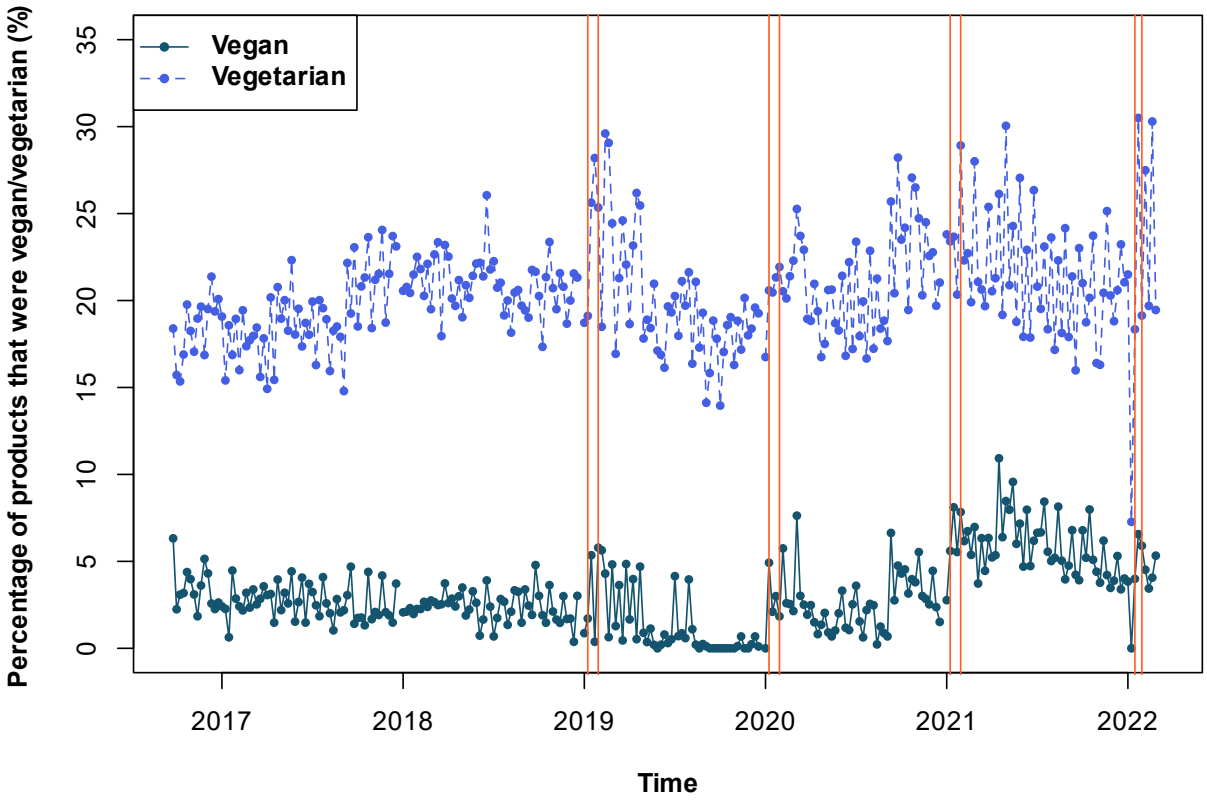
List of figures

Figure 5: Vegan/Vegetarian products (weekly), proportion of total products



Note: The vertical lines mark the beginning and end of each campaign period.

Vegan products accounted for a higher proportion of the total number of products in the campaign periods in 2021 and 2022 (6.77% and 5.24% respectively), compared to pre campaign (2.63%). A similar pattern was observed for vegetarian products: they accounted for a higher proportion in 2021 and 2022 (24.08%, 23.87% respectively), again compared topre campaign (19.79%). See Table 8 in the Appendix for more details on this.

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that date. This would result in lower absolute number of (all/vegan/vegetarian) products, however, the influence on proportion of vegan/vegetarian products out of all products should be relatively small. Overall, the proportions calculated should be treated as imperfect proxies of actual product availability.

Additionally, analysis of the relationship between product proportion and proportion of sales revealed significant correlations for both vegan ($r = 0.868$, $p < 0.001$) and vegetarian ($r = 0.661$, $p < 0.001$) products, meaning that the proportion of vegan/vegetarian sales (out of total sales) varied in a similar pattern to the proportion of vegan/vegetarian products (out of all products) over the analysis period.

Additional information

The statistical significance of model parameters was conducted using a Z-test of coefficients, with a significance level of $\alpha = 0.05$.

For brevity, the results reported in Section 5 outline the primary models fitted to the time series for each outcome. Additional results are appended.

