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COVID19 and Seasonal Adjustment

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From the analysis of the weekly series initial claims, we learn that STL and CAMPLET SAs follow NSA values closely. In addition, the COVID19 crisis caused a structural increase in initial claims. Before the crisis initial claims fluctuated around a lower level than after the crisis.

Keywords

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JEL Classification

C22, E24

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COVID19 and Seasonal Adjustment*

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1 Introduction

COVID19 is seasonal. Historical and current evidence show that it has a strong wave in the Fall, and a weak (or no) wave in the spring. Scientists believe that the seasonality is driven by UV light. (Hölmstrom et al. 2020) The relation between COVID19 and seasonality is examined by e.g. Merow and Urban (2020) and Engelbrecht and Scholes (2021). However, this is not what we do in this paper.

The COVID19 crisis has a huge impact on the economy of the Netherlands and other countries. Macroeconomic time series are typically seasonally adjusted to bring to the fore important fluctuations. In this paper we study the impact of COVID19 on seasonal adjustment.

Economic time series are typically seasonally adjusted before being used in economic, econometric and policy analyses, where Seasonality is defined as systematic, although not necessarily regular or unchanging, intrayear movement that is caused by climatic changes, timing of religious festivals, business practices, and expectations. (Hylleberg 1986). Seasonal adjustment (SA) consists of the estimation of the seasonal component and, when applicable, also trading day and moving holiday effects, followed by their removal from the time series. The goal is usually to produce series whose movements are easier to analyze over consecutive time intervals and to compare to the movements of other series in order to detect co-movements. (U.S. Census Bureau Basic Seasonal Adjustment Glossary); Wright 2013). For common guidelines for seasonal adjustment within the European Statistical System, see Eurostat (2015).

Several SA methods exist, but we confine attention to the methods used in this paper. For quarterly and monthly data we apply Census X13ARIMA-SEATS (henceforth X13): the combination of Census X12-ARIMA and TRAMO-Seats which has become the industry standard (Department of Commerce Census Bureau `http://www.census.gov/srd/www/x13as/`), and a recent competitor CAMPLET (Abeln et al. 2019). For weekly data, Stock (2021) recommends to transform series to logs, annual or 52 weeks differences, and manual adjustment for problem weeks (moving holidays etc.). In this paper we use the STL method (Cleveland et al. 1990) and CAMPLET.[1]

In this paper we compare X13 and CAMPLET seasonal adjustments before and after the COVID19 crisis. We carry out a Quasi Real-Time analysis, i.e. on the basis of the most recent data vintage, for the quarterly series real GDP and the monthly series Consumption of Households in the Netherlands. In addition we compare STL and CAMPLET seasonal adjustments of the weekly series of US Initial Claims before and after the COVID19 crisis and a QRT analysis based on the STL SAs.

We find that differences in SA values are small and that X13 and STL seasonal adjustments are subject to revision. From the analysis of the weekly series US Initial Claims we learned that STL SAs follow NSA values closely, that STL SAs are subject to revision. In addition, the COVID19 crisis caused a structural increase in initial claims. Before the crisis initial claims fluctuated around a lower level than after the crisis. STL SAs capture NSA values in the COVID19 crisis period, whereas CAMPLET does not pick up NSA values in the crisis period completely.

The remainder of this paper is organised as follows. Section 2 briefly discusses SA methodology and describes the SA methods used in this paper. After the sources of the data and SA methods settings in Section 3, the results are presented in Section 4. Section 5 concludes.

[1] Ladiray et al. (2018) present some ideas to adapt the X11 family for daily data (not used in this paper). Alternatives for daily data are Daily Seasonal Adjustment (DSA; based on STL (Ollech 2018) and CAMPLET (Abeln et al. (2021).

2 Seasonal Adjustment Methodology

2.1 Seasonal decomposition

An observed time series y_t can be decomposed into a trend-cycle y_t^{tc}, seasonal y_t^s, irregular y_t^i component, and deterministic effects due to the number of trading days y_t^{td}, and holidays y_t^h, such as Easter and Christmas (Ghysels and Osborne 2001, Section 4.2). Assuming the additive version of the decomposition, we get

$$y_t = y_t^{tc} + \underbrace{y_t^s}_{\text{seasonal effects}} + \underbrace{y_t^{td} + y_t^h}_{\text{calendar effects}} + y_t^i, \qquad t = 1, \ldots, T. \tag{1}$$

The multiplicative decomposition yields

$$y_t = \tau_t \times c_t \times s_t \times i_t, \tag{2}$$

where τ_t is the trend, c_t is the cycle, s_t is the seasonal, i_t is the irregular component; calendar effects have been omitted for convenience.

