

Intervention Analysis in Seasonal Adjustment

In some Consumer Price Index (CPI) series, a process known as seasonal adjustment is used to identify and factor out seasonal movements. The resulting seasonally adjusted data reflect an estimate of nonseasonal price movements. The CPI uses the Bureau of the Census X-13ARIMA-SEATS software to calculate factors for seasonal adjustment of both historical and current series.

Seasonal adjustment for some CPI series uses a technique called intervention analysis that is included in the Census X-13 seasonal adjustment program. Intervention analysis seasonal adjustment allows economic phenomena that are not seasonal in nature, such as outliers and level shifts, to be factored out of indexes before calculation of seasonal adjustment factors. (An *outlier* is an extreme value for a particular month. A *level shift* is a change or shift in the price level of a CPI series caused by an event, such as a sales tax increase or oil embargo, occurring over one or several months.) The result is an adjustment based on a representation of the series with the seasonal pattern emphasized. Intervention analysis seasonal adjustment also makes it possible to account for seasonal shifts, resulting in a better seasonal adjustment in the periods before and after the shift occurred. For those CPI series adjusted using intervention analysis seasonal adjustment techniques, the resulting seasonal factors more accurately represent the underlying seasonal pattern. Seasonal factors are applied to the original unadjusted series without interventions removed. As a result, level shifts and outliers, removed for the calculation of seasonal factors, are present in the seasonally adjusted series.

When X-13ARIMA-SEATS is used to perform intervention analysis seasonal adjustment, unusual events are modeled as part of the seasonal adjustment process. X-13ARIMA-SEATS's built-in regression variables are used for directly estimating the effects of sudden level changes and other disruptions and removing those effects before calculation of the seasonal factors. For a comprehensive discussion of intervention analysis seasonal adjustment, see "Improvements to CPI Procedures for Intervention Analysis Seasonal Adjustment" in the December 1996 issue of the [CPI Detailed Report](#).

A CPI series may receive intervention analysis seasonal adjustment (IASA) if the series is directly adjusted and has a relative importance greater than 0.5% to the U.S. city average all items index. If IASA is used for a component of the seasonally adjusted U.S. city average all items index, series which are subsets of the component series are also eligible for IASA. In January 2015, BLS adjusted the series listed below using intervention analysis seasonal adjustment techniques. BLS examined these series using the 8-year span from January 2007 through December 2014, with the exception of *Used cars and trucks*, which was adjusted using data from January 2010 through December 2014.

Airline fare	Gasoline, unleaded regular	Nondurables less food
Bakery products	Ice cream and related products	Nondurables less food and apparel
Beverage materials including coffee and tea	Juices and nonalcoholic drinks	Nondurables less food and beverages
Carbonated drinks	Leased cars and trucks	Nondurables less food, beverages, and apparel
Cereals and bakery products	Motor fuel	Prescription drugs
Cheese and related products	New cars	Public transportation
Cigarettes	New cars and trucks	Tobacco and smoking products
Coffee	New trucks	Used cars and trucks
Electricity	New vehicles	Utilities and public transportation
Gasoline, all types	Nonalcoholic beverages and beverage materials	Utility (piped) gas service
Gasoline, unleaded midgrade	Nondurables	
Gasoline, unleaded premium		

For each series that was adjusted using X-13ARIMA-SEATS intervention analysis seasonal adjustment, a list of level shifts is provided in the table below, along with the identified causes (events). Outliers are also included in the list.

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Consumer Price Index series – intervention analysis seasonal adjustment