Appendix

Additional data on product availability and price

Table 8: Availability of vegan and vegetarian products for different periods

Period	Number of all products (per week on average)	Number of Vegan products per week (per week on average)	Number of vegetarian products (per week on average)	Proportion of vegan products (per week on average)	Proportion of vegetarian products (per week on average)
Baseline period	955	25	188	2.63%	19.79%
January 2017	1049	26	183	2.45%	17.49%
January 2018	886	19	185	2.12%	20.82%
Campaign period 2019	**810**	**28**	**201**	**3.31%**	**24.58%**
Non-campaign period 2019	911	11	178	1.16%	19.56%
1st Quarter 2019	867	29	205	3.24%	23.73%
2nd-4th Quarter 2019	914	7	172	0.74%	18.80%
Campaign period 2020	**901**	**27**	**190**	**2.97%**	**21.08%**
Non-campaign period 2020	843	23	179	2.64%	21.13%
1st Quarter 2020	885	30	191	3.33%	21.62%
2nd-4th Quarter 2020	836	21	177	2.46%	20.97%
Campaign period 2021	**896**	**61**	**216**	**6.77%**	**24.08%**

Model	With drift?	AIC
ARIMA(3,1,1)	-	-828.087
ARIMA(2,1,1)	-	-822.809
ARIMA(3,1,0)	-	-812.401
ARIMA(4,1,1)	-	-826.112
ARIMA(3,1,2)	-	-826.109
ARIMA(2,1,0)	-	-784.946
ARIMA(2,1,2)	-	-824.704
ARIMA(4,1,0)	-	-820.066
ARIMA(4,1,2)	-	-824.65
ARIMA(2,1,2)(0,1,0)[52]	-	-403.2494
ARIMA(0,1,0)(0,1,0)[52]	-	-364.5596
ARIMA(1,1,0)(0,1,0)[52]	-	-380.213
ARIMA(0,1,1)(0,1,0)[52]	-	-405.5357
ARIMA(1,1,1)(0,1,0)[52]	-	-404.6834
ARIMA(0,1,2)(0,1,0)[52]	-	-405.3587
ARIMA(1,1,2)(0,1,0)[52]	-	-404.5259

Intervention analysis - outliers

Aside from the campaign periods, highly significant innovative and additive outliers[14] were detected. Innovative outliers were observed in Weeks 207 and 240 (weeks 37 and 17 of 2020 and 2021, respectively), and an additive outlier was observed in Week 180 (week 10 of 2000).

The lack of periodicity between these outliers suggests that these are not related to seasonal consumption patterns.

[14] Innovative outliers refer to outliers which have an effect on subsequent observations, while additive outliers refer to those which do not. See Chang, I.H., Tiao, G.C. and C. Chen (1988). Estimation of Time Series Parameters in the Presence of Outliers. *Technometrics*, 30, 193-204.

Figure 12: Distribution of standardised residuals and ACF, pre-campaign ARIMA $(3,1,1)\ (0,0,0)_{52}$ model (vegan)

