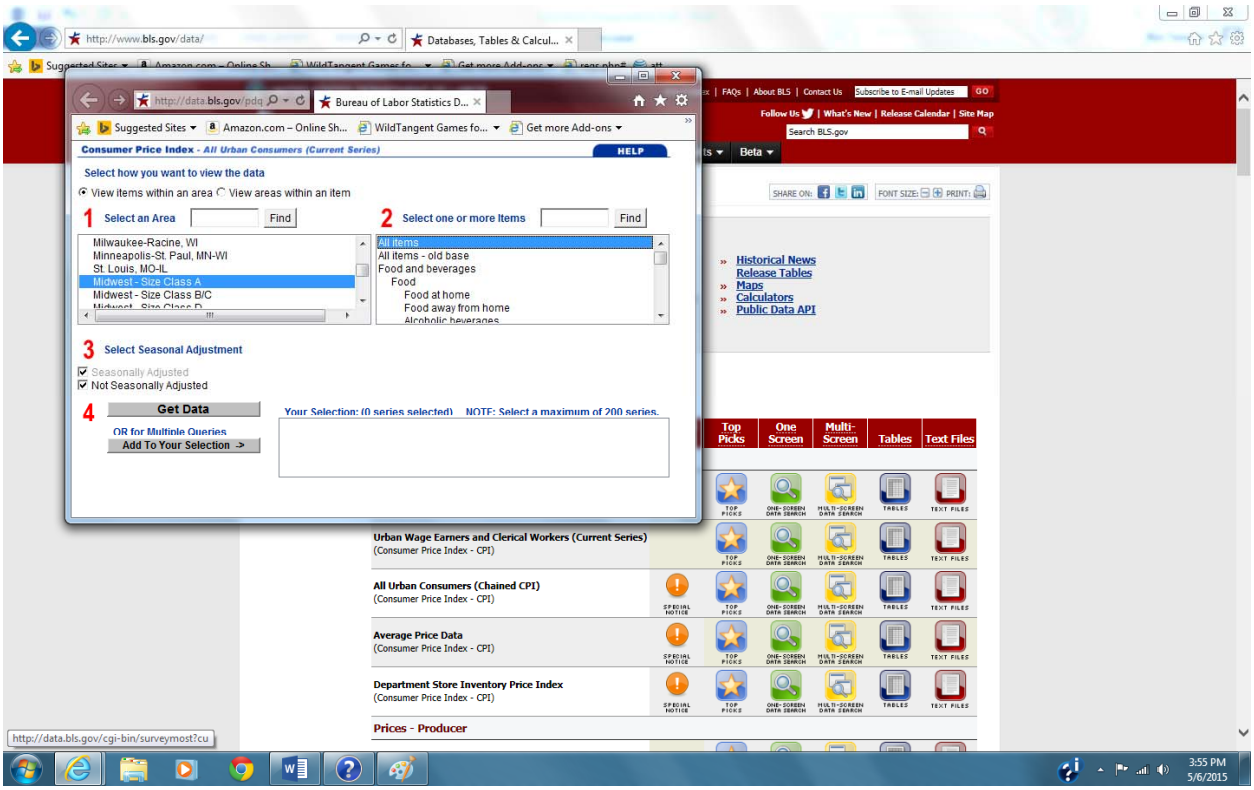
These instructions will retrieve values for the CPI-U, Midwest Size Class A, All Items. Open the Bureau of Labor Statistics website, www.bls.gov and click "Data Tools" in the black menu bar at the top.