2.2 Brief description of SA methods used in this paper

X13 is based on the multiplicative decomposition, Equation (2).[2] In a *Pretreatment* step the series is extended forward and backwards using a regression model with ARIMA residuals (a regARIMA model). In addition outliers, and trading-day and holiday effects (calendar effects) are adjusted for. The actual seasonal adjustment consists of moving average filters for the components moving average filters (X-11) or ARIMA model-based adjustment from SEATS.

[2]To deal with COVID19, the additive decomposition is required instead of multiplicative decomposition. In September 2020, US Department of Labor (DOL) switched from multiplicative SA to additive. (Stock 2021).

For details see: U.S. Department of Commerce Census Bureau `http://www.census.gov/srd/www/x13as/` .

CAMPLET is based on an additive decomposition: $y_t = y_t^{SA} + y_t^S,\ t = 1, \ldots, T$, where y_t^{SA} are the seasonal adjustments en y_t^S are the seasonal components. In contrast to X13, no pretreatment is required, neither for forecasting or backcasting nor for the adjustment of calendar effects. CAMPLET does not employ moving average filters or time series models for unobserved components. The program consists of a simple adaptive procedure to extract the seasonal and the nonseasonal component from an observed series. Once this process is carried out there will be no need to revise these components at a later stage when new observations become available.

For details see Abeln et al. (2019). The package can be download at `http://www.camplet.net`

STL decomposes a time series (y_t) additively into a trend-cycle (τ_t), a seasonal (s_t) and an irregular component (i_t) using Loess regressions and moving averages.

In Loess regressions, a weight is attached to each observation of the time series. This weight is negatively related to the distance (in time) between a given observation and the value that is to be smoothed. If the distance is too large, the weight is zero. Thus, Loess regressions are local regressions because each value is regressed on a local neighbourhood of a linear or quadratic function of the (weighted) observations.

For details see Cleveland et al. (1990, 2018)

2.3 Adjustments because of the COVID-19 crisis

In a methodological note to provide guidance on the treatment of COVID19 crisis effects on data, Eurostat (2020) wrote :

> In the context of seasonal adjustment, a calendar adjustment corresponds to a predictable and recurrent phenomenon linked to the calendar. In contrast, the COVID-19 crisis is completely different and must be handled by means of outliers. At this stage, the data point in question shall not be treated as a seasonal outlier, since it would imply that the current COVID-19 outbreak occurs each year in the same period with similar magnitude. For each following observation, a change may occur in the seasonal pattern and/or a discontinuity in seasonality.

X13 requires adjustments in the implementation of the standard procedure.[3] CAMPLET and STL, however, do not!

3 Data and settings of SA methods

NL data used in this paper are from Statistics Netherlands (CBS) Statline, the US Initial Claims series comes from FRED, St Louis FED.

Seasonal adjustments are computed for the whole period the series are available. All X13 and STL seasonal adjustments are done in Eviews 11, with default settings of the procedures. CAMPLET computations are done with `CampletExcel-v5s4.xlsm`, also with default parameters settings.