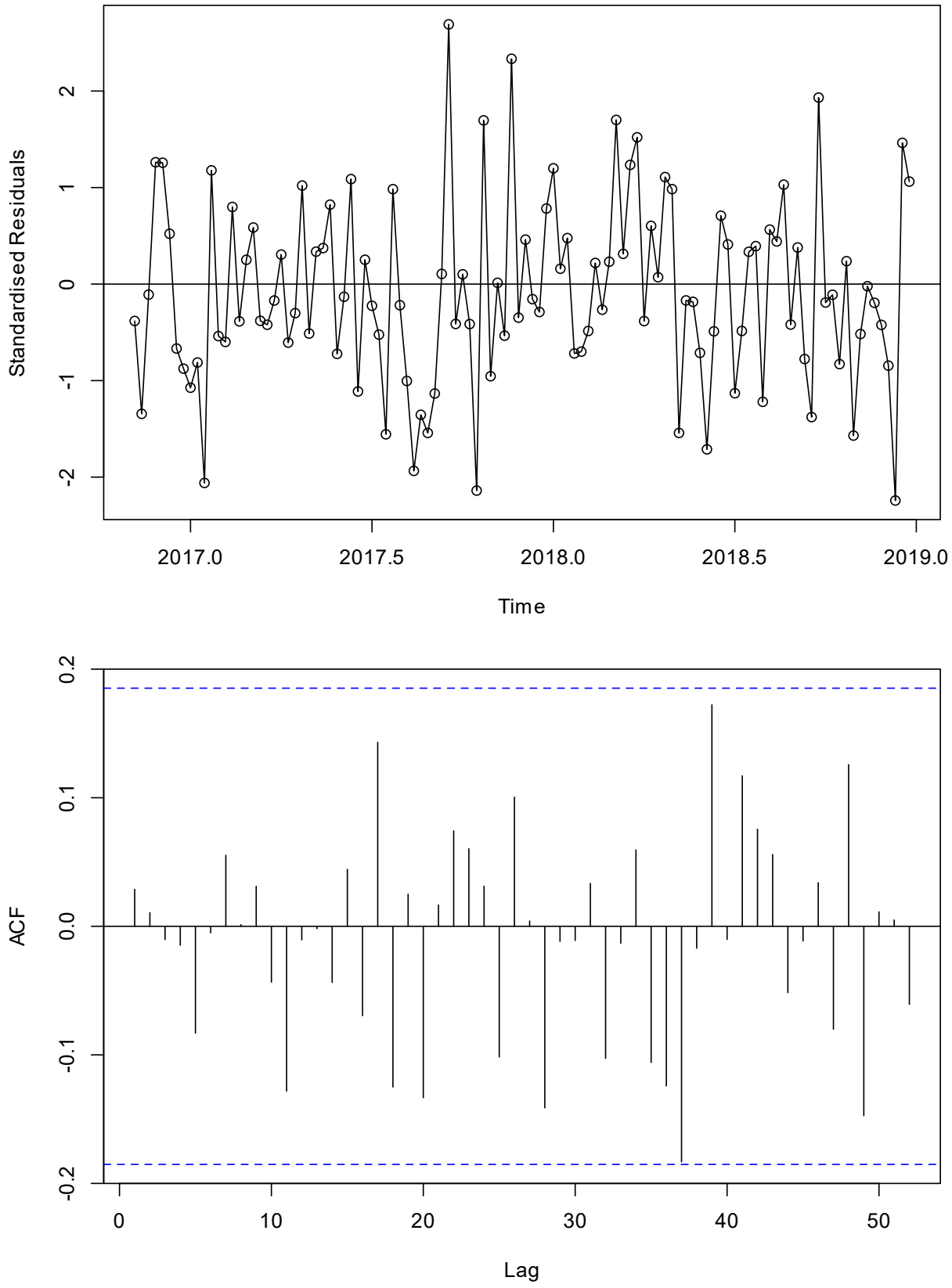
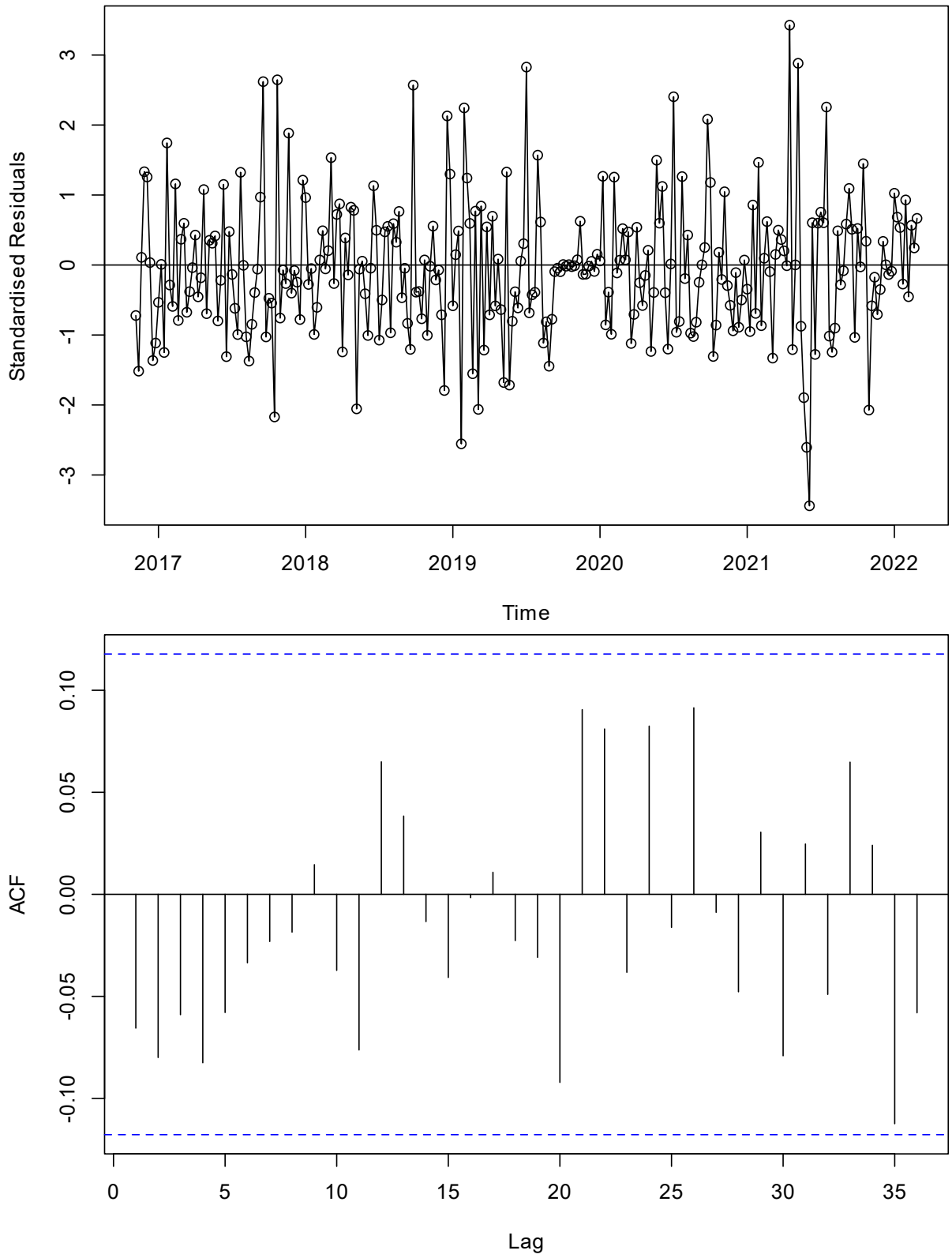