Series	Level shift period(s)	Event	Outliers
Airline fare	4/08-7/08	Higher fuel surcharges implemented by airlines due to increased fuel costs	3/13
	8/08-1/09	Return to normal pricing	
	8/09-12/09	Reduction in airplane capacity led to less availability, fewer discounts, and higher prices	
	11/13 (Seasonal Shift)	A higher percentage of web-based airline fares were included in the sample, better capturing advance prices for holiday travel	
Bakery products	1/08-5/08	World grain shortage, rising ingredient costs, and rising fuel costs led to higher prices	None
Beverage materials including coffee and tea	9/10	Bad weather conditions in Brazil and Colombia, planned supply hoarding by exporters in Brazil and Vietnam, and a general manufacturer's price increase	2/08
	2/11-8/11	Bad weather conditions in Brazil and Colombia and increased supply hoarding	
Carbonated drinks	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	3/07, 12/07, 4/08, 3/09, 10/10, 12/10
Cereals and bakery products	1/08-5/08	World grain shortage, rising ingredient costs, and rising fuel costs led to higher prices	None
Cheese and related products	6/07-10/07	Cheese prices increased due to volatile spot trading, strong demand and higher Class III milk prices	None
	4/08-8/08	Significantly greater demand for corn used in ethanol led to higher feed prices; higher energy and milk prices	
	12/08-05/09	Decline in domestic demand and softer export sales due to exchange rates; increased milk production led to larger cheese stocks	
	1/11	Increased milk output and ample cheese stocks	
	3/11-9/11	Higher feed prices, rising energy prices, and strong international demand for dairy products	
	2/14-5/14	Increase in cheese prices due to higher demand and stronger export sales	
Cigarettes	2/09-4/09	Increase in federal excise tax coupled with manufacturer price increases	None
Coffee	4/08	Speculation of a smaller Brazilian crop, and a weak U.S. dollar	None
	7/10-9/10	Bad weather conditions in Brazil and Colombia, planned supply hoarding by exporters Brazil and Vietnam, and a general manufacturer's price increase during the modeled period	
	2/11-8/11	Bad weather conditions in Brazil and Colombia and increased supply hoarding	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Electricity	None	None	2/10, 4/14
Gasoline, all types	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	10/14-12/14	Weak global demand along with increased supply from continued growth in North American crude production	
Gasoline, unleaded midgrade	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	10/14-12/14	Weak global demand along with increased supply from continued growth in North American crude production	
Gasoline, unleaded premium	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
Gasoline, unleaded regular	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	10/14-12/14	Weak global demand along with increased supply from continued growth in North American crude production	
Ice cream and related products	11/10-2/11	Strong foreign demand for whey, butter fat and other ingredients used in ice cream	None
Juices and nonalcoholic drinks	9/08	Higher commodity costs combined with a declining demand for soft drinks	3/07, 12/07, 4/08, 3/09, 12/10
Leased cars and trucks	7/08-10/08	Decreased demand for SUV's and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices	08/09
	12/08-2/09	Decreased demand for SUV's and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices	
	6/09	"Car Allowance Rebate System" initiative led to a lower supply of used cars and an increase in used car prices, allowing manufacturers to decrease leased car prices as the residual prices returned to normal	
	2/10	Recalls put downward pressure on residual values for used cars, resulting in higher lease prices	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Motor fuel	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	10/14-12/14	Weak global demand along with increased supply from continued growth in North American crude production	
New cars	9/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	None
	3/11-6/11	Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories	
New cars and trucks	2/09-7/09	Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories	None
	9/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
	3/11-6/11	Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories	
New trucks	1/09-7/09	Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories	None
	9/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
New vehicles	2/09-7/09	Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories	None
	9/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
	3/11-6/11	Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories	
Nonalcoholic beverages and beverage materials	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	3/07, 12/07, 4/08, 3/09, 12/10

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Nondurables	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
Nondurables less food	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
Nondurables less food and apparel	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
Nondurables less food and beverages	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
Nondurables less food, beverages, and apparel	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
Prescription drugs	1/07-3/07	Significantly lower prices for some generic drugs due to patent loss and new generic drug discount program implementations at several major retailers	2/14
	10/12-12/12	Expiration of patents resulted in increased availability of generic alternatives	
	5/13	Higher concentration than normal of brand to generic conversions due to patent loss for a variety of drugs	
	12/13	Higher concentration than normal of brand to generic conversions due to patent loss for a variety of drugs	
Public transportation	4/08-7/08	Higher fuel surcharges implemented by airlines due to increased fuel costs	3/13
	8/08-1/09	Return to normal pricing	
	8/09-12/09	Reduction in airplane capacity led to less availability, fewer discounts, and higher prices	
	11/13 (Seasonal Shift)	A higher percentage of web-based airline fares were included in the sample, better capturing advance prices for holiday travel	
Tobacco and smoking products	2/09-4/09	Increase in federal excise tax coupled with manufacturer price increases	None

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Used Cars and Trucks	3/11-6/11	Reduced supply of new cars in 2009 and 2010 due to the recession led to lower supply of used cars in 2011; shortages caused by the earthquake in Japan affected parts and supplies resulting in increased new car prices and higher demand for used cars	None
Utilities and public transportation	2/08-7/08	Effect of a widening storage deficit, combined with strong summer demand	4/14
	8/08-1/09	Introduction of lower winter gas rates, and recovery of storage inventories	
	12/13-3/14	Dramatic increase in demand due to extreme winter in Midwest and Northeast	
Utility (piped) gas service	3/08-7/08	Effect of a widening storage deficit, combined with strong summer demand	None
	1/14-3/14	Dramatic increase in demand due to extreme winter in Midwest and Northeast	