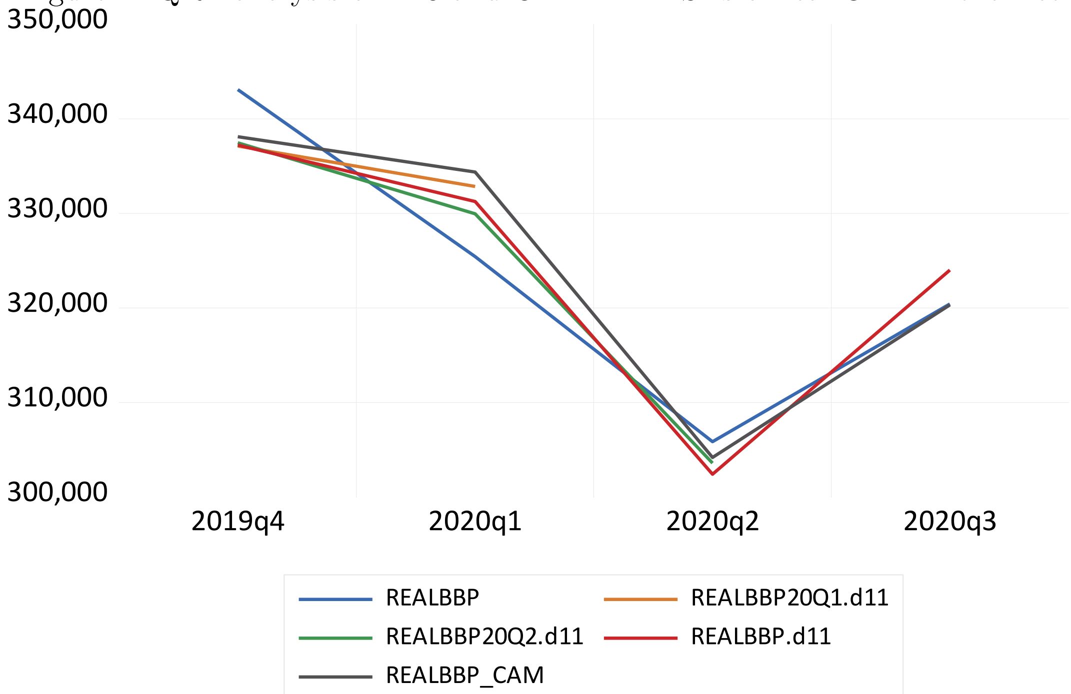
[3]Since X13 seasonal adjustment in Eviews with default settings produce quite good SAs, the changes in the procedure need not be large.

4 Results

4.1 Real GDP in the Netherlands (NLBBP)

Figure 1 shows the raw series of real GDP in the Netherlands, CAMPLET seasonal adjustments, and three series of X11 seasonal adjustments: for NLBBP ending 2020Q1, 2020Q2 and 2020Q3, i.e. the quarter before the COVID19 crisis, the COVID19 crisis quarter, and the quarter after the crisis. The values behind the figure are listed in Table A.1 in the Appendix.

Figure 1: QRT analysis of X13 and CAMPLET SAs of real GDP in the Netherlands



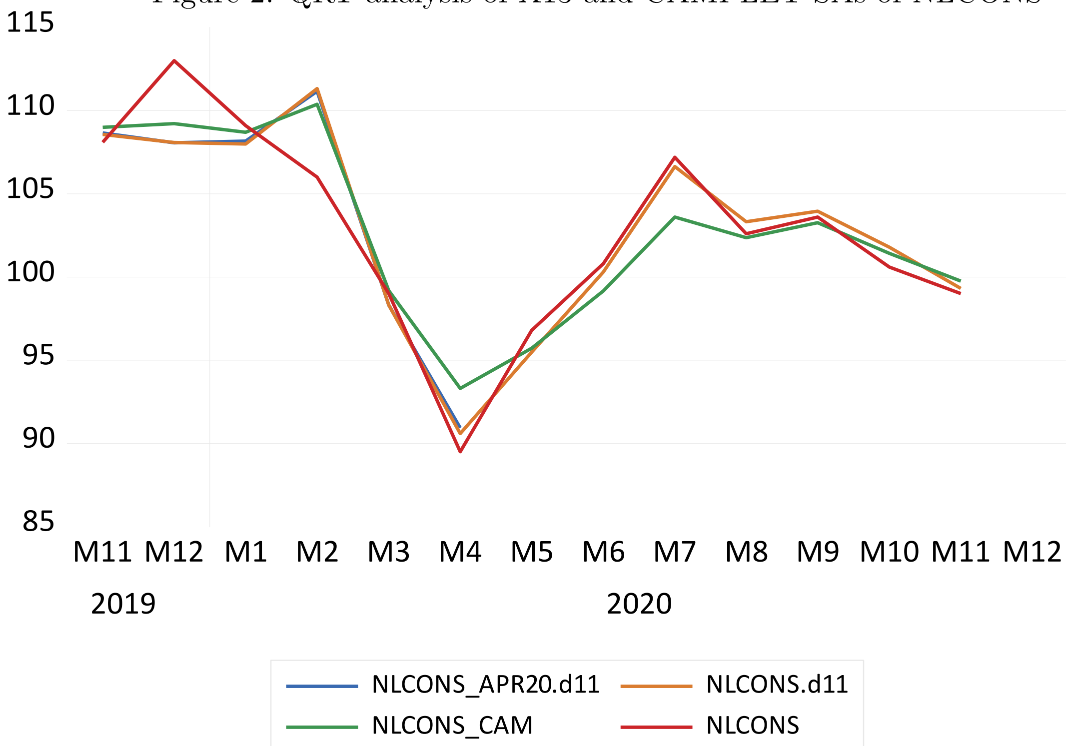
We observe that SA values produced by X13 and CAMPLET are close over the last year, an observation that holds for the whole series of SA values. CAMPLET SAs are not revised when new observations become available, whereas X13 SA shows revisions. SA values in 2002Q2 are **below** raw values. CAMPLET SA value in 2002Q2 is above