Figure 13: Distribution of standardised residuals and ACF, full time series ARIMA (3,1,0) $(0,0,0)_{52}$ model (vegan)



Secondary outcomes, total sales (vegan)

A different model was fitted to these data: an ARIMA (0,1,1) $(0,0,0)_{52}$. Examination of model residuals indicated an acceptable fit, corroborated by the Ljung-Box Q-statistic (Q = 54.20, p = 0.139). The results of this model suggested a similar pattern of results to the primary analysis: significant effects were observed for the 2020, 2021 and 2022 campaign periods, with the smallest peak magnitude observed for 2020 (ω_1 2020 = 135.249, $p < 0.01$), and broadly similar peak magnitudes observed for 2021 (ω_1 2021 = 156.950, $p < 0.05$) and 2022 (ω_1 2022 = 166.558, $p < 0.01$).

Table 12: Secondary analysis (absolute vegan weekly sales), ARIMA $(0,1,1)$ $(0,0,0)_{52}$ model parameters

Parameter	Coefficient	Standard error	P-value
MA(1)	-0.819	0.034	$p < 0.001$
AOL, Week 10 (2016)	244.690	60.447	$p < 0.001$
AOL, Week 180 (2020)	197.091	59.585	$p < 0.001$
IOL, Week 11 (2016)	188.390	63.493	$p < 0.01$
IOL, Week 207 (2020)	150.534	62.328	$p < 0.05$
IOL, Week 224 (2021)	109.466	62.325	$p = 0.079$
IOL, Week 238 (2021)	240.949	62.331	$p < 0.001$
ω_1 2020	135.249	59.725	$p < 0.05$
δ 2020	0.095	0.036	$p < 0.01$
ω_1 2021*	156.950	60.934	$p < 0.05$
δ 2021	0.130	0.015	$p < 0.001$
ω_1 2022	166.558	63.036	$p < 0.01$
δ 2022	0.263	0.090	$p < 0.01$

Log likelihood = -1565.86, AIC = 3157.72

* 2021's impact was lagged a week in this model

Intervention analysis model additional outputs, vegetarian data

Table 13: Pre-campaign ARIMA (4,0,0) $(0,0,0)_{52}$ model parameters, vegetarian

Parameter	Coefficient	Standard error	P-value
AR(1)	-0.057	0.087	p = 0.507
AR(2)	0.030	0.086	p = 0.728
AR(3)	-0.127	0.088	p = 0.146
AR(4)	0.337	0.088	p < 0.001

Log likelihood = 333.07, AIC=-654.13

Table 14: Alternative ARIMA models for the pre-campaign period, including AIC values, vegetarian

