Seasonality in soft fruit supply: distributional impact on nutrient demand and purchases

Abstract

The production of soft fruits in Scotland, the main fruit category produced in the country, has a marked seasonality. This has a mirroring effect on nutrition and diet quality every year. However, the extent to which seasonality affect soft fruit purchases (demand), nutrient supply, and different income groups has not been studied. The two main motivations for this topic are: (1) the need to understand the extent to consumers' purchases of soft fruit follow locality and seasonal patterns; and (2) whether this affects the purchase quantity/nutrient demanded for it, and therefore, getting consumers closer/far daily recommended intake. The study relied on time series for 6 main soft fruits constructed from the Kantar Worldpanel dataset for the period 2013 to 2021. Two main analyses were conducted: 1) seasonality analysis, and 2) estimation of an incomplete demand system by socioeconomic groups augmented by seasonal and trend terms. Results were compared by seasons (Summer, Winter, Autmn, and Spring) and income groups (less than £30,000, £30,000 – 50,000 and above £50,000 annual household income). The results show strong seasonal patterns in the purchases of soft fruit despite the possibility of getting out-of-season imported soft fruit. In addition, some fruits showed an increasing trend in prices. Significant average seasonal gaps were found in prices, ranging from 13.8 - 219.0 per cent during off season. In general, soft fruit purchases are very low during spring periods. Consumers are less sensitive to prices (expenditure) during booms (harvest periods) but extremely sensitive to prices (expenditure) during scarcity periods (low supply). Cherries had the largest range of sensitivity to prices whilst grapes had the least. Using seasonal gaps in the prices, household quantity and nutrient purchases had cyclical patterns, reducing significantly during low supply. It can be concluded that seasonality in soft fruit prices influence both quantity demanded and nutrient purchases negatively. A strategy by retailers to maintain constant supply of soft fruits or reduce the price gaps during peak and off-peak seasons could help to reduce the impact of seasonality of household food security.

Keywords: Demand for soft fruits; Scotland; Seasonality; Demand modelling

JEL Classification: D12; D04

1. Introduction

Seasonality is a complex term and has largely been associated with locally produced foods, especially fruits and vegetables. Little attention is paid to seasonality in other food groups (Macdiarmid, 2014). DEFRA (2012) defines seasonal food as one that is produced during the natural production period for the country or region where it is produced. It can also be defined in two contexts: globally seasonal, where the food is produced in the natural production season and consumed anywhere in the world; and locally seasonal, where the food is produced during the natural season and consumed within the same climatic environment it was produced without high-energy use for climate modification or storage (Brooks et al., 2012).

Scotland has four main seasons grouped as winter (December to February), spring (March to May), summer (June to August), and autumn (September to November). These four main seasonal patterns have a significant impact on dietary behaviour and nutritional intake during the year (Prasad et al., 2010). The purchases of fruits, vegetables, eggs, meat, cereals, and alcoholic beverages follow a seasonal consumption pattern which also has an effect on nutrient intake. For instance, the consumption of fruit is usually low during winter and spring and high during autumn and summer (Stelmach-Mardas et al., 2016).

Demand for seasonal foods is promoted by non-governmental agencies and media campaigns as a means to achieve sustainability (Commission & others, 2009; Defra, 2008). As of 1 January 2020, the French government has passed a bill requiring that 40% of products used in the food service sector be local, seasonal and from sustainable sources (Régnier et al., 2022). In addition, "eating seasonally" is included in the recommendations of the French National Program on Nutrition and Health. According to Stelmach-Mardas et al. (2016) the European Joint Program for Initiative identifies seasonality as a major determinant of diet hence requiring research.

The seasonal differences in nutrient intake, mainly vitamins and minerals, depend on the availability of foods (Fahey et al., 2003). Studying the impact of seasonal fluctuations on the diet of pregnant Finish women, Prasad et al. (2010) found that the four main seasonal patterns have impact on dietary behaviour and nutritional intake during the year. Similarly, a study by Rossato et al. (2010) on the seasonal effect of nutrient intake in adults in Brazil concluded that seasonality has a significant impact on nutrient intake. Malnutrition among children in Bangladesh was found to be higher during the summer season (Brown et al., 1982, 1985). In Spain, Capita & Alonso-Calleja, (2005) found that fruit and vegetable showed significant seasonal differences with average daily total food consumption being higher in the winter than in summer among males. Phillips et al., (2018) also found that the nutrient content of fruits and vegetables tends to vary depending on the season of the year. For instance, winter spinach and oranges had a higher vitamin C content than summer spinach and orange. The reverse is true for potatoes.

Despite the association between diet and health (de Ridder et al., 2017; Funtikova et al., 2015), and diet and the environment (Tukker et al., 2008; Yin et al., 2020), a few studies have delve into the role of seasonal food patterns in explaining this relationship. It is often assumed that eating more seasonal food would make consumption more sustainable by reducing the environmental impact of diet (Macdiarmid, 2014). The need for seasonal food consumption is anchored on the premise that it would reduce long-distance imports and unseasonal local production, both of which are energy-consuming (Esnouf et al., 2011). Macdiarmid (2014) adds that seasonal foods do not require the high-energy input from artificial heating or lighting needed to produce crops outside of their natural growing season. There is substantial evidence to support that foods grown in heated glasshouses have higher greenhouse gas emissions. Economic-wise, buying locally grown foods helps communities by stimulating local economies and protecting the environment.

On the contrary, it has been argued that eating locally or seasonally may not be sustainable from the health context (Stein & Santini, 2022). This is because only a limited number of fruits and vegetables can be grown in Scotland during the winter season. This would possibly reduce the amount of fruit and vegetable available to be purchased during this period and result in lower nutrient intake.

In another context, seasonal foods are perceived by different socioeconomic groups as expensive, difficult to come by, and limiting the variety of food ingredients used for cooking (Chambers et al., 2007; Ferbeck & Crombecque, 2017). A study by Johnston et al., (2011) suggests that whilst eating more local and seasonal food is considered ethical, this trend is pronounced among the higher socio-economic group.

Fruits and vegetables are essential for providing vital nutrients such as vitamins and minerals, dietary fibre and antioxidants that help in growth and development (Hongu et al., 2014). Fruits and vegetable consumption is a key ingredient in the UK's Eatwell guide (Buttriss, 2016). The World Health Organisation campaigns for the consumption of 400 grams of fruits and vegetables a day for the smooth functioning of the body and the prevention of obesity-related diseases (World Health Organization, 1991). There have been many attempts to increase the consumption of fruit and vegetable in Scotland. In the midst of the cost of living crisis, Aldi one of the main discounters in Scotland slashed the prices of fruit and vegetables by 36 per cent (Duncan, 2023b).

The dominant seasonal fruit produced and consumed in Scotland is soft fruit (Revoredo-Giha et al., 2011). Scottish soft fruit production is confined predominantly to genotypes of raspberry (Rubus), strawberry (Fragaria) and blackcurrant (Ribes) (Stewart et al., 2001). Soft fruits especially berries are one of the richest sources of natural antioxidants that help in the prevention of some chronic and degenerative diseases (Manganaris et al., 2014). For instance, blackcurrant extracts have the greatest antioxidant activity, followed by raspberries, with strawberries marginally lower (Stewart et al., 2001). Similarly, McDougall et al. (2008) concluded that berry extracts (Rowan berry, raspberry, lingonberry, cloudberry, arctic bramble, and strawberry) are able to exert antiproliferative effects against cervical and colon cancer cells grown in vitro. Therefore, changing one's diet to increase the content of soft fruits (high in natural antioxidants) could help reduce the incidence of many degenerative and age-related diseases such as coronary heart diseases, atherosclerosis and many cancers including those of the mouth, and stomach and colon (Block et al., 1992). Economically, the output value of soft fruits produced in Scotland increased from £20 million to £128 million between 2001 and 2015 (Michie, 2021). This suggests that an increase in production driven by increased local demand would generate more revenue for the national economy.

Until recently the soft fruit output has been on the decline due to inflationary cost of production, bad weather and unstable labour markets (Duncan, 2023a). Although retailers have increased the prices of berries in the supermarket, this has not been felt in the margin of farmers (BBG, 2023). Despite the present challenge, there is pressure from some retailers on suppliers to drop prices (Quinn, 2023). If the current situation continues, farmers could be put out of work or respond by reducing land allocated to soft fruit production which could potentially reduce the supply of locally grown soft fruits (Duncan, 2023a).

Considering the potential benefits of soft fruits to public health and the national economy and the current market situation to production, this paper aims to update the evidence of a previous analysis (Revoredo-Giha et al., 2011) regarding the purchases of soft fruit in Scotland. The main conclusion of that study, which was based on data for the 2006-09 period, is that the purchases speak of a demand that it is very seasonal (peaking during summer and decreasing significantly during winter) and can be identified despite that the presence of substantial imports that complement the UK seasonality (e.g., from Spain, Holland, Egypt). As regards the locality of the purchases, it was clear that the Scottish provenance represent a relatively small proportion of the purchases of soft fruit in Scotland. The Scottish demand was satisfied with soft fruit from the rest of the UK and abroad. Furthermore, purchases of strawberries and raspberries of Scottish origin were found in the data whilst all blackberries and blueberries bought were of UK origin and from abroad was found in the sample.

There are two main motivations on the topic: (1) to what extent consumers' purchases of soft fruit follow locality and seasonal patterns; (2) whether the expansion of the domestic supply of soft fruit may increase the quantity demand for it, and therefore, getting consumers closer to the health-related recommendations.

For the empirical work we used time series constructed from the Kantar Worldpanel dataset for the period 2013 to 2021. Besides a descriptive analysis where we consider the origin of soft fruit purchased in Scotland, we pursued two further analyses: one was a seasonality analysis, and another was an estimation of an incomplete demand system by socioeconomic groups augmented by seasonal and trend terms.

The results show strong seasonal patterns in the purchases of soft fruit despite the possibility of getting out-of-season imported soft fruit. In addition, some fruits showed an increasing trend in prices. Significant seasonal gaps were found in prices, ranging from 13.8 - 219.0 per cent during off season. In general, soft fruit purchases are very low during spring periods. Consumers are less sensitive to prices (expenditure) during booms (harvest periods) but extremely sensitive to prices (expenditure) during scarcity periods (low supply). Cherries had the largest range of sensitivity to prices whilst grapes had the least. Using seasonal gaps in the prices, quantity and nutrient purchases had cyclical patterns, reducing significantly during low supply. It can be concluded that seasonality in soft fruit prices influences both quantity demanded and nutrient purchases negatively. A strategy by retailers to maintain constant supply of soft fruits or reduce the price gaps during peak and off-peak seasons could help to reduce the impact of seasonality of household food security.

The structure of the paper is as follows: It starts presenting the methodology used for analysis, followed by the results and discussion and ends with some conclusions.

2. Methodology

2.1 Data

The analysis for the current work is based on the Kantar Worldpanel (KWP) dataset for the period 2013 until 2021. KWP monitors the grocery purchasing habits of a huge number of demographic representative households in Scotland. Variables that are captured in the dataset include price, quantity, origin of the product, date purchased, type and location of supermarket, type of products etc, as well as demographic characteristics of the consumer including annual household income levels. Using the price, quantity, date, and type of product purchased, a time series of 117 observations of 4-week "months" was created. The monthly price data was used because there is usually little variation in the weekly prices paid for by consumers. The series were grouped by supermarket, type soft fruit and four origins: Scottish, Rest of the UK, EU origin and Rest of the world. The study focuses on blackberries, blueberries, cherries, grapes, raspberries, strawberries, and other soft fruits. As explained above, soft fruit has enormous economic and health benefits for the Scottish economy. Moreover, these produces exhibit strong seasonality which affect prices and intake throughout the year. Finally, on the preference for locally grown fruits, it is expected that consumers would react to their demand considering their origin. The fact that the data were divided by origin meant that one could evaluate the importance of local produce.

Figures 1 shows the evolution of quantities of soft fruit and unit values (estimated as the average of the prices for each month). Quantities purchased show a steady increasing trend, whilst unit values increased from 2014 to 2018, and started to decline afterwards. The decline from 2018 is contrary to what was reported by the Grocery about retailers increasing the prices of berries (soft fruits) (Duncan, 2023a).

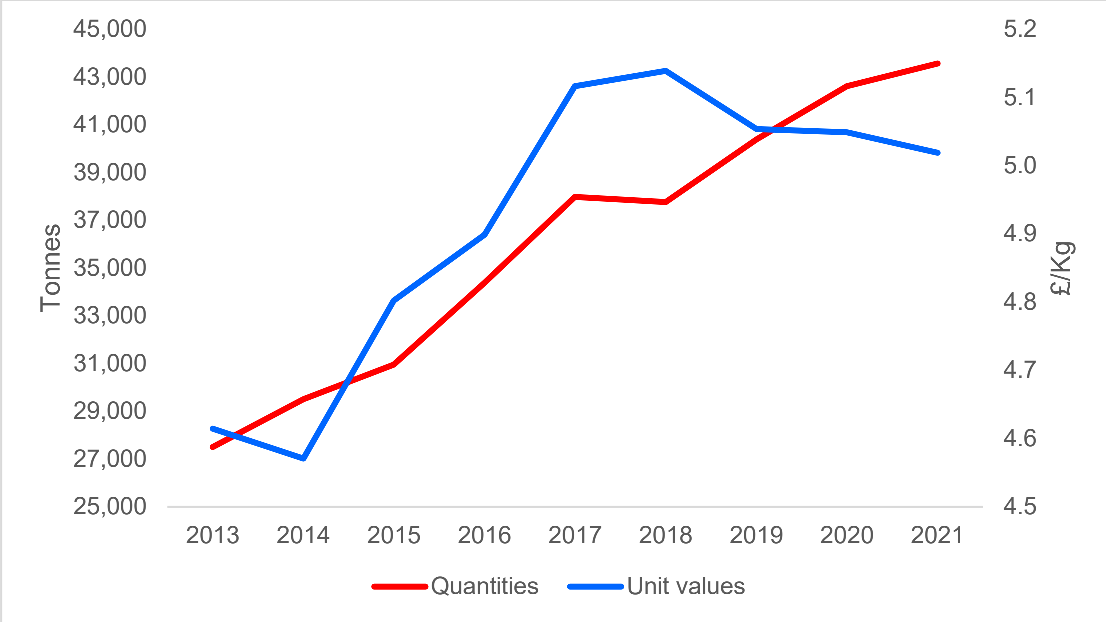


Figure 1 - Scotland: Soft fruit - Evolution of quantities purchased and unit values
Source: Own elaboration based on Kantar Worldpanel data from 2013-2021

Table 1 shows the importance of the different soft fruits in terms of their share in total expenditure and quantities purchased annually. In both cases, grapes and strawberries are favourite soft fruit representing 32.2% and 29.3% of the share of total soft fruit expenditure, in 2021. In terms of quantity, this was 50.7% and 28.3% of the total quantities of soft fruits bought in 2021.