X13 SAs. Finally, X13 SAs are revised in downward direction when new observations become available (cf. realBBP20Ql2d11 and realBBPd11).

4.2 Consumption of households in the Netherlands (CONS)

Figure 2 shows the corresponding monthly series for consumption of households in the Netherlands. The values behind the figure are listed in Table A.2 in the Appendix.

Figure 2: QRT analysis of X13 and CAMPLET SAs of NLCONS

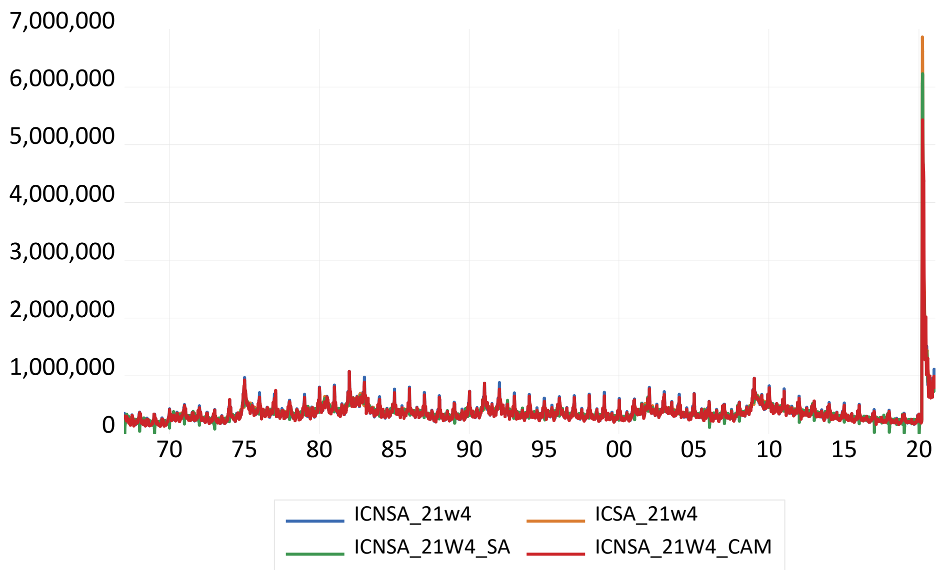


Here SA values in the COVID19 crisis period 2002M4 are **above** NSA values. The CAMPLET SA value in 2002Q2 is above X13 SA. X13 SAs are revised (a bit) in downward direction when new observations become available (cf. NLCONSAPRIL20d11 and NLCONSd11).