Model	Mean	AIC
ARIMA(0,0,0)	With zero mean	-157.3592
ARIMA(0,0,0)	With non-zero mean	-641.7266
ARIMA(0,0,1)	With zero mean	-264.234
ARIMA(0,0,1)	With non-zero mean	-641.7996
ARIMA(0,0,2)	With zero mean	-363.4315
ARIMA(0,0,2)	With non-zero mean	-640.0633
ARIMA(0,0,3)	With zero mean	-396.9117
ARIMA(0,0,3)	With non-zero mean	-640.8059
ARIMA(0,0,4)	With zero mean	-425.0282
ARIMA(0,0,4)	With non-zero mean	-648.698
ARIMA(0,0,5)	With zero mean	-454.3674
ARIMA(0,0,5)	With non-zero mean	-647.0897
ARIMA(1,0,0)	With zero mean	-541.756
ARIMA(1,0,0)	With non-zero mean	-642.0666
ARIMA(1,0,2)	With non-zero mean	-638.22
ARIMA(1,0,3)	With non-zero mean	-649.6786
ARIMA(1,0,4)	With non-zero mean	-646.9031
ARIMA(2,0,0)	With non-zero mean	-640.6975
ARIMA(2,0,1)	With non-zero mean	-638.3395
ARIMA(3,0,0)	With non-zero mean	-642.2764
ARIMA(3,0,1)	With non-zero mean	-650.281
ARIMA(3,0,2)	With non-zero mean	-648.5888
ARIMA(4,0,0)	With non-zero mean	**-654.1311**
ARIMA(4,0,1)	With non-zero mean	-652.2098
ARIMA(5,0,0)	With non-zero mean	-652.2488

Outliers

Aside from the campaign periods, highly significant innovative and additive outliers were detected. Innovative outliers were observed in Week 140 (week 22 of 2019), Week 236-239 (week 13-16 of 2021), Week 251 (week 28 of 2021), and Week 278 (week 3 of 2022). Additive outliers were observed in Week 14 (week 52 of 2016), Week 35 (week 21 of 2017), and Week 240 (week 17 of 2021).

Figure 14: Distribution of standardised residuals and ACF, pre-campaign ARIMA (4,0,0) $(0,0,0)_{52}$ model (vegetarian)