Table 1 Expenditure and quantities shares of soft fruits (percentages)

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Expenditure									
Blackberry	1.9	1.8	1.8	2.1	2.3	2.5	2.4	2.6	2.4
Blueberry	11.6	11.0	12.8	14.1	13.5	14.9	15.8	15.5	15.5
Cherries	4.4	5.9	5.7	5.2	5.1	5.0	4.5	3.9	4.7
Grapes	43.5	42.2	37.8	36.0	35.3	35.6	32.7	33.0	32.2
Raspberry	8.2	9.5	11.5	13.3	13.7	14.1	15.2	14.9	14.6
Strawberry	29.7	28.9	29.4	28.4	28.9	27.0	28.6	28.8	29.3
Others	0.7	0.7	0.9	0.9	1.1	0.9	0.8	1.3	1.3
Quantities									
Blackberry	1.0	0.9	0.8	0.9	1.1	1.2	1.1	1.1	1.0
Blueberry	5.3	5.5	6.9	7.4	7.2	7.8	8.4	8.2	8.5
Cherries	3.6	5.1	4.7	4.1	4.3	4.1	4.1	3.2	3.8
Grapes	56.4	55.4	51.2	51.5	49.8	52.3	50.3	51.8	50.7
Raspberry	3.6	4.0	5.3	5.6	6.3	6.5	7.2	6.9	6.8
Strawberry	29.6	28.7	30.4	29.9	30.6	27.4	28.3	27.8	28.3
Others	0.4	0.4	0.7	0.7	0.8	0.6	0.6	0.9	0.9

Source: Own elaboration based on Kantar Worldpanel data.

Table 2 presents the share by origin of each one of the soft fruits. As mentioned in Revoredo-Giha et al. 2011, the proportion of soft fruit purchased coming from Scotland is limited. Note that this might be because some of the Scottish fruits are marketed as British.

Table 2 Expenditure and quantities shares of soft fruits by origin (percentages)

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Based on expenditure (%)										
Blackberry	Scottish	0.0	0.5	2.8	2.4	3.1	3.2	4.9	4.2	3.1
	Rest UK	35.8	31.2	17.3	24.9	9.8	11.3	14.4	15.6	8.7
	EU	5.6	6.4	23.9	2.2	.0	.0	2.1	14.9	15.6
	Rest world	58.6	61.9	56.0	70.4	87.0	85.5	78.6	65.3	72.5
Blueberry	Scottish	0.0	0.0	0.0	0.0	1.3	0.8	0.7	0.2	0.0
	Rest UK	2.6	6.2	1.8	2.9	.5	5.6	2.4	1.1	.0
	EU	31.5	28.0	22.6	17.6	13.0	19.2	13.8	10.1	7.2
	Rest world	65.9	65.8	75.7	79.6	85.2	74.4	83.1	88.5	92.8
Cherries	Scottish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
	Rest UK	6.4	6.9	10.0	7.7	3.7	8.2	11.5	10.1	14.2
	EU	21.8	25.3	13.9	14.1	23.8	27.5	30.2	33.0	31.2
	Rest world	71.8	67.8	76.1	78.2	72.4	64.3	58.4	56.9	53.6
Grapes	Scottish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Rest UK	.3	.3	.3	.3	.3	.5	.2	.0	.1
	EU	10.0	13.6	21.1	33.9	35.6	29.0	28.4	16.6	14.6
	Rest world	89.7	86.1	78.6	65.8	64.1	70.5	71.3	83.3	85.3
Raspberry	Scottish	1.1	1.9	2.5	9.2	4.6	3.9	1.8	2.0	2.6
	Rest UK	38.8	49.9	23.9	26.0	35.8	34.3	22.6	22.2	21.6
	EU	39.1	31.1	30.1	16.8	12.8	15.4	17.0	17.1	15.1
	Rest world	21.1	17.2	43.5	47.9	46.8	46.4	58.5	58.6	60.7
Strawberry	Scottish	4.0	1.4	2.4	1.6	3.5	4.9	4.7	3.4	5.4
	Rest UK	56.2	49.9	32.9	48.6	37.4	44.9	37.4	33.5	31.6
	EU	19.2	18.1	32.5	19.5	15.4	12.3	33.3	37.6	41.1
	Rest world	20.6	30.6	32.1	30.4	43.7	37.9	24.6	25.5	21.9
Others	Scottish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Rest UK	20.4	23.1	23.0	15.4	10.3	17.4	17.3	17.5	26.4
	EU	9.1	11.7	10.6	21.2	19.7	7.7	22.9	18.7	5.8
	Rest world	70.5	65.2	66.5	63.4	70.0	74.9	59.8	63.8	67.8

Source: Own elaboration based on Kantar Worldpanel data.

The figures of Table 2 also show the importance of the EU and rest of the world = in supply of soft fruit in Scotland. Apart from strawberries and raspberries, where the Scottish and Rest of UK origins are important (which represented, in 2021, 36 per cent and 24 per cent, respectively) in all the other cases the adding up of the EU origin and the rest of the work is about 90 per cent.

It should be noted that in the case of raspberries and strawberries the domestic proportions were higher in 2013 and they have steadily decline. It is important that this is not a consequence of the UK exiting the European Union. Moreover, whilst on some of the soft fruit categories (e.g., grapes) rest of the world share has partly replaced the EU share, in other categories (e.g., blackberries) it has been just the opposite.

2.2 Seasonal models

Most agricultural produce exhibit seasonality in prices, peaking just before the period of harvest and falling substantially immediately after. For instance, the price of soft fruit in the summer is relatively lower than in the winter. Volatility in food prices could result in poor dietary intake and nutritional outcomes; and wrong measurement of indices based on food price i.e. poverty index (Gilbert et al., 2017).

Seasonality is commonly measured by seasonal gap as the difference between the high price immediately prior to harvest and the low price following harvest, averaged across years (Kaminski et al., 2014).

In addition to the seasonal gap estimates, a dummy variable seasonal model was estimated in order to understand the extent to which seasonality influences soft fruit prices in Scotland.

The dummy variable representation of seasonality in a price series considers three components (notation are from Gilbert et al., 2017): trend, seasonal factors, and irregular variation:

$$\mathrm{p}_{\mathrm{ym}} = \mu_{ym} + s_m + \varepsilon_{ym} \quad \text{...} (1)$$

Where p_{ym} is the series in month m in year y in logs, $\mu_{ym}$is the trend, $s_1 \ldots s_{12}$ are a set of 12 seasonal factors and ε_{ym} is a disturbance (κ is the intercept for the first 4-week month). Either a linear[1] (as adopted by (Sahn & Delgado, 1989) or a quadratic trend (as adopted by Sanchez-Vazquez et al., 2012) could be specified for (1). For the purpose of this analysis, a quadratic trend is specified. The seasonal factors can be estimated from the regression:

$$p_{ym} = \kappa + \gamma_0 t + \gamma_1 t^2 + \sum_{j=2}^{13} \delta_j z_{mj} + \varepsilon_{ym} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The linear trend approach assumes that prices are trend stationary, i.e., they revert to a deterministic trend. However, economic theory does not provide any basis to support that food price trends are constant. One way to allow for a variable trend is to estimate the trend as a centred moving average, which can vary from month to month:

$$\mu_{ym} = \frac{1}{12}\left[\sum_{j=-5}^{5} p_{y,m+j} + \frac{1}{2}\left(p_{y,m+6} + p_{y,m-6}\right)\right]$$

Although the dummy variable approach to measuring the seasonal gap is highly parametrized, it has the advantage that it does not pose many restrictions on the data so it is chosen over the saw-tooth and trigonometric (Hindrayanto et al., 2013) seasonal models.

2.3 Incomplete demand system model

To compute the demand for soft fruits averaged across different seasons, the demand system used was the Linquad model, which starts from a quasi-expenditure function of prices in quadratic terms (LaFrance, 1990, 1991, 1998). One of the most useful properties of the Linquad quasi-expenditure function is its complete characterization of the included goods with regards to prices and income. This result from the duality theory of incomplete demand systems which allows exact welfare measures to be obtained from the quasi-indirect utility function (LaFrance 1991). The quasi-expenditure function is given by:

$$\varepsilon(p, q, z, \theta) = p'\alpha + \delta(z) + p'Az + 0.5p'Bp + \theta(q, u, z)e^{\gamma' p} \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

[1] under the assumption that prices are trend stationary

where p is the vector of deflated prices, $p_i/\bar{p}$, where $\bar{p}$ is an average price index (in this case the monthly consumer price index for Scotland), q is the vector of consumption levels for the commodities of interest, z is a set of shifters such as relevant other prices or lagged demand, $\delta(z)$ is an arbitrary real valued function of all variables in z, $\theta(q, u, z)$ is the constant of integration and α, A and B are the parameters to be estimated.

Applying Shepherd's lemma (i.e., differentiating with respect to prices) to the quasi-expenditure function generates Hicksian demands of the form:

$$q = \alpha + Az + Bp + \gamma[\theta(q, u, z)e^{\gamma' p}] \quad \ldots\ldots (9)$$

Solving the Linquad expenditure function for $\theta(q, u, z)e^{\gamma' p}$, and replacing expenditure with m for income, gives the final Marshallian demand specification of Linquad model (LaFrance, 1990).

$$q = \alpha + Az + Bp + \gamma[m - p'\alpha - p'Az - 0.5p'Bp] \quad \ldots\ldots (10)$$

γ is the coefficient for the total expenditure, *m*. The quadratic term in prices increases the flexibility in Slutsky symmetry removing the restrictions that constrain the preference ordering of a linear system. The Linquad quasi-expenditure function is a second order Taylor series approximation to any arbitrary expenditure function.

The Slutsky substitution matrix (i.e., Hessian matrix of the derivative of the expenditure function with respect to prices) is given by:

$$S = B + [m - p'\alpha - p'Az - 0.5p'Bp - \delta(z)]\gamma\gamma' \quad \ldots\ldots (11)$$

The symmetry of the Slutsky matrix is determined by B. Note that B is not necessarily symmetric so symmetry is a testable hypothesis; however, it is a property that can be imposed on the system. The matrix of price effects is given by (from which the Marshallian price elasticities can be computed):

$$\frac{\partial \mathrm{x}}{\partial \mathrm{p}'} = \mathrm{B} - \gamma[\alpha + \mathrm{p}'\mathrm{B}] \quad \text{……………………………………………………..} \quad (12)$$

The Marshallian own and cross-price elasticities (e_{ii} and e_{ij}) are estimated by:

$$e_{ii} = \left[b_{ii} - \gamma_i\left(\alpha_i + \sum_j b_{ij} p_j\right)\right]\left(\frac{p_i}{q_i}\right) \quad \text{……………………………………………} \quad (13)$$

$$e_{ij} = \left[b_{ij} - \gamma_i\left(\alpha_j + \sum_k b_{jk} p_k\right)\right]\left(\frac{p_j}{q_i}\right) \text{………………………………………….} \quad (14)$$

There are no restrictions on individual income coefficients. The income effects are given by (from which the income elasticities can be computed):

$$\frac{\partial \mathrm{x}}{\partial \mathrm{m}} = \gamma \quad \text{…………………………………………………………………..........} \quad (15)$$

Therefore, the income elasticities are:

$$\mathrm{n}_i = \gamma_i \frac{m}{x_i} \quad \text{……………………………………………………………..........} \quad (16)$$

The Hicksian elasticities can be obtained from the Slutsky matrix.

3. Results

Seasonality analysis

First, a graphical analysis is performed to understand how prices evolve over time. Figures 2 to 7 show the evolution of quantities purchased for different soft fruits by origin. All figures show a strong seasonal component, whilst only a few shows both seasonality and a trend component. The peak and low periods differ by fruit type. For instance, the peak periods for blackberries are in the summer whilst the low periods are usually in the winter. For blueberry, the peak periods are usually in the spring whilst low purchases are recorded in the winter seasons. Finally, seasonality is very severe in cherries and strawberries as depicted by Figure 4 and Figure 7[2].

[2] All Figures show well-defined seasonality and trends suggesting that the trigonometric and the sawtooth models, though parsimonious

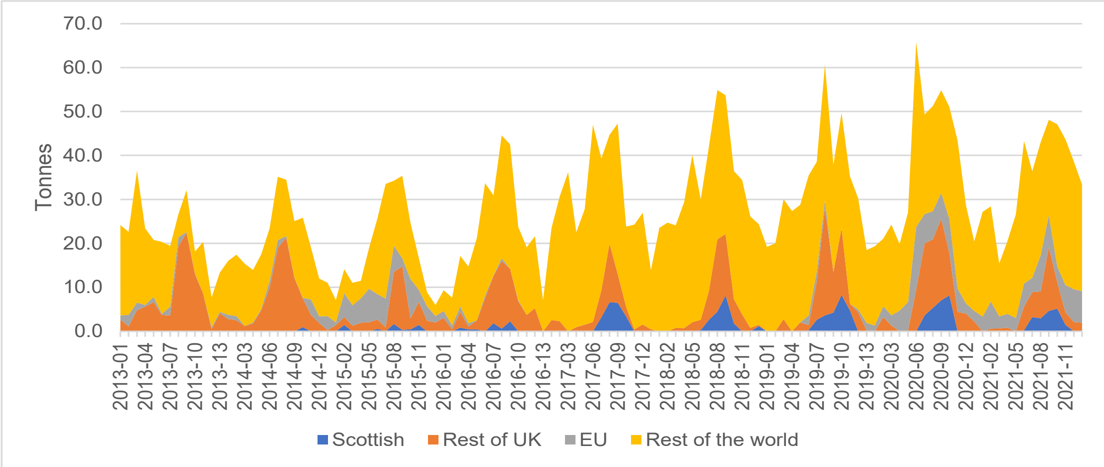


Figure 2: Purchases of blackberries according to origin
Source: Own elaboration based on Kantar Worldpanel data.