4.3 US Initial Claims in the US

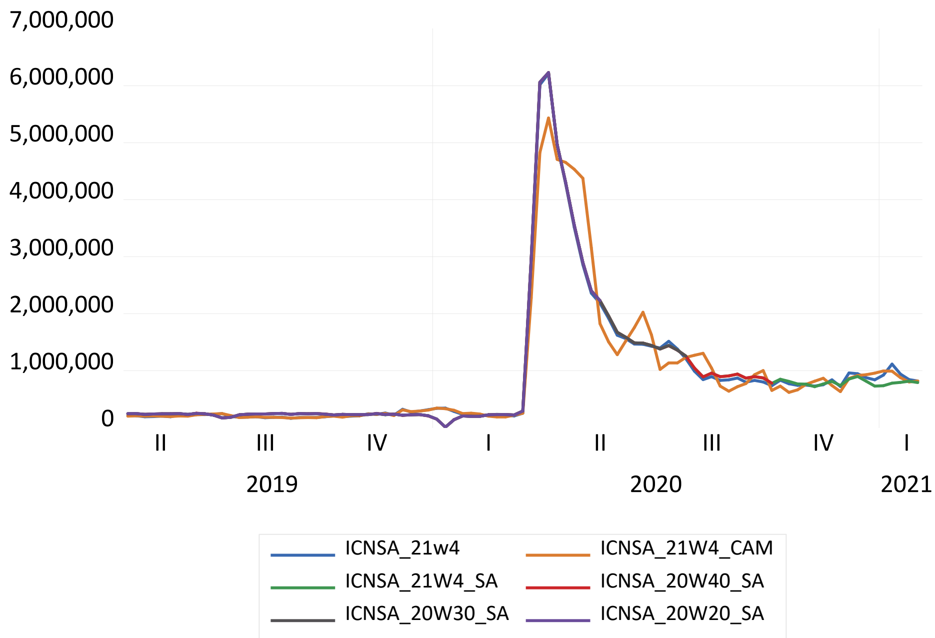
An initial claim is a claim filed by an unemployed individual after a separation from an employer. The claim requests a determination of basic eligibility for the Unemployment Insurance program. Figure 3 shows the weekly series of US initial series, based on weeks ending Saturday, and official SA values as available at FRED, and STL and CAMPLET seasonal adjustments for the period 1967w1–2021w4.

Figure 3: US Initial claims, weekly, ending Saturday. STL and CAMPLET SAs, 1967w1–2021w4



The published SA values of the initial claims series are close to STL and CAMPLET SA values. Raw, i.e., NSA, data are higher than SA values. In Figure 4 we exclude the raw series but include QRT seasonal adjustments of STL for 2020w20, 2020w30, 2020w40 and 2021w4 and zoom in on the most recent two years. Since CAMPLET SAs are not revised, we do have to compute QRT seasonal adjustments of CAMPLET. The values behind the figure are listed in Table A.3 in the Appendix.

Figure 4: US Initial claims, QRT analysis, STL and CAMPLET SAs, 2019w1–2021w4



The US initial claims series is a peculiar series with a large spike in the COVID19 period between March and May 2020. It can easily put SA methods to the test! STL SAs are close to CAMPLET SAs. Focusing on last two years of data we observe that initial claims have become higher since the COVID19 crisis. STL SAs are subject to revision. STL SAs capture NSA values in the COVID19 crisis period. So according to STL SAa there is no evidence of seasonal effects during the crisis! In contrast CAMPLET SAs underestimate NSA values in the COVID19 crisis. Finally, CAMPLET SAs are less smooth than STL SA after the COVID19 crisis.[4]

[4]Setting one of CAMPLET's parameters the multiplier M, which increments the adjustment length, to 100 instead of 50 renders CAMPLET SAs after the COVID19 crisis close to STL SAs.

5 Conclusion

The COVID19 crisis has a huge impact on economies all over the world. In this paper we compared seasonal adjustments of X13 and CAMPLET before and after the COVID19 crisis in a Quasi Real Time analysis of the quarterly series real GDP and the monthly series Consumption of Households in the Netherlands, and STL and CAMPLET seasonal adjustments for the weekly series US initial claims.

We find that differences in SA values are small and that X13 and STL seasonal adjustments are subject to revision. It is a puzzle why quarterly SA values are smaller than the NSA or raw values during the COVID19 crisis, whereas for the monthly series SA values are above NSA values.

From the analysis of the weekly Initial Claims series we learned that STL SAs follow NSA values closely, and that STL SAs are subject to revision. In addition, the COVID19 crisis caused a structural increase in initial claims. Before the crisis initial claims fluctuated around a lower level than after the crisis. STL SAs capture NSA values in the COVID19 crisis period, whereas CAMPLET does not pick up NSA values in the crisis period completely. CAMPLET finds a seasonal effect. CAMPLET SAs are less smooth than STL SA after the COVID19 crisis.

Further research is needed to validate these findings for more sophisticated SA methods parameter settings, other series and other countries, and to carry out a Real-Time experiment because macroeconomic time series are subject to revision. But to really understand the outcomes, simulation studies may be required. Seasonal adjustment produces latent variables, so it makes sense to design experiments in which the processes of the non-seasonal and seasonal are known, and possibly correlated (Hindrayanto el al. 2019).