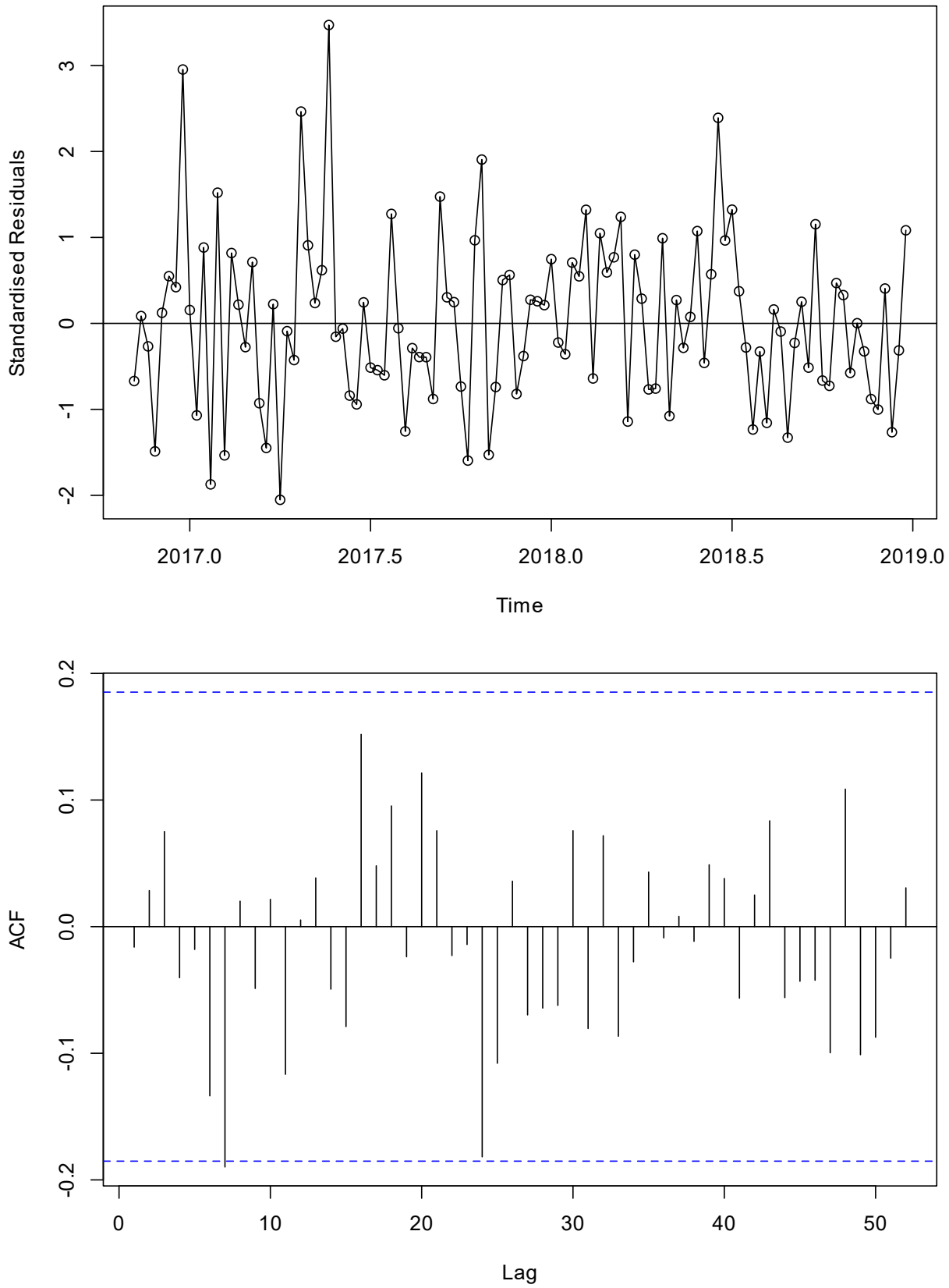
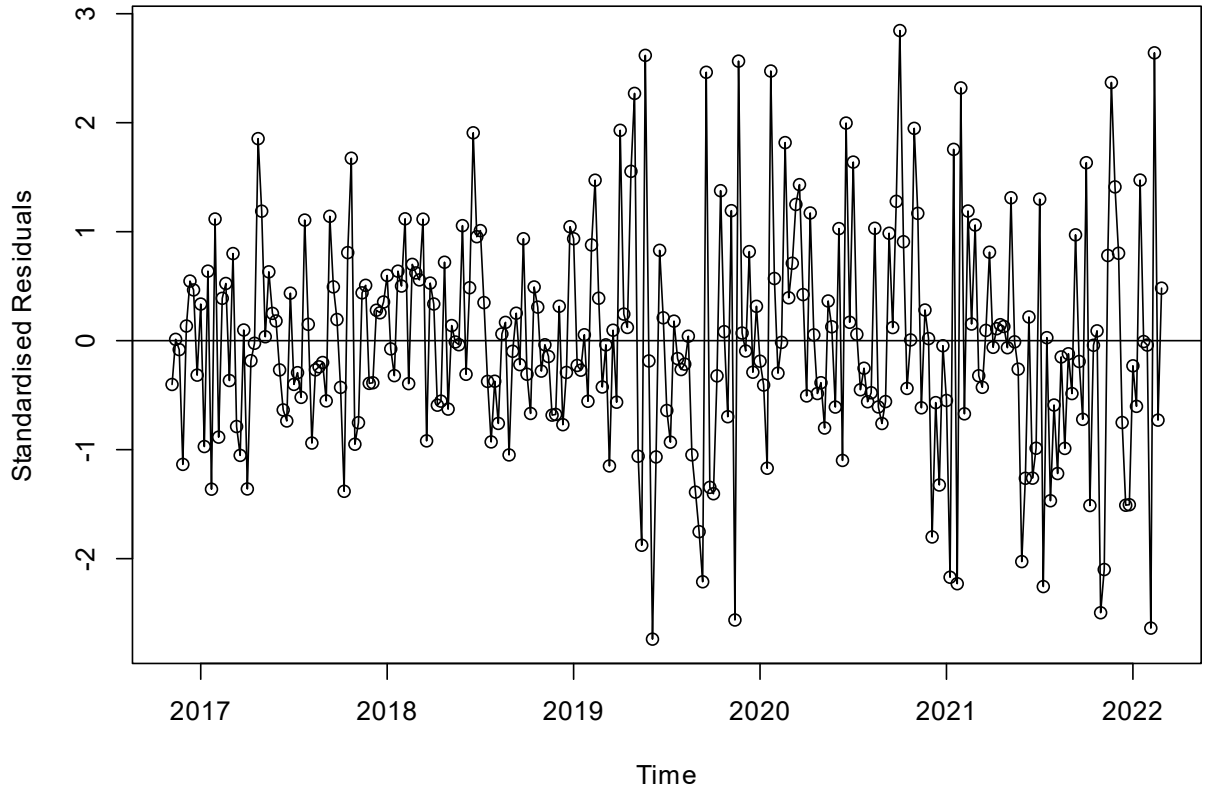