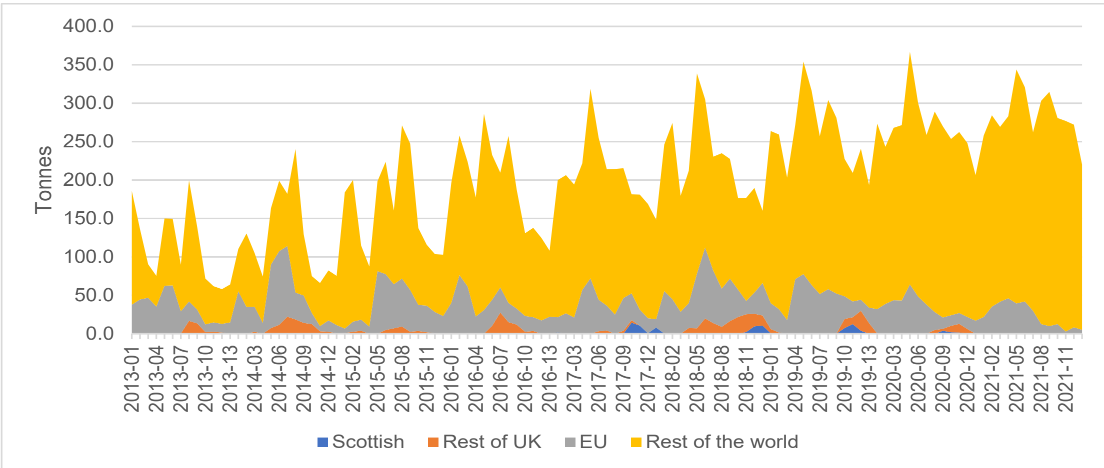


Figure 3: Purchases of blueberries according to origin
Source: Own elaboration based on Kantar Worldpanel data.

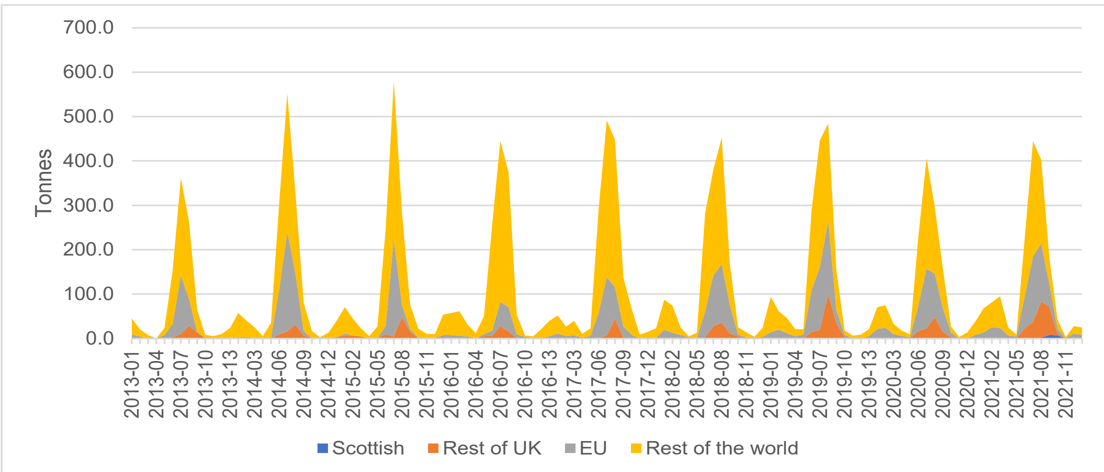


Figure 4: Purchases of cherries according to origin
Source: Own elaboration based on Kantar Worldpanel data.

are not ideal for this data. For comparison purposes, the results for both models are presented in the appendix.

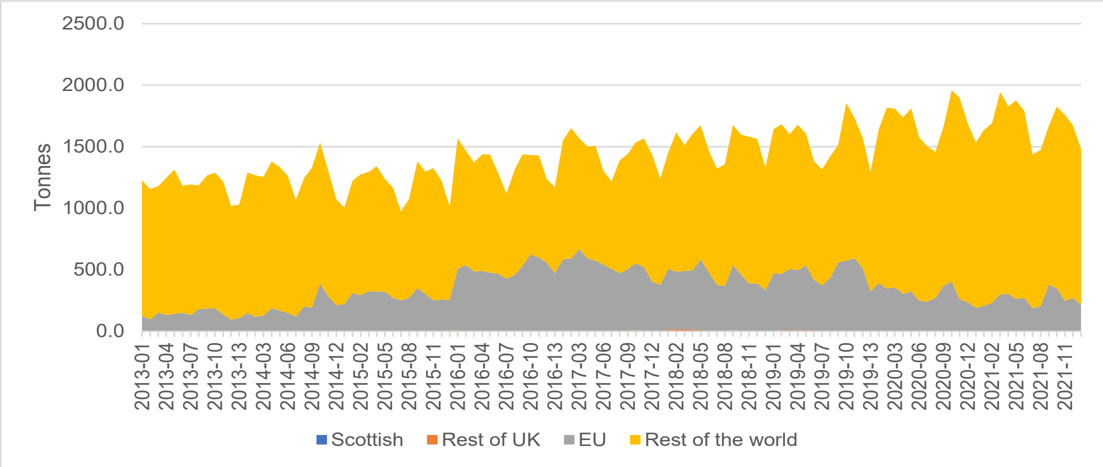


Figure 5: Purchases of grapes according to origin

Source: Own elaboration based on Kantar Worldpanel data.

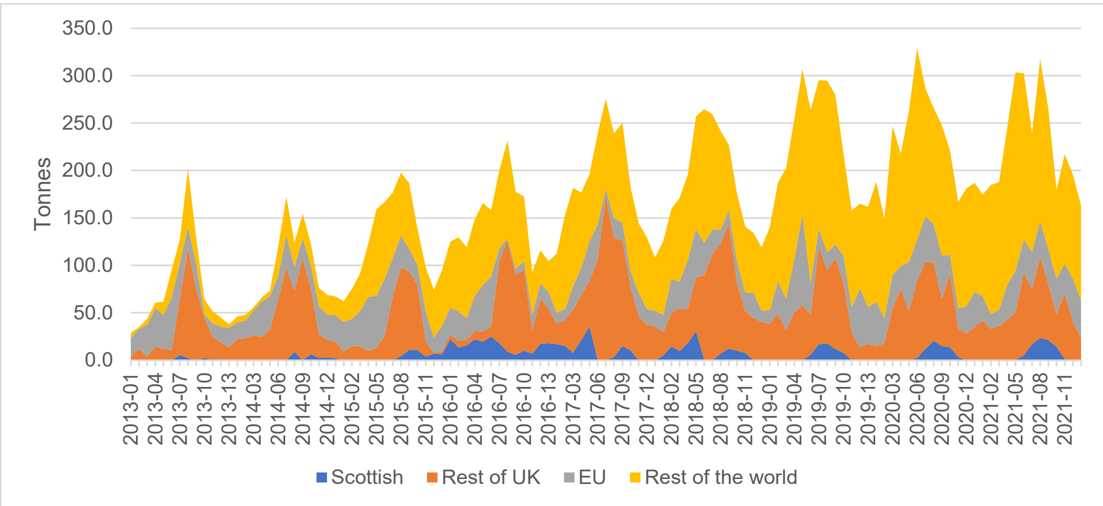


Figure 6: Purchases of raspberries according to origin

Source: Own elaboration based on Kantar Worldpanel data.

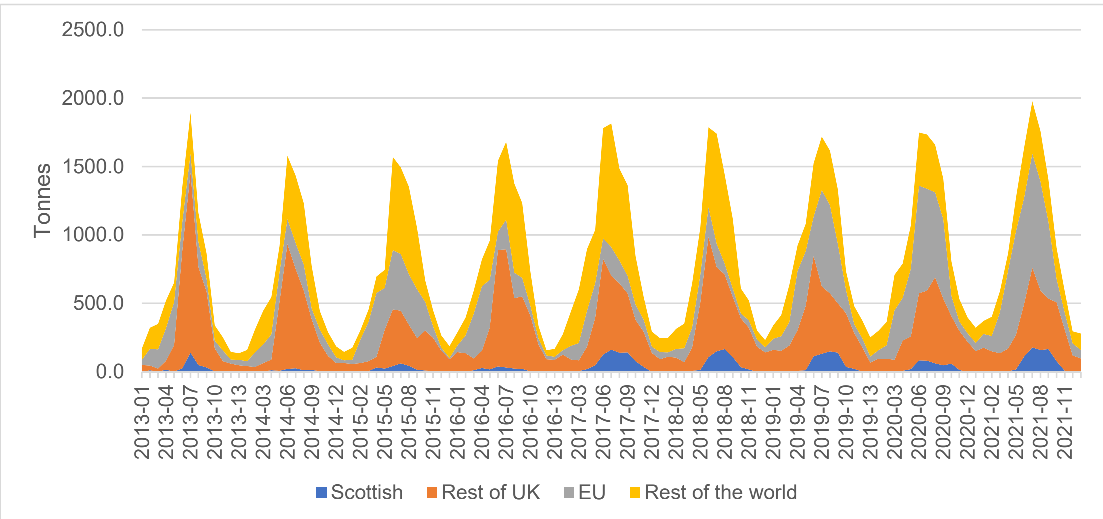


Figure 7: Purchases of strawberries according to origin

Source: Own elaboration based on Kantar Worldpanel data.

Seasonality soft fruit prices

This section presents the result for the seasonal gap analysis, estimated as $gap = max\ s_{h0} - \min\ s_{l0}$ adopted from (Gilbert et al., 2017). Where s_h is the seasonally high price in year 0 and the s_h is the seasonally low price in the same year. The extent of seasonality is examined for the 6 main soft fruits sold in retail supermarkets in Scotland over the period 2013 – 2021. The seasonal gap varies across years and fruit type. In cherries, the average seasonal gap is more than 200 per cent (twice the trough price) which means that the highest price is more than twice of the lowest price in a particular year. Strawberry and blueberry had average gaps above 50 per cent whilst the remaining had gaps below 50 per cent. The high variation in the price for cherries could affect demand and intake during off season. In the same vein, stability in prices for grapes could encourage consumers to buy the produce all year round.

Table 3 Annual percentage variation in soft fruit prices due to seasonality

Year	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry
2013	72.5	153.3	441.2	19.2	62.7	72.9
2014	41.5	119.8	181.0	21.8	48.5	80.2
2015	31.8	90.5	249.7	12.3	43.9	76.3
2016	25.4	84.8	263.3	17.3	49.4	96.0
2017	44.2	50.7	131.4	9.1	32.1	82.5
2018	34.9	48.6	239.5	10.3	23.9	63.3
2019	44.8	32.5	91.0	12.1	31.2	65.8
2020	30.9	25.1	159.1	12.6	17.7	61.0
2021	33.6	10.3	214.8	9.7	23.7	74.5
Average	**40.0**	**68.4**	**219.0**	**13.8**	**37.0**	**74.7**
Standard error	**13.0**	**44.5**	**95.4**	**4.3**	**14.0**	**10.2**

Source: Own elaboration based on Kantar Worldpanel data.

The extent to which seasonality explains variations in retail prices for soft fruit is examined for 6 types of soft fruit. Results are presented in Table 4. The R-square indicates the share of the price variation in the data that is explained by seasonal factors. Table 4 shows that between 66 and 96 per cent of the variation in quantities of soft fruit purchased is explained by seasonal factors. More of the variation in strawberries purchases are determined by seasonal factors compared with blackberries.

In terms of prices, 93 per cent (highest) of the variation in strawberry prices are determined by seasonal factors whilst only 50 per cent (lowest) of the variation in the price of cherries are due to seasonal factors. Seventy-one percent of the variation in the prices of raspberry was determined could be explained seasonality.

The results translate into seasonal peaks and troughs in the cost of nutritious diet (Bai et al., 2020). For instance, a news item based on DEFRA report confirms that summer seasonal vegetable prices increased by 31.3 per cent in 2023 compared with the same period in 2022 due to bad weather conditions in the UK (Maurice-Jones, 2023). This report shows the negative impact of seasonal factors on vegetable prices; similar can be said for soft fruits. Also, the US's FRED Economic Data shows that the abundance of supply of strawberries during the summer pushes their prices to their annual lows (The FRED Blog, 2020). Whilst this is good for low-income consumers and overall diet quality, the instability in prices is likely to destabilize diet quality during low supply (van der Toorn et al., 2020). Tons of literature suggest that high food price volatility tend to limit consumption and overall diet quality for low-income people (Becquey et al., 2012; Hirvonen et al., 2016; Kaminski et al., 2016).

Referring to Table 3 above shows that the gaps in soft fruit prices could be as high as four times the trough price especially for cherries (reference to 2013). The reduction in intake[3] brought about by the price gap could offset their health benefit. However, the extent of the reduction depends on the seasonal-varying sensitivity of consumers to prices. Studies in the electricity sector suggest that price elasticity or sensitivity of consumers to prices vary by hours of the day, days of the week, month or season of the year (Andruszkiewicz et al., 2020; Fan & Hyndman, 2011; Lijesen, 2007). Sensitivity of consumers to prices of soft fruits in the four main seasons is discussed in the next section.