Finally, our analyses do not allow a pertinent answer to the question SA or not SA?. Seasonal adjustment is feasible, even after the COVID19 crisis, it is a matter of taste whether one wants to analyse SA variables or to keep the seasonals in the models. But in any case, one should allow for time-varying volatility (see e.g. Carriero et al. 2021) to capture the extreme COVID19 shock.

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A Data behind Figures 1, 2 and 4

Table A.1: Data behind Figure 1

	REALBBP	REALBBP20Q1 D11	REALBBP20Q2 D11	REALBBP D11	REALBBP CAM
2019Q1	323663	330721.962	328815.058	329647.2047	330026.4063
2019Q2	339377	333972.491	335937.1642	335145.0249	333690.0938
2019Q3	332023	336056.0447	335957.103	335969.1979	335787.6563
2019Q4	343092	337122.2298	337456.5132	337211.1001	338102.9063
2020Q1	325432	332856.2744	329957.0619	331248.1189	334361.375
2020Q2	305847		303590.0123	302409.9464	304198.4375
2020Q3	320415			324013.3141	320311.3125

Table A.2: Data behind Figure 2

	NLCONS APR20 D11	NLCONS D11	NLCONS CAM	NLCONS
2019M07	108.2057433	108.5582231	108.213974	109.2
2019M08	108.3195611	107.7094862	108.1172028	106.8
2019M09	107.627193	106.9937382	107.736618	106.6
2019M10	108.7699511	108.5208417	108.9591446	107.2
2019M11	108.6579356	108.5656881	108.9968643	108.1
2019M12	108.0711209	108.08436	109.2213974	113
2020M01	108.1694771	107.995975	108.6974945	109.1
2020M02	111.1608853	111.3297269	110.3824387	106
2020M03	98.30995696	98.3145655	99.18599701	99
2020M04	90.93720016	90.59791883	93.29655457	89.5
2020M05		95.48584734	95.71723175	96.8
2020M06		100.3085844	99.17362213	100.8
2020M07		106.6342024	103.6055679	107.2
2020M08		103.3228853	102.3597412	102.6
2020M09		103.9573772	103.2582092	103.6
2020M10		101.786211	101.4243774	100.6
2020M11		99.31190599	99.7594986	99
2020M12				

Table A.3: Data behind Figure 4

	ICNSA 21W4	ICNSA 21W4 CAM	ICNSA 21W4 SA		ICNSA 20W40 SA	ICNSA 20W30 SA	ICNSA 20W20 SA
01/05/2019	350681	333577.7813	162978.4452	162333.2014	162467.0274	162168.9719	
01/12/2019	343678	337782.875	9948.313544	9859.593774	10253.91159	10343.56302	
1/19/2019	269369	271622.2188	123836.9606	123685.0658	123163.4683	122868.7755	
1/26/2019	250580	264768.8438	223024.4696	221554.299	222683.2545	222710.673	
02/02/2019	254263	274986.375	224687.7068	223168.8912	224459.491	224472.1333	
02/09/2019	242762	259225.375	218504.5552	216745.2065	218192.0559	218184.475	
2/16/2019	210679	209798.6094	223880.364	222987.3973	222632.5434	222653.5295	
2/23/2019	203049	196700.9531	231239.2228	230189.214	229532.5879	229551.4812	
03/02/2019	220540	214217.125	230877.7996	229613.1684	228823.8484	228834.031	
03/09/2019	209302	208573.0156	227261.3794	226960.5795	226641.428	226663.5592	
3/16/2019	194335	203489.8438	230382.1142	229930.735	230056.4538	230079.1551	
3/23/2019	190023	198242.3594	234293.3525	234246.3543	234372.5482	234396.2189	
3/30/2019	183775	188179.4688	228689.3677	228645.6223	228788.3378	228821.3869	
04/06/2019	196071	193005.2656	214658.7416	214610.4393	214745.6376	214763.8483	
4/13/2019	196364	190941.8281	197261.3357	197169.6622	197357.129	197377.5405	
4/20/2019	211762	196403.7188	235894.9595	235875.9544	235973.1797	235996.7622	
4/27/2019	204755	197102.375	241314.9293	241298.2978	241426.9041	241466.855	
05/04/2019	204033	206128.5781	243235.4592	243195.3511	243423.4569	243496.8011	
05/11/2019	188264	196821.375	229698.3298	229710.8509	229798.314	229833.2799	
5/18/2019	191931	200677.4531	237076.103	237083.2718	237232.177	237291.3736	
5/25/2019	198194	199681.4375	238717.9877	238750.9135	238853.27	238900.5072	
06/01/2019	189577	193067.9688	239735.2572	239814.6439	239785.7209	239790.2904	
06/08/2019	220186	201094.4531	242817.8271	242889.7715	243022.6559	243097.5374	
6/15/2019	205921	197538.375	228339.4996	227383.84	228460.7516	228501.3785	
6/22/2019	225819	222003.2188	247725.8547	248487.8706	247880.54	247935.7761	
6/29/2019	224565	230335.0156	238301.3517	238463.1286	238414.0918	238449.2779	
07/06/2019	231995	237392.4688	214541.1838	214724.6299	214926.9552	215056.5342	
7/13/2019	243621	243885.7813	168472.2569	168006.5779	168676.2886	168712.3552	
7/20/2019	196382	207094.0469	178736.4529	177238.4394	177275.5245	176118.8899	
7/27/2019	178897	173349.2344	223583.4795	223858.4712	223666.0691	223689.6213	
08/03/2019	179879	181337.2031	232724.2248	233023.1131	232791.6551	232808.8867	
08/10/2019	186914	186677.8438	235639.8447	235963.3847	235708.1756	235727.4502	
8/17/2019	171386	178995.1094	235029.9899	235376.1259	235089.0639	235108.4651	
8/24/2019	176867	178907.625	242405.2635	242733.788	242463.5825	242482.0292	
8/31/2019	179516	173112.4219	246318.8868	246669.7204	246421.3055	246453.6141	