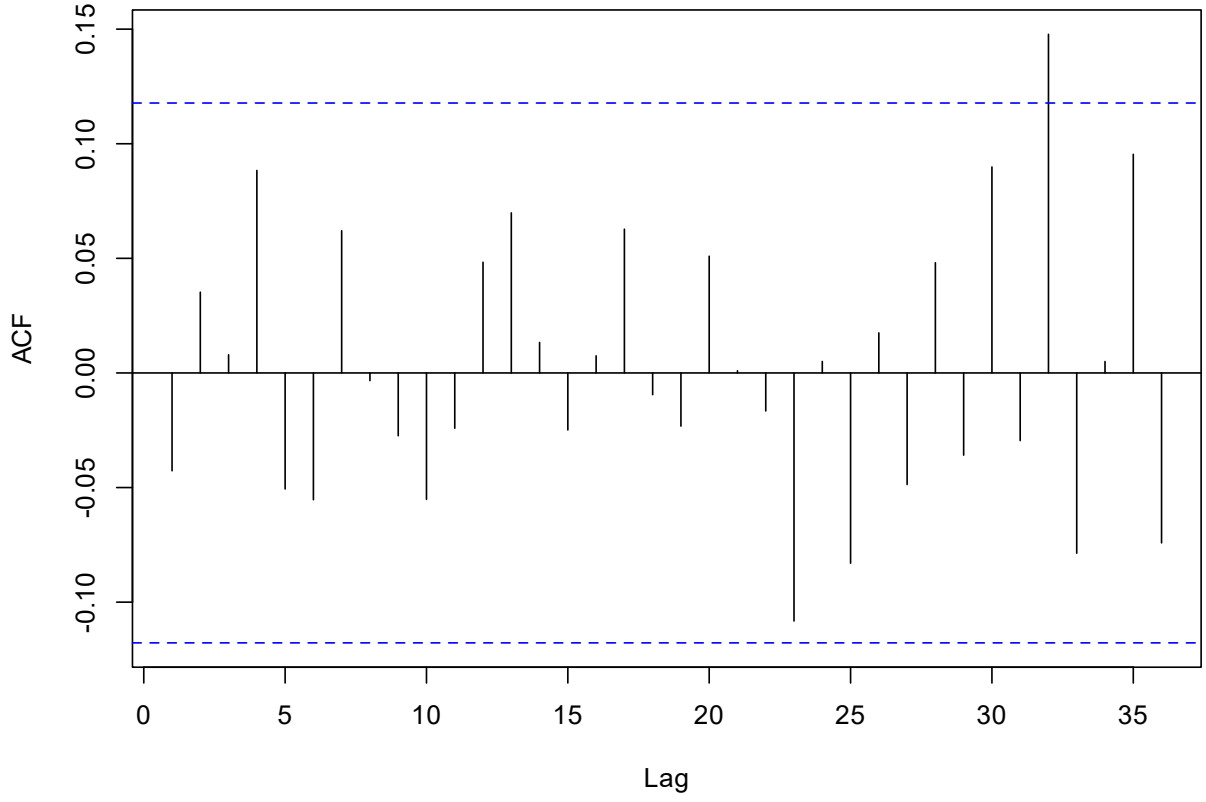