[3] See appendix A6

Table 4 Trend and seasonality analysis of soft fruit quantities purchased and unit value

	Quantities						**Unit values**					
	Blackberries	Blueberries	Cherries	Grapes	Raspberries	Strawberries	Blackberries	Blueberries	Cherries	Grapes	Raspberries	Strawberries
Trend												
Trend	0.0035	0.02	0.0205	0.00	0.0287	0.01	0.0078	0.00	0.0002	0.00	0.0002	0.00
t	1.0227	7.93	3.4127	5.36	15.0946	5.11	7.9861	0.00	0.0621	2.43	0.2502	2.17
Trend2	0.0000	0.00	-0.0001	0.00	-0.0001	0.00	-0.00005	0.00	0.0000	0.00	-0.00001	0.00
t	1.0190	-3.29	-2.5550	0.37	-9.0603	-2.23	-5.6905	-0.60	0.2142	-5.23	-0.8674	-0.21
Seasonality												
Intercept	2.2858	4.10	2.7623	6.87	3.5494	4.94	2.2060	2.45	2.1533	1.30	2.5198	1.91
t	17.0218	50.10	11.7159	266.91	47.6417	71.51	57.3490	48.67	20.2861	83.82	90.4435	74.20
Month 2	0.2694	0.58	0.8246	0.23	0.0463	0.23	0.0006	-0.27	-0.1335	-0.03	0.0016	-0.08
t	1.8374	6.44	3.2030	8.01	0.5687	2.99	0.0138	-4.99	-1.1520	-2.02	0.0536	-2.67
Month 3	0.3736	0.60	0.5349	0.25	0.1579	0.59	-0.0247	-0.30	-0.0971	-0.03	-0.0173	-0.24
t	2.5492	6.72	2.0784	8.79	1.9421	7.89	-0.5893	-5.52	-0.8381	-1.85	-0.5682	-8.68
Month 4	0.4761	0.37	0.0243	0.23	0.2922	0.94	-0.0303	-0.12	-0.0298	-0.03	-0.0284	-0.41
t	3.2497	4.09	0.0945	8.36	3.5952	12.49	-0.7220	-2.10	-0.2572	-1.79	-0.9349	-14.50
Month 5	0.3660	0.31	-1.4109	0.25	0.4447	1.29	0.0183	-0.04	0.1856	-0.04	-0.0487	-0.47
t	2.4987	3.51	-5.4865	8.99	5.4724	17.17	0.4371	-0.65	1.6035	-2.08	-1.6030	-16.90
Month 6	0.5942	0.79	-0.3713	0.25	0.5926	1.56	0.0098	-0.25	-0.0279	-0.05	-0.0824	-0.40
t	4.0577	8.84	-1.4441	8.89	7.2943	20.72	0.2333	-4.54	-0.2410	-2.71	-2.7131	-14.26
Month 7	0.9048	0.71	2.1261	0.14	0.7159	2.07	-0.0443	-0.23	-0.4487	-0.04	-0.1241	-0.48
t	6.1809	7.98	8.2719	5.02	8.8140	27.52	-1.0566	-4.26	-3.8780	-2.08	-4.0849	-17.24
Month 8	0.9338	0.47	2.7193	0.03	0.7943	2.13	-0.0876	-0.16	-0.6221	-0.06	-0.2322	-0.50
t	6.3804	5.31	10.5819	1.05	9.7827	28.29	-2.0886	-2.98	-5.3773	-3.44	-7.6465	-17.99
Month 9	1.1195	0.71	2.4946	0.10	0.8247	1.95	-0.2417	-0.35	-0.5002	-0.08	-0.2582	-0.51
t	7.6504	8.01	9.7094	3.46	10.1588	25.94	-5.7654	-6.37	-4.3248	-4.46	-8.5040	-18.27
Month 10	1.0677	0.54	1.2854	0.21	0.7167	1.72	-0.2332	-0.27	-0.1822	-0.09	-0.2447	-0.50
t	7.2972	6.00	5.0038	7.42	8.8290	22.86	-5.5640	-4.95	-1.5756	-5.51	-8.0606	-17.66
Month 11	0.7963	0.19	-0.3719	0.27	0.4191	1.14	-0.1126	0.00	-0.1164	-0.09	-0.1410	-0.30
t	5.4434	2.19	-1.4479	9.54	5.1643	15.19	-2.6880	-0.07	-1.0065	-5.58	-4.6454	-10.84
Month 12	0.6310	0.13	-1.6605	0.23	0.1262	0.72	-0.0437	0.05	-0.2163	-0.08	-0.0409	-0.14
t	4.3133	1.50	-6.4656	8.12	1.5554	9.56	-1.0431	0.97	-1.8710	-4.58	-1.3485	-5.10
Month 13	0.3139	0.13	-0.9277	0.12	0.0681	0.19	-0.0105	0.04	0.0901	-0.02	-0.0296	0.00
t	2.1460	1.42	-3.6124	4.16	0.8396	2.57	-0.2506	0.72	0.7796	-1.47	-0.9756	-0.06
R^2	**0.66**	**0.84**	**0.88**	**0.88**	**0.91**	**0.96**	**0.69**	**0.62**	**0.50**	**0.68**	**0.71**	**0.93**

Source: Own elaboration based on Kantar Worldpanel data.

Seasonal demand elasticities

The goal of this section is to show that consumers reaction to soft fruit prices vary by seasons of the year. For the best fit, the demand model was augmented with seasonal dummies. The results of the regression are presented at the end paper in the Annex section. The demand models were estimated by socioeconomic groups (reported gross annual household income groups).

The complete elasticities from the Linquad demand model for 3 types of households based on their income groups are in Tables 5 to 8. All expenditure elasticities were found to be positive except for grapes for households earning between 30,000 – 50,000. The negative expenditure elasticity of grapes shows that this group of consumers consider grapes as an inferior good and buys fewer when their income rises. In addition, all own price elasticities were found to be negative and significant across all income groups except for grapes having positive own price elasticities for income groups below 30,000 and those above 50,000. This indicates that changes in prices affect the quantity demanded for the soft fruits; however, with the exception of raspberries, which showed an above one elasticity, all the other cases showed own price elasticities lower than one (in absolute values).

Interestingly, the elasticities for the three socioeconomic groups for strawberries are fluctuate between -0.25 and -0.38, which indicate that a substantial decrease in the price by 50 per cent would only increase the quantities consumed/purchased of strawberries by 12.5 per cent or 19.0 per cent depending on the group.

Table 5 Group 1 (£0 to £29,000)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.9257	0.3193	-0.0985	0.9014	0.5163	-0.8493	-0.0518	0.5443
	(.2753)	(.2225)	(.0795)	(.0638)	(.3747)	(.1282)	(.1198)	(.3948)
Blueberry	0.4640	-0.8487	-0.0030	0.1047	0.1504	-0.0022	0.0032	0.8527
	(.0758)	(.084)	(.0339)	(.0104)	(.0819)	(.0298)	(.0425)	(.1275)
Cherries	-0.9952	-0.9129	-0.8683	0.1134	-0.2112	1.6882	-0.2037	2.5601
	(.0803)	(.0976)	(.072)	(.0083)	(.0719)	(.1215)	(.0758)	(.2517)
Grapes	0.1321	0.0326	-0.0038	0.0007	0.3067	0.0064	0.1058	0.3289
	(.0092)	(.0039)	(.0148)	(.0049)	(.0214)	(.0017)	(.0088)	(.0534)
Raspberry	0.3291	0.2142	-0.1409	0.8605	-1.3186	-0.1977	-0.1290	0.8466
	-0.1096	-0.1003	-0.0408	-0.0662	(.0921)	-0.0439	-0.0539	(0.1611)
Strawberry	0.0125	-0.1445	-0.3080	0.0036	-0.1575	-0.2619	-0.0960	2.0679
	-0.0028	-0.0154	-0.0242	-0.0013	-0.0107	(.0208)	-0.0074	(0.1092)
Other soft fruit	0.3545	-0.5651	0.0076	2.8108	-0.3878	-1.3057	-0.1791	0.9169
	(.4136)	(.3332)	(.1155)	(.2491)	(.464)	(.1905)	(.1741)	(.5775)

Note: Standard errors in parenthesis under the coefficients.

Table 6 Group 2 (£30,000 to £49,999)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.0803	-0.1090	0.0327	0.2450	-0.0927	-0.1856	-0.1059	1.1603
	(.0705)	(.1843)	(.0849)	(.0316)	(.2637)	(.1924)	(.0787)	(.3209)
Blueberry	0.3445	-0.8311	-0.0760	0.3922	0.3035	0.2251	0.0531	0.0683
	(.0513)	(.0745)	(.0368)	(.0298)	(.0589)	(.0468)	(.0294)	(.103)
Cherries	-0.7028	-0.6383	-1.0004	0.5207	-1.0198	1.5904	-0.0471	2.0539
	(.0689)	(.0596)	(.0671)	(.0421)	(.0926)	(.1058)	(.0684)	(.2977)
Grapes	0.1694	0.0680	-0.0147	-0.0593	0.3839	-0.0011	0.0781	0.0859
	(.0101)	(.0056)	(.0077)	(.0393)	(.0252)	(.0018)	(.0138)	(.0771)
Raspberry	0.4867	-0.0315	-0.0418	0.7345	-1.0798	0.0769	-0.0790	0.4883
	-0.0971	-0.0726	-0.0492	-0.0568	(.0752)	-0.0468	-0.0423	(0.1297)
Strawberry	0.0985	-0.0549	-0.3071	0.0032	-0.1267	-0.2452	-0.1982	1.7529
	-0.0104	-0.0037	-0.0236	-0.0009	-0.0083	(.018)	-0.0130	(0.1306)
Other soft fruit	-0.8571	0.8187	0.0756	0.1903	1.6962	-2.8945	-0.2294	-0.3952
	(.4694)	(.3512)	(.1651)	(.1461)	(.5573)	(.327)	(.1521)	(.7067)

Note: Standard errors in parenthesis under the coefficients.

Table 7 Group 3 (£50,000 to above)

	Marshallian price elasticities							Expenditure
	Blackberry	Blueberry	Cherries	Grapes	Raspberry	Strawberry	Other soft fruit	elasticities
Blackberry	-0.2945	-0.7056	-0.1271	-0.9627	0.2164	0.2981	0.0337	1.5359
	(.123)	(.2081)	(.0859)	(.0821)	(.3099)	(.2502)	(.0799)	(.3637)
Blueberry	0.4414	-0.9571	-0.1138	0.0833	0.2368	0.1775	0.0694	0.7988
	(.0894)	(.0686)	(.0276)	(.0075)	(.0635)	(.0447)	(.0324)	(.156)
Cherries	-0.1751	-1.5790	-0.9085	1.2586	-2.2900	2.5599	-0.0167	2.2967
	(.1142)	(.1228)	(.1034)	(.0925)	(.1994)	(.2022)	(.1119)	(.3764)
Grapes	0.1165	0.0582	-0.0030	0.0012	0.3893	-0.0129	0.0493	0.2061
	(.0097)	(.0058)	(.009)	(.0013)	(.0239)	(.0039)	(.0108)	(.0537)
Raspberry	0.4975	-0.0963	-0.0730	0.4295	-1.0590	-0.2281	-0.0262	1.1761
	-0.1045	-0.0651	-0.0374	-0.0312	(.118)	-0.0322	-0.0372	(0.1840)
Strawberry	0.0151	0.0301	-0.3718	0.0135	-0.0897	-0.3755	-0.0632	1.7541
	-0.0060	-0.0053	-0.0256	-0.0022	-0.0074	(.0265)	-0.0050	(0.1077)
Other soft fruit	-0.6469	-0.5270	0.0392	-1.4485	-0.7848	1.0540	-0.1483	3.5757
	(.4835)	(.4456)	(.1687)	(.1589)	(.6028)	(.4432)	(.1225)	(.6683)

Note: Standard errors in parenthesis under the coefficients.

Seasonality in demand for income group less than 30,000

Figure 8 shows the seasonality in own-price and income elasticities for soft fruits by season of the year for income earners below £30,000. For blueberry, cherries, raspberry and strawberry, seasonality increases from Autumn and fall in the summer period. This is evident for both expenditure and own-price elasticities. Cherries and strawberries had the biggest volatility in their own price elasticities whilst grapes had the least variation in own price elasticities across seasons. For cherries, consumers are most responsive to price changes in spring (-1.765) but least responsive in Autumn (-0.172). Similarly, consumers are most responsive to price changes for strawberry in spring (-0.385) but least responsive in Autumn (-0.220). The cyclical behaviour of own price elasticities could be explained by harvest times (period of boom) and period before harvest (period of scarcity). For instance, cherries are harvested from June to August leading to abundance during the summer and autumn and hence the lower own price elasticity. Also, strawberries are picked from June to October which could explain the lower own price elasticity during the summer and autumn periods. The cyclical behaviour of the own-price elasticity confirms the conclusion of Harrod (1936) that demand is less elastic during booms and highly elastic during recessions. The Figure also show that other soft fruit and blackberry have the lowest price elasticities during the winter periods. For blackberry, the harvest period mid-summer to early autumn leading to abundance in the winter.

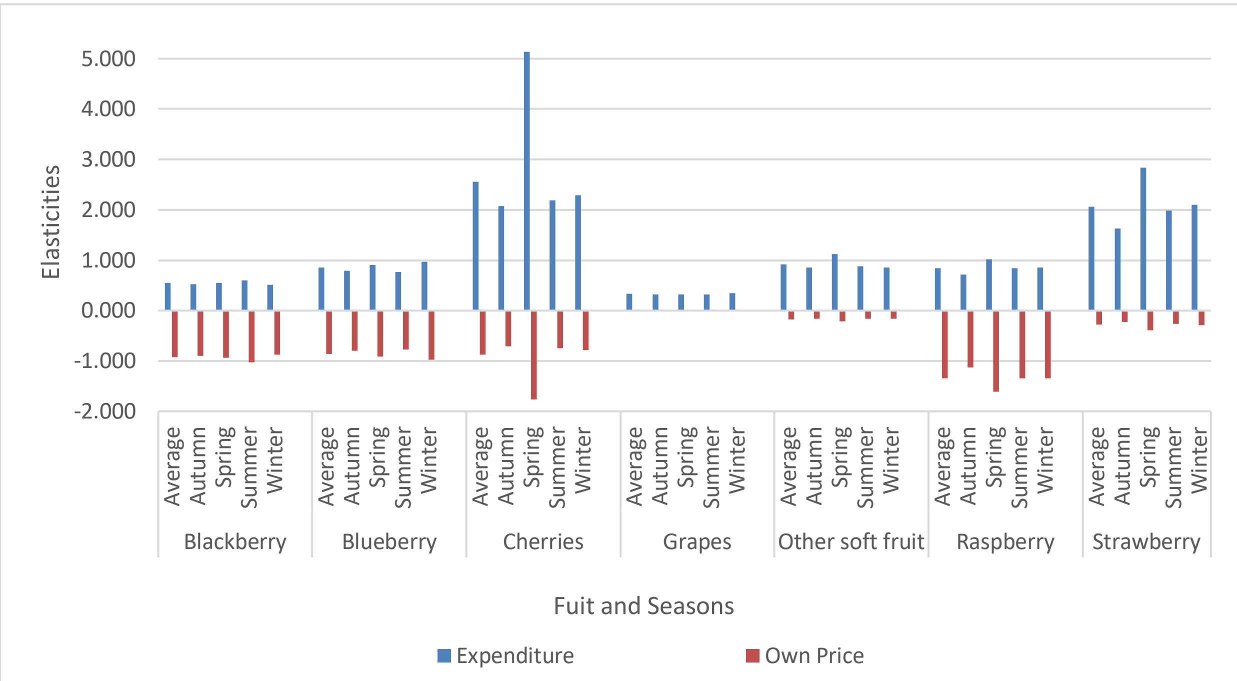


Figure 8. Variation in own price and expenditure elasticities for income groups <30,000

Seasonality in demand for income group 30,000 – 50,000

Figure 8 shows the seasonality in own-price and income elasticities for soft fruits by season of the year for income earners £30,000 – £50,000. Variations in the own price elasticities are like those found for the previous income group. Cherries has the largest variation in own-price elasticities across seasons, followed by raspberry and blueberry. Grapes had positive own-price elasticities across all seasons whilst blackberry had the lowest negative own price elasticities across seasons. Cherries, raspberry, other soft fruits, and strawberry have cyclical own-price elasticities increasing from autumn and peaking during the spring periods. High and low elasticities could be explained by harvest (booms) and lows (scarcity) due to planting seasons. As indicated previously, Harrod (1936) explained the low elasticities by higher opportunity cost or less utility for searching for lesser priced product. The results from Figure 9 also show that product with larger seasonal variations in elasticities tend to have bigger price declines from peak to trough (Butters et al., 2022). For instance, the price elasticities for cherries have a price range of 1.185 whilst blackberry has a price elasticity range of 0.036. similar explanations could be made for the expenditure elasticities.