Table A.4: Table A.3 continued

	ICNSA 21W4	ICNSA 21W4 CAM	ICNSA 21W4 SA		ICNSA 20W40 SA	ICNSA 20W30 SA	ICNSA 20W20 SA
09/07/2019	160342	165201.2031	229061.6337	229562.7649	229049.8684	229048.1606	
9/14/2019	173134	170659.3281	242537.8732	243112.8441	242587.9897	242606.6729	
9/21/2019	175394	174577.3125	240258.7452	240973.7155	240304.8554	240332.1958	
9/28/2019	172968	169356.0156	242605.994	243646.9584	242659.9113	242694.744	
10/05/2019	188106	192566.0781	232751.5261	234617.707	232801.1543	232841.6389	
10/12/2019	201677	198507.2188	218940.3	219202.2863	219010.4565	219069.7676	
10/19/2019	186748	180397.1563	228769.3498	228997.9907	228764.068	228798.1852	
10/26/2019	198733	205238.7344	224373.0937	225688.1729	225785.1729	225813.8245	
11/02/2019	205625	204173.75	222557.3898	224037.2101	224249.2527	224293.2756	
11/09/2019	238996	236116.75	227480.1188	226462.3947	226528.3971	226580.3708	
11/16/2019	227892	228367.7344	242787.8372	245346.2791	244271.9636	244421.3207	
11/23/2019	252428	246017.5625	224008.6905	226193.4811	225953.3141	225898.1931	
11/30/2019	216827	206983	235422.1162	234897.9131	234083.0679	234117.2213	
12/07/2019	317866	308806.125	212672.3314	213235.0639	214566.4712	214619.5482	
12/14/2019	270547	279083.5	222576.1895	222282.3804	222383.9504	222416.8819	
12/21/2019	287243	289342.375	226749.6067	227347.1261	227124.1581	227224.4924	
12/28/2019	312524	305462.875	203736.0367	201483.545	203576.9115	203645.7781	
01/04/2020	335480	338238.9375	148134.0724	147480.9553	147624.6827	147325.0989	
01/11/2020	338550	329742.4688	4748.48585	4657.560801	5054.122882	5143.296708	
1/18/2020	282088	301529.125	136917.6481	136762.5056	136229.989	135928.0864	
1/25/2020	229002	243751.7188	201631.9309	200141.3349	201283.5211	201311.2057	
02/01/2020	224664	250270.7031	195294.9684	193751.9991	195061.4317	195074.5742	
02/08/2020	219601	234839.9219	195635.9603	193854.8112	195313.8606	195306.2766	
2/15/2020	209336	198868	222663.1857	221758.8578	221392.4097	221413.7825	
2/22/2020	199278	185313.6875	227597.2038	226530.4492	225856.802	225876.2857	
2/29/2020	216982	182936.3125	227357.2332	226066.4224	225263.9822	225274.8786	
03/07/2020	200382	215528.5781	218514.7013	218206.9536	217874.5052	217897.2904	
3/14/2020	251416	250716.5	287568.8977	287113.2255	287244.1444	287267.4907	
3/21/2020	2920162	2273192.5	2964460.456	2964411.29	2964542.8	2964567.154	
3/28/2020	6015821	4827383	6060729.459	6060683.795	6060831.211	6060864.764	
04/04/2020	6211406	5432310.5	6230004.926	6229954.702	6230094.549	6230113.204	
04/11/2020	4965046	4703966.5	4965954.174	4965859.627	4966053.148	4966074.16	
4/18/2020	4281648	4652225	4305746.184	4305725.551	4305827.766	4305852.145	
4/25/2020	3515439	4531660	3551957.233	3551939.128	3552072.641	3552113.384	
05/02/2020	2855561	4372697	2894688.345	2894646.916	2894879.905	2894954.112	
05/09/2020	2356626	3152284.5	2398027.997	2398039.64	2398131.627	2398167.543	
5/16/2020	2181640	1823414.75	2226656.946	2226663.5	2226816.59	2226876.657	
5/23/2020	1915138	1501082.75	1955482.048	1955514.775	1955620.661		
5/30/2020	1620008	1277067.25	1670009.812	1670089.194	1670063.741		