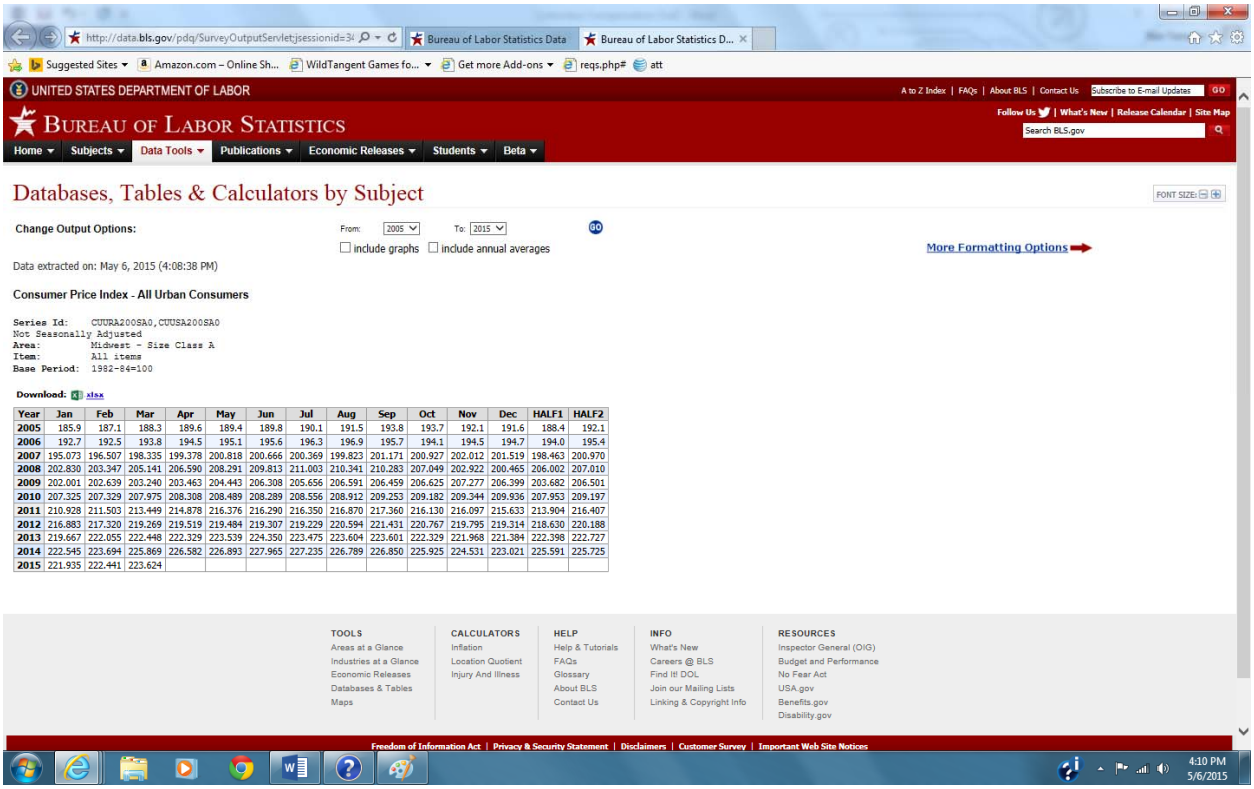
A page titled "Databases, Tables & Calculators by Subject" comes up. The first entry on this page is "All Urban Consumers (Current Series). If you have a Java-equipped browser, click the green "One Screen Data Search" button to the right of this entry. Otherwise, click the yellow "Multi-Screen Data Search" button. (You may have to click "run" after clicking "One Screen Data Search.")



In the Java screen, first scroll down the menu titled “Select an Area” until you see “Midwest – Size Class A” (it is under the Midwest heading). Second, click the first “All items” entry under the “Select one or more items” heading. Click “Get data.”



Your data appear in a new tab or window. Ensure that the heading identifies the data as, “Not seasonally adjusted, Midwest - Size Class A, All items.” Note that annual averages are not automatically included; you have to click the “Include annual averages” checkbox at the top of the screen.



Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HALF1	HALF2
2005	185.9	187.1	188.3	189.6	189.4	189.8	190.1	191.5	193.8	193.7	192.1	191.6	188.4	192.1
2006	192.7	192.5	193.8	194.5	195.1	195.6	196.3	196.9	195.7	194.1	194.5	194.7	194.0	195.4
2007	195.073	196.507	198.335	199.378	200.818	200.666	200.369	199.823	201.171	200.927	202.012	201.519	198.463	200.970
2008	202.830	203.347	205.141	206.590	208.291	209.813	211.003	210.341	210.283	207.049	202.922	200.465	206.002	207.010
2009	202.001	202.639	203.240	203.463	204.443	206.308	205.656	206.591	206.459	206.625	207.277	206.399	203.682	206.501
2010	207.325	207.329	207.975	208.308	208.489	208.289	208.556	208.912	209.253	209.182	209.344	209.936	207.953	209.197
2011	210.928	211.503	213.449	214.878	216.376	216.290	216.350	216.870	217.360	216.130	216.097	215.633	213.904	216.407
2012	216.883	217.320	219.269	219.519	219.484	219.307	219.229	220.594	221.431	220.767	219.795	219.314	218.630	220.188
2013	219.667	222.055	222.448	222.329	223.539	224.350	223.475	223.604	223.601	222.329	221.968	221.384	222.398	222.727
2014	222.545	223.694	225.869	226.582	226.893	227.965	227.235	226.789	226.850	225.925	224.531	223.021	225.591	225.725
2015	221.935	222.441	223.624											

The process for the multi-screen data search is the same process, but you just have to step through multiple screens to get to the data screen above.