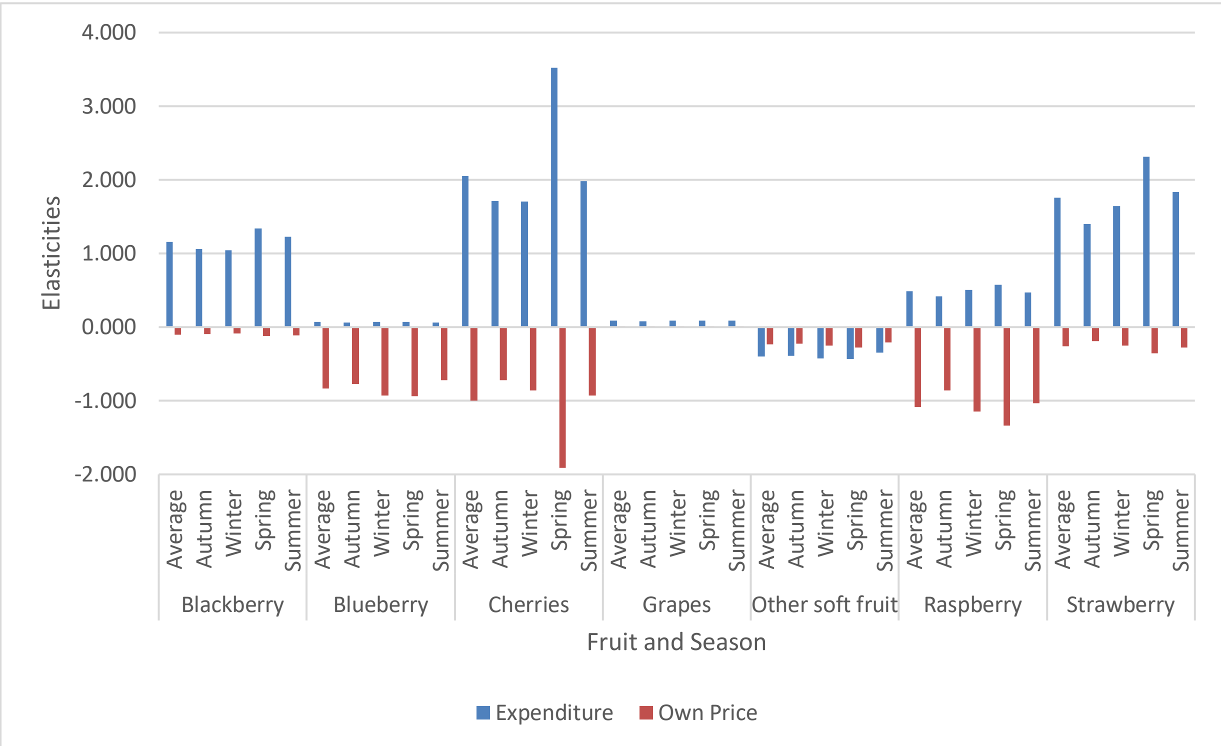
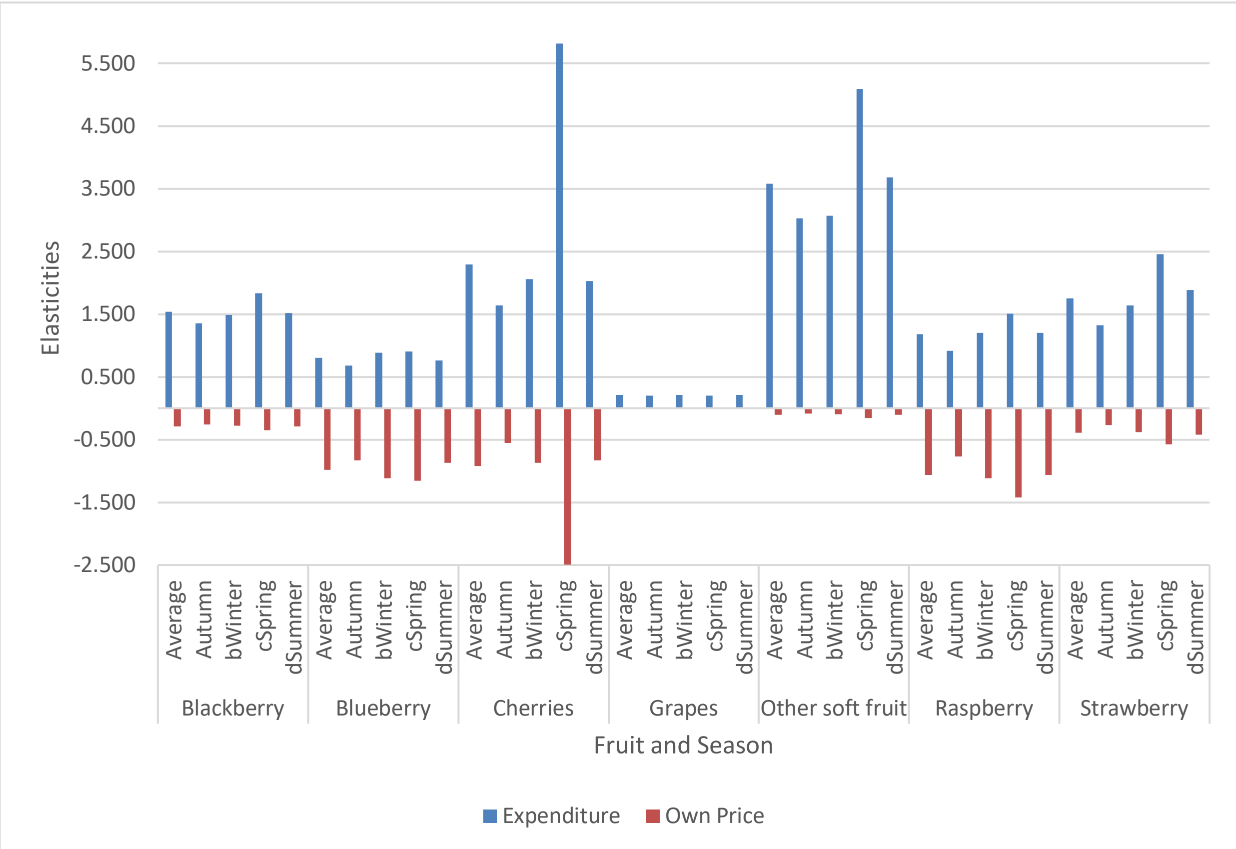


Figure 9. Variation in own price and expenditure elasticities for income groups 30,000-50,000

Seasonality in demand for income group earning above £50,000

Figure 10 also variations in price and expenditure elasticities for households earning above £50,000 for the four main seasons in Scotland. Like the other income groups, cherries had the largest seasonal variation in own price and expenditure elasticities whilst other soft fruits had the lowest variation. Cherries, blueberry, raspberry and strawberry show own-price elasticities increasing from autumn and peaking in the spring while falling in the summer. For this income group, other soft fruits had the lowest variation in own price elasticities, ranging from (-0.082) – (-0.161) whilst cherries with the largest peak own-price elasticity had the biggest seasonal variation, ranging from (-0.557) – (-2.491). As already explained, low and high elasticities can be explained by increase in quantities during harvest periods (characterised as booms (Harrod, 1936)) and low supply (characterised as recession in business cycles). Like the previous income groups, grape had positive own-price elasticities in all seasons. Consumers, therefore, consider grapes as inferior good buying more at higher prices and low at lower prices or use the price as a signal for quality and buying more at higher



prices.

Figure 10. Variation in own price and expenditure elasticities for income groups > £50,000

Discussions

Appendix A4 shows the average prices for the different soft fruits during the four main seasons. Seasonality in perishable produce like soft fruits is mirrored by the prices consumers pay for at retail shops. Across all income groups, peak prices are usually recorded in the spring and the trough prices in autumn. This explains the increased reaction by consumers to changes in the spring for raspberry, strawberries, cherries, blueberries and blackberries especially those earning above £50,000.

The implication of the results is that it exposes the inaccuracies in food demand elasticities that ignore the seasonality in price elasticities. Using averages, as shown in Figures 8-10, as indicators of consumer reaction to prices is flawed. Consumers reaction to soft fruit prices vary significantly depending on the season of the year. This could potentially affect pricing policies and dietary goals. Accounting for seasonal differences in price elasticities, especially for perishable foods, is important both for policy accuracy and to understand consumer behaviour. For instance, Herrmann & Roeder (1998) found that seasonal variables have significant impact on price elasticities in Germany. A strategy to maintain the same price elasticities all year round would help to stabilise consumers' diet.

Seasonal patterns also have significant impact on both diet quality and nutrient intake[4] (Fahey et al., 2003). Purchases of soft fruits are higher at low elasticities, and prices are low as shown by Figures 8-10 and Appendix A8-1, A8-2, A8-3. Total average daily intake of fruit and vegetable consumption was found to vary significantly by the season of the year (Capita & Alonso-Calleja, 2005). At higher elasticities and or higher prices, demand is low, and the nutritional benefits derived from soft fruit are masked.

4. Conclusion

The evidence provided here show that share of Scottish soft fruit as a proportion of the total purchases is still modest and the purchases of soft fruit are still highly seasonal despite the possibility of getting out-of-season imported soft fruit; however, some of them show an increasing trend. In addition, the paper present strong evidence of the cyclical behaviour of the price elasticities of demand for soft fruits. Seasonality in

[4] A5 in the appendix shows direct effect of seasonal price variations on quantities purchased. Also A6 shows the implications for vitamin purchases in Scotland.

prices and quantity are evident by the peaks and troughs during different seasons of the year.

Significant variation in the prices for soft fruits was found all years. Cherries had the largest price range whilst grapes had the least. The seasonal graph analyses show that seasonality is evident in most of the soft fruits. About 50 – 90 per cent of the variation in the prices and quantities of soft fruits is explained by seasonal factors.

Furthermore, the prices and quantities of soft fruit purchased in Scotland from 2013 to 2021 to estimate Linquad demand elasticities. The Linquad model was chosen over the so-called AIDS and EASI demand model because it performs better when estimating incomplete demand systems. All fruit types were found to have significant and negative own-price elasticities except grapes which had positive and significant own-price elasticities.

Seasonality in price elasticities were evident for all soft fruits. This is driven by periods of abundance and scarcity. Consumers are least responsive to prices when there is abundance due to opportunity cost of searching for lower prices. However, consumers are most responsive to prices when there is scarcity (periods prior to harvest). The cyclical nature of demand elasticities is mirrored on to the nutrition and diet during different seasons in the year.

To address the mirroring impact of seasonality on nutrition and diet, strategies should be put in place to maintain the same prices all year round or implement policies that ensure that there is stable supply of soft fruits all year round. This could be achieved by imports from countries where the fruits are in season to make up for the low supply from Scotland during off season.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A1 - Expenditure and quantities purchased of soft fruits

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Expenditure (£ '000)									
Blackberry	2,426.8	2,459.7	2,727.4	3,494.6	4,505.6	4,798.3	4,843.5	5,537.2	5,322.1
Blueberry	14,766.0	14,867.7	19,059.2	23,774.5	26,310.3	28,868.0	32,296.0	33,346.9	33,822.3
Cherries	5,634.2	7,947.0	8,453.3	8,728.7	10,000.8	9,787.7	9,226.8	8,448.6	10,178.2
Grapes	55,141.2	56,889.1	56,186.2	60,693.3	68,499.2	69,065.9	66,661.5	70,986.8	70,422.9
Raspberry	10,414.8	12,777.2	17,083.8	22,402.1	26,680.5	27,377.7	31,013.7	31,999.3	32,002.3
Strawberry	37,624.0	38,993.6	43,725.3	47,843.7	56,230.2	52,496.8	58,352.2	61,971.1	64,111.5
Others	886.1	949.3	1,330.0	1,480.6	2,096.0	1,696.7	1,707.2	2,838.8	2,741.2
Quantities ('000 Kg)									
Blackberry	285.7	266.1	247.7	293.3	407.7	443.7	431.4	476.3	451.6
Blueberry	1,470.1	1,631.7	2,144.7	2,529.1	2,718.4	2,950.0	3,379.9	3,509.9	3,688.0
Cherries	988.0	1,496.4	1,450.7	1,414.8	1,634.2	1,551.7	1,671.5	1,372.2	1,635.1
Grapes	15,502.5	16,335.2	15,828.4	17,698.3	18,915.6	19,751.4	20,298.9	22,090.2	22,076.4
Raspberry	981.9	1,193.8	1,646.4	1,941.2	2,387.0	2,470.6	2,925.0	2,949.2	2,975.6
Strawberry	8,151.6	8,456.8	9,406.7	10,273.8	11,625.4	10,366.9	11,421.5	11,843.0	12,344.9
Others	119.3	131.2	215.1	231.8	291.4	235.4	257.2	368.6	388.6

Source: Own elaboration based on Kantar Worldpanel data.