Figure 15: Distribution of standardised residuals and ACF, full time series ARIMA (4,0,0) $(0,0,0)_{52}$ model (vegetarian)





Secondary outcomes, total sales (vegetarian)

A different model was fitted to these data: an ARIMA (15,0,0) $(1,0,0)_{52}$ with three transfer functions taking the same form as the primary analysis. Examination of model residuals indicated an acceptable fit, corroborated by the Ljung-Box Q-statistic (Q = 34.89, p = 0.378).

The coefficients denoting the campaign period for the 2019 (ω_1 2019 = 183.943, p = 0.270), 2021 (ω_1 2021 = 227.618, p = 0.190) and 2022 (ω_1 2022 = 319.043, p = 0.101) were not statistically significant, likely due to challenges modelling the outcome due to additional variability in the outcome variable. Nonetheless, they had a broadly similar pattern to those from the primary analysis: the highest parameter coefficient was observed for 2022.

Table 15: Secondary analysis (absolute vegetarian weekly sales), ARIMA (15,0,0) $(1,0,0)_{52}$ model parameters

Parameter	Coefficient	Standard error	P-value
AR(1)	0.028	0.060	p = 0.640
AR(2)	0.394	0.059	p < 0.001
AR(3)	-0.004	0.066	p = 0.953
AR(4)	0.304	0.064	p < 0.001
AR(5)	-0.092	0.066	p = 0.163
AR(6)	-0.115	0.066	p = 0.082
AR(7)	0.105	0.067	p = 0.118
AR(8)	0.158	0.066	p < 0.05
AR(9)	0.084	0.066	p = 0.208
AR(10)	-0.072	0.067	p = 0.281
AR(11)	0.070	0.068	p = 0.301

Parameter	Coefficient	Standard error	P-value
AR(12)	-0.086	0.064	p = 0.184
AR(13)	0.163	0.066	p < 0.05
AR(14)	-0.028	0.062	p = 0.652
AR(15)	-0.227	0.062	p < 0.001
SAR(1)	0.325	0.074	p < 0.001
Intercept	988.803	51.632	p < 0.001
IOL, Week 225 (2021)	950.170	207.314	p < 0.001
ω_1 2019	183.943	166.773	p = 0.270
δ 2019	0.000	0.014	p = 0.990
ω_1 2021	227.618	173.531	p = 0.190
δ 2021	0.000	0.023	p = 0.983
ω_1 2022	319.043	194.408	p = 0.101
δ 2022	0.004	0.070	p = 0.950

Log likelihood = -1907.25, AIC = 3862.5

Secondary outcomes, total sales (all products)

A different model was fitted to these data: an ARIMA (3,1,0) $(0,1,1)_{52}$ with four transfer functions taking the simple form $\omega_1 P_t^{(T)}$, where ω_1 represented the immediate effect of the intervention. Examination of model residuals indicated an acceptable fit, corroborated by the Ljung-Box Q-statistic (Q = 57.69, p = 0.097).

The results of this model suggested a significant increase in total sales in the 2021 campaign period, and no significant changes of total sales in the 2019, 2020 and 2022 campaign periods.

Table 16: Secondary analysis (absolute total weekly sales), ARIMA (3,1,0) $(0,1,1)_{52}$ model parameters

Parameter	Coefficient	Standard error	P-value
AR(1)	-0.636	0.079	$p < 0.001$
AR(2)	-0.228	0.092	$p < 0.05$
AR(3)	-0.285	0.075	$p < 0.001$
SMA(1)	-0.380	0.081	$p < 0.001$
AOL, Week 54 (2017)	-884.482	565.176	$p = 0.118$
AOL, Week 55 (2017)	-512.342	542.635	$p = 0.345$
AOL, Week 222 (2020)	872.831	554.933	$p = 0.116$
AOL, Week 283 (2022)	-4110.166	717.997	$p < 0.001$
ω_1 2019	446.066	571.986	$p = 0.435$
ω_1 2020	435.884	595.587	$p = 0.464$
ω_1 2021	2243.308	599.502	$p < 0.001$
ω_1 2022	-1024.164	652.039	$p = 0.116$

Log likelihood = -1840.95, AIC = 3705.9

Sensitivity analysis – Individual branch

Model fitting – Pre-intervention model, vegan

An ARIMA (3,1,0) $(0,0,0)_{52}$ model without drift was the best fit for the unperturbed data, based on AIC (AIC = -547.39). An augmented Dickey-Fuller test confirmed differencing was needed (ADF = -2.875, p = 0.213). The model residuals indicated a satisfactory fit, confirmed by the Ljung-Box Q statistic (Q = 19.107, p = 0.839).

Model parameters can be seen below in Table 17.

Table 17: Pre-campaign ARIMA (3,1,0) $(0,0,0)_{52}$ model parameters (selected branch), vegan

Parameter	Coefficient	Standard error	P-value
AR(1)	-0.730	0.085	p < 0.001
AR(2)	-0.710	0.092	p < 0.001
AR(3)	-0.515	0.086	p < 0.001

Log likelihood = 283.22, AIC= -547.39

Model fitting – Pre-intervention model, vegetarian

An ARIMA (0,0,5) $(0,0,0)_{52}$ model with an intercept was the best fit for the unperturbed data, based on AIC (AIC = -356.67). An augmented Dickey-Fuller test confirmed that data were stationary (ADF = -4.0127, p < 0.05). The model residuals indicated an acceptable fit, confirmed by the Ljung-Box Q statistic (Q = 10.859, p = 0.900).

Model parameters can be seen below in Table 18.

Table 18: Pre-campaign ARIMA (0,0,5) $(0,0,0)_{52}$ model parameters (selected branch), vegetarian

Parameter	Coefficient	Standard error	P-value
MA(1)	0.033	0.097	p = 0.736
MA(2)	0.050	0.087	p = 0.557
MA(3)	-0.037	0.096	p = 0.699
MA(4)	0.349	0.094	p < 0.001
MA(5)	-0.154	0.094	p = 0.102
Intercept	0.113	0.006	p < 0.001

Log likelihood = 283.22, AIC= -547.39

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