Table A.5: Table A.3 continued

	ICNSA 21W4	ICNSA 21W4 CAM	ICNSA 21W4 SA		ICNSA 20W40 SA	ICNSA 20W30 SA	ICNSA 20W20 SA
06/06/2020	1561267	1513912.75	1583787.446	1583859.925	1583995.198		
6/13/2020	1463363	1752696.25	1485663.025	1484692.035	1485787.681		
6/20/2020	1460056	2021017	1481792	1482576.261	1481949.901		
6/27/2020	1426618	1626806.875	1440177.552	1440341.284	1440293.008		
07/04/2020	1395081	1019218.25	1377570.091	1377755.293	1377954.072		
07/11/2020	1512816	1134175.875	1437901.134	1437426.843	1438106.317		
7/18/2020	1376925	1134052.875	1359633.696	1358117.79	1358163.781		
7/25/2020	1207045	1228872.125	1251840.847	1252119.548	1251926.137		
08/01/2020	988309	1267399.25	1041160.939	1041464.345			
08/08/2020	838734	1301523.875	887445.5938	887774.1225			
8/15/2020	889738	1044409.688	953270.0395	953621.7475			
8/22/2020	825761	725503.25	891131.6317	891465.7545			
8/29/2020	837008	634649.375	903634.9715	903992.4642			
09/05/2020	865995	714567.625	934587.7053	935097.4591			
09/12/2020	796015	770600.125	865282.0593	865866.8201			
9/19/2020	827212	927335.6875	891954.1066	892682.2408			
9/26/2020	798996	997283.25	868506.5841	869567.0934			
10/03/2020	731249	649730.125	775812.0871	777709.1487			
10/10/2020	829742	724335.8125	846998.6495				
10/17/2020	766520	617196.8125	808376.7702				
10/24/2020	738709	658739.25	764266.719				
10/31/2020	743904	756552.0625	760722.0108				
11/07/2020	725361	812900.75	713886.8869				
11/14/2020	749338	865162.5	764117.5628				
11/21/2020	835914	736979.625	807479.5327				
11/28/2020	718522	629729.25	737072.7826				
12/05/2020	956473	860179.9375	851212.4141				
12/12/2020	941910	910411.875	894004.9317				
12/19/2020	872941	925171.625	812346.4234				
12/26/2020	835972	952545.75	727398.4522				
01/02/2021	919680	989922.875	732679.3846				
01/09/2021	1113098	988759.5	779227.3936				
1/16/2021	936383	874416.75	791559.204				
1/23/2021	839772	799097.1875	812577.6665				
1/30/2021	816247	814913.875	787077.3745				