Table A2 - Trend and trigonometric seasonality

Series	Name	Mean	Intercept	t	Trend	t	Trend^2	t	**Seasonal parameters** α	t	β	t	**λ**	**2λ**	Obs.	R^2
Quantities	Blackberries	3.23	2.8967	32.02	0.0036	1.01	0.0000	0.89	-0.2080	-4.97	-0.3821	-9.08	0.435	0.870	117	0.60
Quantities	Blueberries	5.24	4.5387	63.65	0.0163	5.84	-0.0001	-2.44	-0.2467	-7.47	-0.0155	-0.47	0.247	0.494	117	0.69
Quantities	Cherries	3.80	3.2135	9.00	0.0199	1.42	-0.0001	-1.12	-0.8464	-5.12	-0.7199	-4.34	1.111	2.222	117	0.30
Quantities	Grapes	7.26	7.0483	243.90	0.0034	3.03	0.0000	0.22	-0.0083	-0.62	0.0320	2.38	0.033	0.066	117	0.61
Quantities	Raspberries	4.99	3.9501	80.76	0.0288	15.06	-0.0001	-9.10	-0.3154	-13.93	-0.2597	-11.42	0.409	0.817	117	0.90
Quantities	Strawberries	6.43	6.0563	117.27	0.0092	4.55	0.0000	-2.15	-0.8063	-33.73	-0.5891	-24.53	0.999	1.997	117	0.94
Unit values	Blackberries	2.40	2.1427	76.07	0.0078	7.10	0.0000	-4.99	0.0064	0.49	0.0927	7.07	0.093	0.186	117	0.57
Unit values	Blueberries	2.27	2.2938	49.48	0.0002	0.10	0.0000	-0.45	0.0981	4.57	0.0041	0.19	0.098	0.196	117	0.17
Unit values	Cherries	2.02	1.9865	24.42	0.0002	0.06	0.0000	0.23	0.1087	2.88	0.1923	5.08	0.221	0.442	117	0.24
Unit values	Grapes	1.23	1.2516	115.42	0.0010	2.26	0.0000	-4.81	0.0010	0.19	0.0308	6.10	0.031	0.062	117	0.59
Unit values	Raspberries	2.41	2.4233	122.34	0.0001	0.17	0.0000	-0.67	0.0522	5.69	0.1096	11.90	0.121	0.243	117	0.62
Unit values	Strawberries	1.68	1.5971	61.70	0.0014	1.42	0.0000	-0.08	0.2289	19.10	0.0986	8.19	0.249	0.498	117	0.81

Table A3 - Trend and sawtooth seasonality

Series	Name	Mean	Intercept	t	Trend	t	Trend^2	t	**Seasonal parameter** λ	t	**m***	**2λ**	Obs.	R^2
Quantities	Blackberries	3.23	2.7809	23.83	0.0054	1.19	0.0000	0.36	0.5902	4.74	12	1.180	117	0.35
Quantities	Blueberries	5.24	4.4862	55.41	0.0171	5.48	-0.0001	-2.56	0.3976	4.60	12	0.795	117	0.61
Quantities	Cherries	3.80	3.2287	7.69	0.0207	1.27	-0.0001	-0.99	-0.3753	-0.87	13	-0.751	117	0.03
Quantities	Grapes	7.26	7.0256	264.87	0.0038	3.66	0.0000	-0.15	0.1582	5.59	12	0.316	117	0.67
Quantities	Raspberries	4.99	3.8853	42.38	0.0299	8.44	-0.0002	-5.23	0.3739	3.82	12	0.748	117	0.67
Quantities	Strawberries	6.43	5.8870	30.67	0.0120	1.62	-0.0001	-1.00	1.0161	4.96	12	2.032	117	0.22
Unit values	Blackberries	2.40	2.1541	64.44	0.0077	5.94	0.0000	-4.24	-0.0558	-1.63	13	-0.112	117	0.39
Unit values	Blueberries	2.27	2.3115	48.32	0.0002	0.08	0.0000	-0.39	-0.1796	-3.69	10	-0.359	117	0.12
Unit values	Cherries	2.02	2.0257	22.31	-0.0001	-0.02	0.0000	0.21	-0.2276	-2.47	11	-0.455	117	0.06
Unit values	Grapes	1.23	1.2610	104.43	0.0008	1.76	0.0000	-4.17	-0.0425	-3.30	12	-0.085	117	0.50
Unit values	Raspberries	2.41	2.4360	79.88	0.0001	0.07	0.0000	-0.45	-0.0879	-2.82	13	-0.176	117	0.09
Unit values	Strawberries	1.68	1.6288	31.93	0.0013	0.66	0.0000	0.04	-0.2792	-5.38	11	-0.558	117	0.25

Table A4 - Expenditure and quantities purchased of soft fruits by origin

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Expenditure (£ '000)										
Blackberry	Scottish	.0	12.7	77.6	84.0	140.1	152.8	236.3	233.6	166.5
	Rest UK	868.4	767.4	471.8	871.6	443.7	543.5	698.2	862.7	462.8
	EU	136.7	156.5	651.8	77.8	.0	.0	100.3	825.5	832.0
	Rest world	1421.6	1523.1	1526.2	2461.3	3921.8	4102.0	3808.7	3615.5	3860.8
Blueberry	Scottish	.0	.0	.0	.0	349.2	227.4	222.3	60.6	.0
	Rest UK	384.6	918.4	337.0	677.9	127.7	1626.3	789.1	381.2	.0
	EU	4652.4	4168.9	4301.5	4172.6	3414.4	5550.7	4460.3	3378.1	2447.3
	Rest world	9729.0	9780.4	14420.7	18923.9	22418.9	21463.6	26824.4	29527.0	31375.0
Cherries	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	99.2
	Rest UK	361.5	548.2	844.0	670.8	374.6	805.0	1059.5	855.9	1449.6
	EU	1229.5	2011.0	1177.1	1233.5	2383.6	2690.7	2781.9	2785.2	3178.8
	Rest world	4043.2	5387.9	6432.2	6824.4	7242.6	6292.0	5385.4	4807.5	5450.6
Grapes	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	143.4	148.9	165.9	178.1	201.8	364.4	165.2	27.5	49.1
	EU	5517.3	7761.0	11851.2	20590.0	24415.6	20018.9	18941.4	11811.4	10289.9
	Rest world	49480.5	48979.3	44169.1	39925.3	43881.8	48682.6	47554.9	59147.9	60083.9
Raspberry	Scottish	109.7	243.2	430.6	2064.7	1228.0	1071.9	569.2	653.5	833.0
	Rest UK	4038.6	6371.5	4083.5	5835.6	9562.9	9379.5	7022.4	7116.6	6915.7
	EU	4073.1	3970.7	5142.6	3774.3	3401.8	4218.1	5265.6	5469.5	4818.7
	Rest world	2193.4	2191.8	7427.0	10727.5	12487.7	12708.2	18156.4	18759.7	19434.9
Strawberry	Scottish	1521.0	530.2	1069.8	742.7	1970.8	2564.6	2746.3	2135.3	3452.8
	Rest UK	21137.1	19474.8	14385.3	23228.6	21027.8	23578.2	21850.3	20742.0	20233.1
	EU	7212.1	7054.4	14217.8	9350.7	8676.4	6449.5	19412.0	23318.1	26363.7
	Rest world	7753.8	11934.2	14052.4	14521.8	24555.1	19904.5	14343.6	15775.7	14061.9
Others	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	181.1	219.4	305.3	228.2	216.6	295.1	295.2	497.6	723.0
	EU	80.4	111.2	140.8	313.7	413.0	130.4	390.9	529.5	160.1
	Rest world	624.6	618.7	884.0	938.8	1466.3	1271.1	1021.1	1811.8	1858.0

Table A4 - Expenditure and quantities purchased of soft fruits by origin cont'd

Quantities ('000 Kg)		2013	2014	2015	2016	2017	2018	2019	2020	
Blackberry	Scottish	.0	1.0	5.8	6.3	19.6	18.5	23.7	24.2	17.7
	Rest UK	96.0	87.7	49.8	71.2	40.0	53.3	69.6	85.0	46.6
	EU	12.3	14.6	60.5	6.1	.0	.0	8.5	68.2	66.9
	Rest world	177.4	162.9	131.5	209.7	348.1	371.9	329.6	298.9	320.4
Blueberry	Scottish	.0	.0	.0	.0	34.1	22.0	23.9	6.8	.0
	Rest UK	36.3	93.9	35.6	70.2	14.0	146.9	67.1	33.1	.0
	EU	408.8	523.9	490.3	420.7	424.0	619.9	539.5	405.2	305.6
	Rest world	1025.0	1014.0	1618.8	2038.2	2246.3	2161.2	2749.3	3064.8	3382.4
Cherries	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	17.1
	Rest UK	62.7	72.3	100.9	57.7	54.1	86.9	173.6	108.6	212.3
	EU	241.3	454.3	279.6	162.4	328.8	420.2	499.8	422.8	506.0
	Rest world	684.0	969.8	1070.2	1194.7	1251.2	1044.6	998.0	840.8	899.7
Grapes	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	34.0	38.8	48.9	58.3	57.5	101.8	61.8	4.9	7.3
	EU	1775.5	2476.7	3735.7	6576.2	6826.4	5785.0	6195.6	3936.4	3415.1
	Rest world	13693.0	13819.7	12043.9	11063.8	12031.7	13864.5	14041.6	18149.0	18653.9
Raspberry	Scottish	10.5	22.8	43.1	203.2	125.6	115.5	59.7	67.2	82.5
	Rest UK	405.8	590.3	419.3	529.2	891.2	845.4	678.7	690.0	661.1
	EU	347.0	350.3	461.4	301.2	276.0	354.1	475.8	468.9	441.5
	Rest world	218.6	230.4	722.6	907.6	1094.1	1155.6	1710.8	1723.1	1790.5
Strawberry	Scottish	274.6	98.5	237.7	172.5	746.8	599.3	614.0	372.1	717.4
	Rest UK	4166.8	3757.5	2653.9	4341.1	3775.1	4408.5	4173.5	3859.6	3598.8
	EU	1672.5	1557.2	3163.2	2160.0	1724.1	1261.2	3601.2	4399.1	5245.8
	Rest world	2037.7	3043.7	3351.8	3600.2	5379.4	4097.9	3032.8	3212.2	2782.9
Others	Scottish	.0	.0	.0	.0	.0	.0	.0	.0	.0
	Rest UK	34.3	39.6	83.2	56.2	63.6	76.5	100.1	125.3	173.8
	EU	9.0	11.3	24.7	70.4	63.4	25.2	54.0	74.0	27.3
	Rest world	76.0	80.2	107.3	105.2	164.5	133.7	103.1	169.3	187.5

Source: Own elaboration based on Kantar Worldpanel data.

Table A5 - Linquad regressions

Parameters	Socioeconomic groups							
	£0 to £29,000		£30,000 to £49,999		£50,000 to above		Unknown	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
A01	-94.239000	-1.16	122.170000	4.79	1439.600000	15.92	3021.900000	17.32
A02	1518.500000	9.73	2160.700000	12.90	-853.590000	-12.16	1848.200000	12.74
A03	896.880000	12.77	779.320000	12.13	2020.800000	13.18	4595.400000	15.64
A04	1881.300000	12.40	751.550000	14.37	1819.300000	13.42	2747.500000	15.70
A05	1741.300000	13.19	637.410000	12.22	1313.700000	13.26	5189.800000	16.12
A06	175.460000	7.59	141.860000	9.65	26.849000	3.20	651.430000	10.33
A07	-4290.400000	-11.16	1705.600000	9.87	-106.840000	-4.27	-4010.400000	-14.90
B0101	-121.810000	-1.12	177.490000	4.88	2058.500000	15.92	4323.100000	17.32
B0102	-801.290000	-2.81	-1685.800000	-7.62	179.450000	1.57	-558.460000	-2.09
B0103	-1391.500000	-5.12	-2282.800000	-15.16	1547.900000	12.48	-1327.600000	-6.43
B0104	-4456.400000	-12.61	-2409.400000	-12.87	610.040000	3.85	-1960.000000	-7.88
B0105	-1533.700000	-8.98	-1426.000000	-13.43	493.360000	3.45	-855.630000	-3.94
B0106	456.360000	1.82	1067.300000	11.03	374.630000	2.55	960.080000	3.28
B0107	390.890000	1.29	1178.000000	5.50	828.140000	4.48	-152.020000	-0.61
B0108	3956.800000	13.85	2061.000000	11.07	874.910000	5.62	1851.100000	8.25
B0109	2958.600000	7.16	3078.500000	14.11	3144.400000	17.42	52.907000	0.17
B0110	1557.500000	3.26	1359.700000	4.67	2053.800000	12.10	-39.877000	-0.11
B0111	1266.400000	5.33	-320.370000	-1.89	1152.700000	7.94	-688.500000	-4.26
B0112	-525.520000	-1.99	-134.800000	-0.57	558.540000	5.36	-489.580000	-3.70
B0113	-2509.400000	-9.09	-4739.100000	-17.58	520.160000	5.20	-2132.900000	-8.55
B0114	131.110000	7.45	20.955000	1.53	-20.802000	-2.54	45.992000	3.32
B0201	2023.600000	9.73	3087.800000	12.91	-1218.600000	-12.15	2643.100000	12.75
B0202	2366.100000	5.67	2676.400000	16.04	1941.900000	16.91	-4320.300000	-16.54
B0203	3826.300000	12.19	-3666.200000	-17.00	-2259.200000	-12.27	-5085.100000	-17.44
B0204	-5760.000000	-11.85	-467.480000	-5.13	206.130000	2.46	-1581.700000	-9.34
B0205	13658.000000	14.70	10580.000000	14.49	9069.400000	14.16	11188.000000	14.79
B0206	3872.800000	14.68	-3465.500000	-12.65	2763.000000	14.58	2054.300000	9.43
B0207	-8780.000000	-14.79	-2225.800000	-16.96	-5750.400000	-13.96	-8140.000000	-15.62
B0208	11023.000000	13.74	7130.300000	15.28	2017.300000	14.99	-1593.400000	-3.32
B0209	-7294.400000	-10.38	-2597.900000	-11.46	-3433.300000	-13.81	-3382.000000	-13.30
B0210	-11092.000000	-13.82	1346.100000	9.31	-4408.000000	-15.26	-4097.300000	-11.88
B0211	2191.300000	6.20	-4009.200000	-13.31	3098.800000	12.34	2151.000000	9.04
B0212	283.040000	0.86	598.140000	6.07	642.930000	9.81	-5138.900000	-9.29
B0213	-7258.400000	-13.13	-5233.200000	-12.97	-6528.700000	-13.22	-15223.000000	-17.18
B0214	369.380000	7.31	313.510000	8.57	234.710000	5.34	255.140000	5.26
B0301	1192.800000	12.80	1111.300000	12.14	2884.600000	13.19	6564.800000	15.65
B0302	5865.900000	12.14	2000.500000	13.38	2750.900000	13.11	6119.500000	15.91
B0303	1187.600000	6.56	188.120000	3.99	1006.600000	8.86	4500.200000	9.50
B0304	-769.960000	-6.41	-4017.800000	-13.12	-1909.000000	-12.37	-2995.700000	-14.72
B0305	-12318.000000	-11.14	-4408.100000	-11.76	-9494.700000	-12.49	-21338.000000	-14.19
B0306	-5052.300000	-10.43	-4810.500000	-12.23	-2044.700000	-13.06	-6887.200000	-15.32
B0307	11226.000000	11.08	9600.600000	12.25	10129.000000	12.60	27110.000000	14.48
B0308	12018.000000	11.91	6378.600000	12.87	7726.000000	13.45	22971.000000	15.77
B0309	-11365.000000	-11.81	-5896.700000	-13.25	-6148.000000	-13.16	-17170.000000	-15.54
B0310	-2372.300000	-12.47	-556.690000	-13.36	-730.880000	-8.49	-4582.100000	-11.40
B0311	-5565.900000	-11.74	-2106.800000	-12.42	134.090000	5.70	-2352.500000	-15.49
B0312	779.170000	5.88	832.860000	13.84	-1531.900000	-7.83	-4048.700000	-10.17
B0313	-711.170000	-11.39	1198.600000	14.11	-1100.700000	-11.68	-1778.700000	-10.02
B0314	-178.950000	-1.49	44.021000	0.53	-138.600000	-2.40	192.930000	1.93
B0401	2511.700000	12.40	1075.500000	14.37	2601.800000	13.43	3930.800000	15.70
B0402	2451.400000	12.53	1193.900000	11.73	663.670000	14.00	6810.600000	15.38
B0403	722.580000	7.21	370.350000	17.54	1468.500000	12.69	1087.400000	12.94
B0404	2147.200000	14.08	337.420000	18.13	-43.043000	-5.70	1867.900000	12.56
B0405	1108.600000	6.59	-596.180000	-14.91	-1619.000000	-12.57	-880.560000	-15.60
B0406	-2206.800000	-11.48	289.000000	9.67	-356.110000	-11.18	-1415.400000	-13.56

B0407	-377.220000	-4.36	-374.290000	-7.86	-784.840000	-10.87	-4805.200000	-14.10

(Continued)

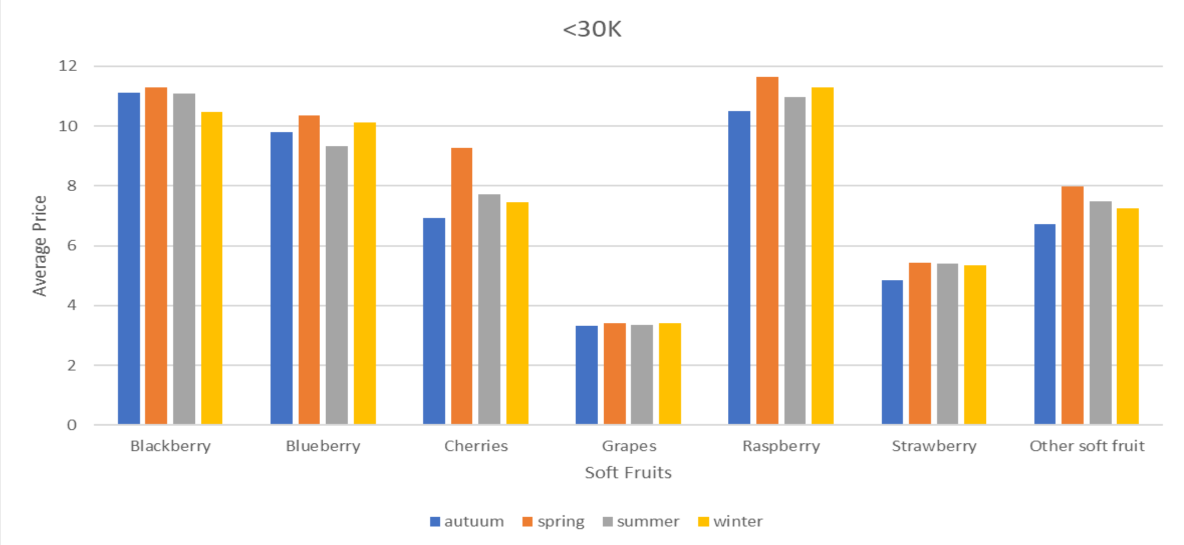
Parameters	Socioeconomic groups							
	£0 to £29,000		£30,000 to £49,999		£50,000 to above		Unknown	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
B0408	-166.990000	-1.96	-570.520000	-15.11	-365.290000	-17.03	4635.400000	15.30
B0409	173.630000	8.95	73.890000	6.12	2813.300000	11.99	961.120000	9.49
B0410	5311.200000	11.82	1556.900000	12.83	3579.900000	13.27	7205.700000	14.57
B0411	-566.910000	-11.72	732.490000	15.46	-245.010000	-11.22	1957.200000	12.14
B0412	-3545.000000	-11.19	-1695.900000	-12.85	-2978.600000	-12.67	-5927.700000	-14.26
B0413	-7947.100000	-11.56	-3485.700000	-12.88	-4595.400000	-12.94	-13303.000000	-14.10
B0414	1252.000000	4.49	1686.700000	9.34	688.300000	6.08	1166.900000	5.02
B0501	2326.800000	13.20	914.130000	12.24	1880.100000	13.27	7421.500000	16.13
B0502	-1166.400000	-9.51	-995.140000	-16.83	-644.190000	-4.90	1856.700000	9.68
B0503	1808.200000	10.26	2344.200000	17.18	2969.600000	13.11	4303.600000	13.35
B0504	1237.700000	13.74	645.740000	5.63	326.030000	3.27	5223.500000	13.56
B0505	5298.600000	10.87	3646.500000	11.95	-818.710000	-8.67	11083.000000	17.29
B0506	-6358.400000	-15.41	-1718.200000	-12.58	-1868.900000	-16.20	5879.900000	8.24
B0507	-9094.100000	-13.16	-2166.600000	-10.29	-2908.000000	-12.70	714.730000	2.64
B0508	12706.000000	13.98	560.650000	5.41	2552.100000	13.72	7109.700000	12.88
B0509	5538.700000	14.16	3107.900000	14.42	-411.620000	-6.27	3792.600000	9.10
B0510	-708.250000	-3.60	44.803000	0.37	416.610000	3.27	-4891.400000	-14.55
B0511	-7470.700000	-14.75	-3086.300000	-14.77	-3771.000000	-12.48	-2872.500000	-11.00
B0512	-1153.600000	-3.57	-43.537000	-0.48	1670.400000	13.26	-8882.000000	-17.27
B0513	-12873.000000	-12.61	-1412.100000	-9.95	175.180000	4.30	-8541.100000	-10.43
B0514	557.360000	12.03	262.990000	7.14	134.640000	3.76	270.340000	6.29
B0601	228.650000	7.56	199.990000	9.65	33.887000	2.90	921.010000	10.30
B0602	-2785.800000	-11.40	-1159.500000	-12.43	-1458.400000	-12.67	-3996.700000	-15.81
B0603	-1578.700000	-10.46	-345.500000	-9.34	-854.670000	-12.45	-2658.000000	-12.42
B0604	319.620000	7.79	873.500000	14.23	206.030000	5.22	393.780000	6.39
B0605	2104.800000	9.72	169.380000	5.52	1438.400000	11.55	3652.900000	11.85
B0606	4131.100000	11.26	2869.300000	12.59	2021.000000	12.97	6908.100000	15.43
B0607	1331.400000	14.27	-252.550000	-9.97	433.080000	14.30	325.970000	9.44
B0608	-2620.500000	-13.57	-583.680000	-13.84	-507.130000	-13.49	-2727.300000	-15.86
B0609	4053.000000	11.85	1717.500000	12.75	2087.700000	13.28	6906.200000	15.30
B0610	179.060000	12.47	-527.370000	-13.48	-168.660000	-8.70	-678.730000	-15.33
B0611	489.900000	13.34	89.073000	10.69	-836.900000	-11.80	-1830.400000	-14.33
B0612	-1750.500000	-14.00	-1285.000000	-13.63	-1000.800000	-14.32	-1884.900000	-15.96
B0613	-865.250000	-9.09	-1027.300000	-11.95	-553.490000	-12.64	-2339.000000	-14.26
B0614	-559.250000	-6.96	170.730000	0.61	180.630000	1.17	1003.200000	4.00
B0701	-5715.200000	-11.15	2440.100000	9.88	-150.160000	-4.20	-5728.600000	-14.90
B0702	-257.970000	-1.12	358.060000	5.81	1873.400000	16.78	2117.000000	5.90
B0703	-1274.800000	-5.04	-2422.100000	-11.42	1884.300000	8.25	2535.500000	7.36
B0704	-822.840000	-4.02	-1907.600000	-17.11	2229.300000	11.27	2490.800000	6.21
B0705	1111.300000	2.57	3484.000000	14.51	2251.200000	6.29	5284.100000	11.30
B0706	6535.400000	14.02	4922.400000	17.07	1121.600000	5.88	5858.000000	14.45
B0707	2019.800000	6.10	2543.600000	6.52	-1674.600000	-8.03	1900.700000	5.79
B0708	783.430000	2.26	2448.600000	9.58	-1570.000000	-15.78	3818.400000	11.12
B0709	117.900000	0.53	-717.420000	-5.14	275.670000	4.98	4148.200000	10.60
B0710	586.870000	1.31	-896.510000	-3.63	1052.500000	3.63	3589.200000	14.75
B0711	1850.600000	5.99	217.350000	1.25	115.170000	0.66	1312.300000	4.74
B0712	3701.100000	10.74	2373.700000	8.11	805.980000	4.68	3329.400000	12.33
B0713	8072.200000	15.50	7664.600000	17.40	3051.500000	18.68	3240.000000	10.24
B0714	75.220000	4.21	76.662000	4.87	-16.831000	-1.75	4.399000	0.22
C0101	-31.145000	-6.74	8.388300	2.87	10.177000	4.73	20.970000	8.01
C0102	362.250000	1.40	-101.750000	-0.69	-304.380000	-3.57	277.270000	2.56
C0103	-145.490000	-1.25	36.617000	0.42	-68.811000	-1.57	-40.537000	-0.60
C0104	3063.400000	14.06	552.070000	7.69	-1118.100000	-11.66	-50.820000	-0.34
C0105	519.760000	1.32	-67.944000	-0.37	75.676000	0.70	-81.456000	-0.48
C0106	-1853.100000	-6.62	-271.790000	-0.99	208.340000	1.16	-765.420000	-3.06
C0107	-72.186000	-0.39	-82.221000	-1.05	26.134000	0.65	23.109000	0.36

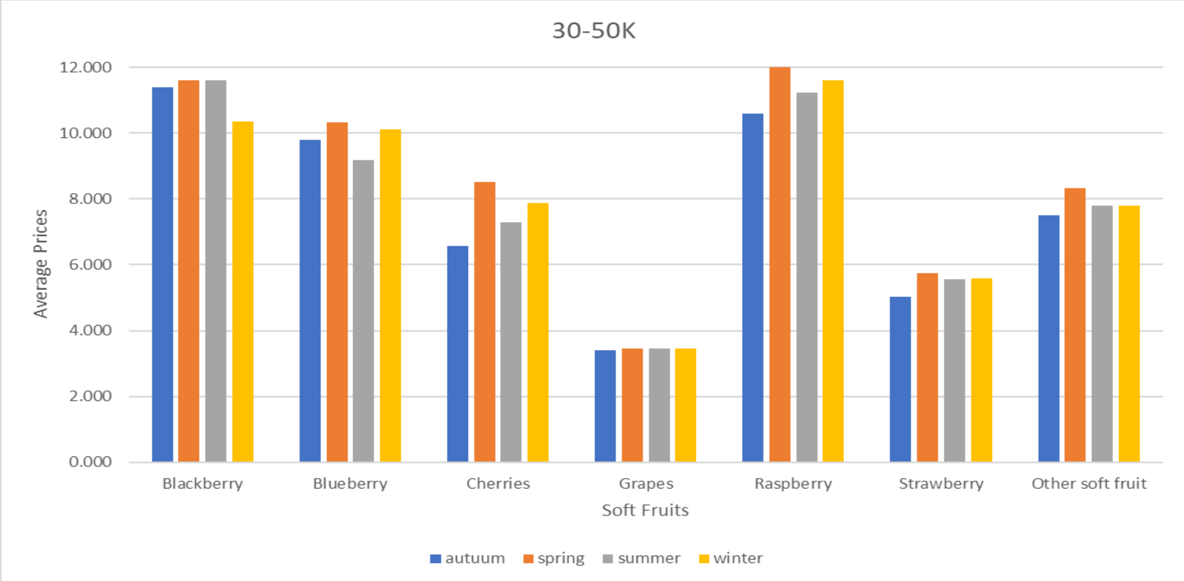
C0201	3493.800000	6.06	1407.500000	6.65	1642.600000	4.97	-21.269000	-0.09

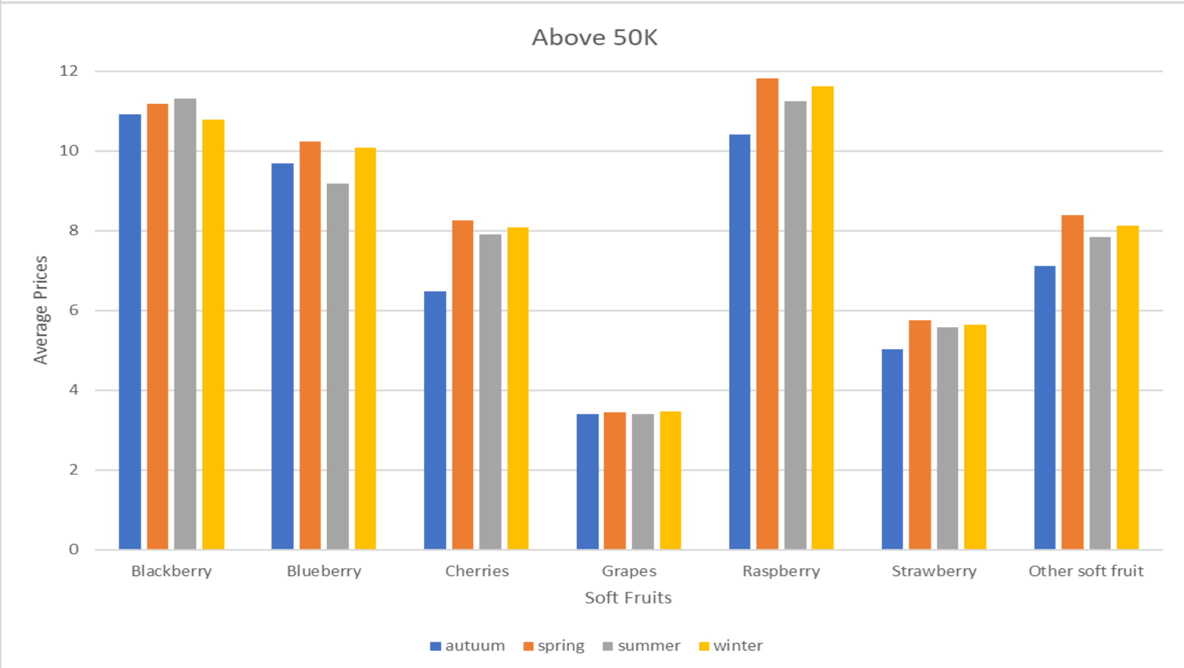
(Continued)

Parameters	Socioeconomic groups							
	£0 to £29,000		**£30,000 to £49,999**		**£50,000 to above**		**Unknown**	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
C0202	-7235.100000	-10.19	-3887.400000	-11.12	-4105.800000	-14.16	-2667.100000	-8.14
C0203	-49.101000	-0.14	-460.400000	-2.06	-624.060000	-4.25	-276.230000	-1.20
C0204	2533.100000	10.04	5248.000000	13.15	935.360000	11.04	11902.000000	13.97
C0205	973.330000	1.56	1227.000000	5.14	858.130000	3.73	-2009.700000	-5.43
C0206	-81.503000	-0.17	1885.900000	4.80	1290.100000	3.87	1438.100000	2.45
C0207	132.260000	0.28	319.280000	1.93	409.910000	2.47	-226.420000	-1.02
C0301	-5610.400000	-12.47	-1564.900000	-10.20	-248.700000	-1.48	-278.770000	-0.81
C0302	-5831.400000	-9.47	-1620.900000	-10.52	-2753.800000	-12.57	-2092.400000	-7.34
C0303	-6800.500000	-12.04	-3120.000000	-14.89	-1945.000000	-8.82	-2375.100000	-6.65
C0304	1931.600000	14.47	3569.600000	12.46	5917.600000	13.74	14912.000000	16.36
C0305	-1508.500000	-3.54	-2153.700000	-10.94	-3304.400000	-11.49	-2302.800000	-3.89
C0306	19488.000000	13.95	6850.800000	15.12	7541.300000	12.66	3638.900000	3.50
C0307	-1477.700000	-2.39	-17.605000	-0.09	22.661000	0.10	-344.790000	-1.00
C0401	7729.000000	13.93	4926.000000	15.60	2227.400000	12.17	1928.800000	5.39
C0402	1872.600000	6.76	2224.900000	11.22	1104.600000	7.74	-2094.400000	-5.34
C0403	-369.980000	-0.30	-631.580000	-1.90	-110.130000	-0.44	1596.700000	4.38
C0404	-5.597000	-0.07	75.492000	3.02	-1.048700	-0.03	-12.874000	-0.46
C0405	17486.000000	13.92	11114.000000	15.10	7243.300000	16.26	9808.600000	19.54
C0406	651.310000	2.90	-85.952000	-0.80	-525.950000	-3.46	-5502.400000	-9.79
C0407	9622.000000	12.71	3345.200000	5.98	1379.900000	4.87	-558.720000	-1.01
C0501	1950.500000	2.97	1625.300000	4.92	1360.000000	4.79	906.960000	2.97
C0502	1355.500000	2.02	-153.350000	-0.54	-413.140000	-2.01	1056.100000	4.54
C0503	-1195.200000	-3.49	-204.880000	-0.83	-306.400000	-2.10	-330.910000	-1.71
C0504	16768.000000	12.98	8143.300000	12.92	3694.200000	13.72	1572.300000	3.82
C0505	-7944.100000	-14.24	-3634.300000	-14.34	-2811.400000	-8.96	-4365.900000	-9.90
C0506	-2507.900000	-4.54	520.340000	1.59	-1270.500000	-7.12	2443.800000	5.92
C0507	-1077.100000	-2.25	-335.870000	-1.67	-45.633000	-0.32	-355.660000	-1.85
C0601	89.694000	0.89	1074.600000	8.68	253.930000	3.09	7182.600000	14.71
C0602	-6029.100000	-9.44	-1526.000000	-13.47	-390.120000	-6.15	2877.000000	14.71
C0603	-13969.000000	-12.65	-7165.400000	-13.12	-6867.200000	-14.34	-6213.600000	-15.88
C0604	-206.440000	-3.68	-13.423000	-0.71	110.120000	2.55	4320.100000	11.39
C0605	-6587.800000	-12.51	-2143.100000	-14.47	-1100.400000	-12.83	2051.300000	9.22
C0606	-17957.000000	-12.40	-8261.600000	-13.39	-9683.900000	-14.05	-19694.000000	-16.26
C0607	-3592.200000	-13.73	-3719.700000	-17.07	-742.450000	-11.32	-2328.900000	-15.47
C0701	254.870000	0.85	-324.390000	-1.81	-152.730000	-1.32	425.170000	2.62
C0702	-464.940000	-1.72	358.820000	2.33	-174.340000	-1.42	-132.480000	-0.86
C0703	5.921000	0.05	42.190000	0.45	7.516700	0.13	-60.001000	-0.62
C0704	6656.600000	11.26	238.050000	1.30	-1136.500000	-9.30	1746.100000	6.68
C0705	-295.140000	-0.87	639.900000	3.04	-183.910000	-1.30	-560.010000	-2.40
C0706	-1984.300000	-6.86	-2259.200000	-8.85	499.010000	2.34	249.820000	0.67
C0707	-184.200000	-0.98	11.373000	3.11	5.946100	1.71	6.210300	0.95
I01	0.000018	1.38	0.000051	3.62	0.000052	4.22	0.000011	1.41
I02	0.000203	6.69	0.000018	0.66	0.000282	5.12	0.000176	6.00
I03	0.000447	10.17	0.000276	6.90	0.000323	6.10	-0.000006	-0.11
I04	0.000611	6.17	0.000160	1.11	0.000374	3.84	0.000990	7.42
I05	0.000159	5.26	0.000105	3.77	0.000305	6.39	0.000109	4.44
I06	0.002077	18.94	0.001776	13.42	0.002109	16.29	0.000849	7.76
I07	0.000021	1.59	-0.000010	-0.56	0.000082	5.35	0.000053	4.55
Log-Likelihood	-9081.70		-8576.20		-8362.81		-8536.21	
Obs.	116		116		116		116	

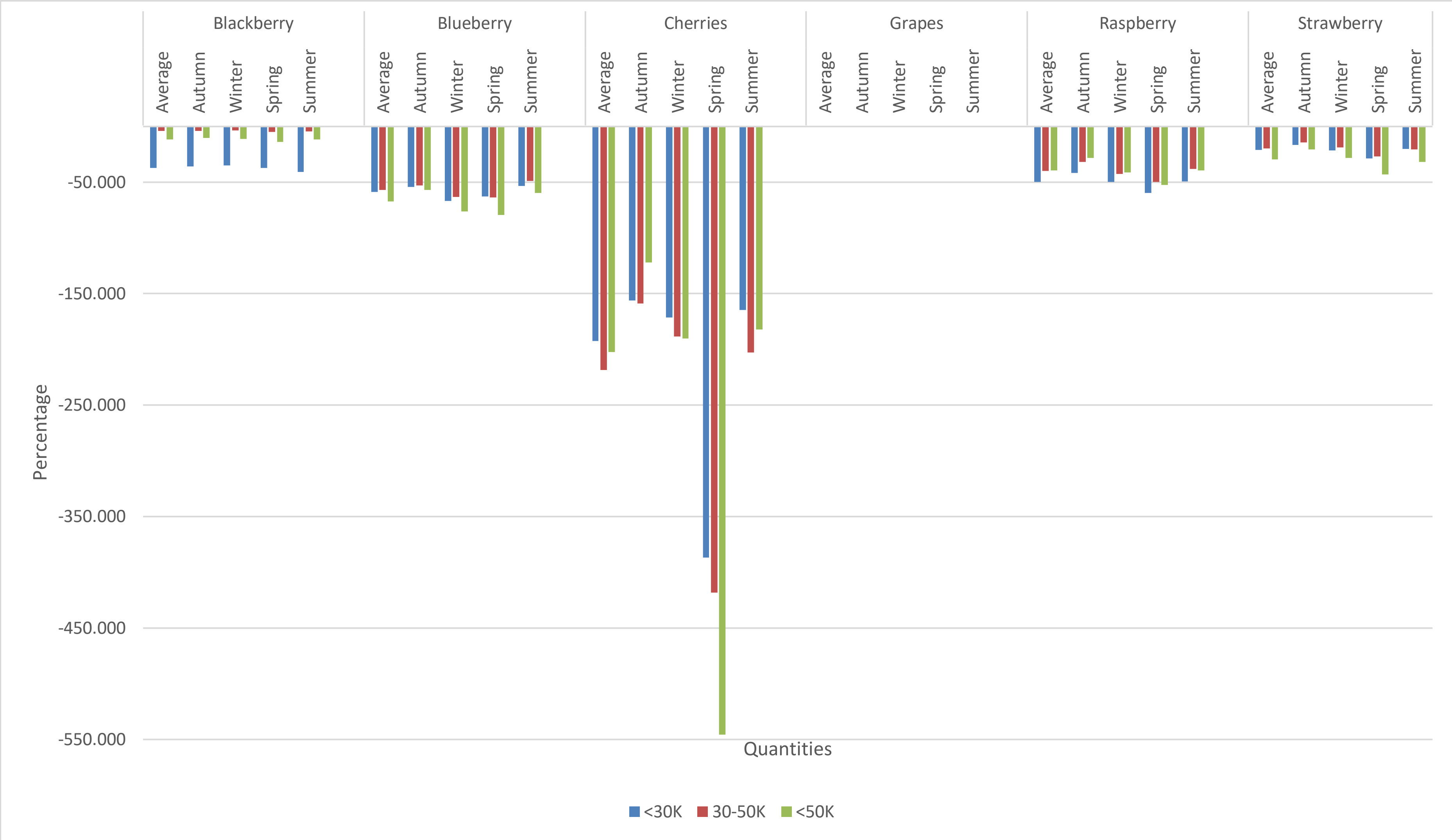
A6 - Average prices of soft fruits during different seasons in Scotland







A7 - Impact seasonal price ranges on quantities of soft fruit purchased by income group and seasons



Source: Own computation based on Kantar Worldpanel data

A8-1 - Expected loss in vitamin purchases due to seasonal price changes for income group less than 30K.

Fruit	Season	Carotene (µg)	Retinol (µg)	Vitamin D (µg)	Vitamin E (mg)	Vitamin K1 (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Tryptophan/60 (mg)	Niacin (mg)	Vitamin B6 (mg)	Folate (µg)	Pantothenate (mg)	Biotin (µg)	Vitamin C (mg)
Blackberry	Average	-15.22	-2.60	0.00	-0.88	0.00	-0.01	-0.02	-0.19	-0.04	-0.22	-0.02	-12.62	-0.09	-0.15	-2.60
	Autumn	-14.67	-2.50	0.00	-0.85	0.00	-0.01	-0.02	-0.18	-0.04	-0.21	-0.02	-12.16	-0.09	-0.14	-2.50
	Winter	-14.37	-2.45	0.00	-0.83	0.00	-0.01	-0.02	-0.18	-0.04	-0.21	-0.02	-11.91	-0.09	-0.14	-2.45
	Spring	-15.28	-2.61	0.00	-0.88	0.00	-0.01	-0.02	-0.19	-0.04	-0.22	-0.02	-12.67	-0.09	-0.15	-2.61
	Summer	-16.73	-2.86	0.00	-0.97	0.00	-0.01	-0.02	-0.20	-0.04	-0.24	-0.02	-13.87	-0.10	-0.16	-2.86
Blueberry	Average	-8.23	-1.18	0.00	-0.55	0.00	-0.02	-0.02	-0.18	-0.12	-0.29	-0.01	-4.70	-0.12	-0.88	-3.53
	Autumn	-7.60	-1.09	0.00	-0.51	0.00	-0.02	-0.02	-0.16	-0.11	-0.27	-0.01	-4.34	-0.11	-0.81	-3.26
	Winter	-9.34	-1.33	0.00	-0.63	0.00	-0.03	-0.03	-0.20	-0.13	-0.33	-0.01	-5.34	-0.13	-1.00	-4.00
	Spring	-8.77	-1.25	0.00	-0.59	0.00	-0.03	-0.03	-0.19	-0.13	-0.31	-0.01	-5.01	-0.13	-0.94	-3.76
	Summer	-7.45	-1.06	0.00	-0.50	0.00	-0.02	-0.02	-0.16	-0.11	-0.27	-0.01	-4.26	-0.11	-0.80	-3.19
Cherries	Average	-35.60	-5.93	0.00	-0.27	0.00	-0.06	0.00	-0.38	-0.17	-0.56	-0.19	-6.16	-0.48	-0.81	-5.77
	Autumn	-28.85	-4.81	0.00	-0.22	0.00	-0.05	0.00	-0.31	-0.14	-0.45	-0.16	-4.99	-0.39	-0.65	-4.68
	Winter	-31.71	-5.28	0.00	-0.24	0.00	-0.05	0.00	-0.34	-0.15	-0.50	-0.17	-5.48	-0.43	-0.72	-5.14
	Spring	-71.52	-11.92	0.00	-0.54	0.00	-0.12	0.00	-0.77	-0.35	-1.12	-0.39	-12.37	-0.97	-1.62	-11.60
	Summer	-30.44	-5.07	0.00	-0.23	0.00	-0.05	0.00	-0.33	-0.15	-0.48	-0.16	-5.26	-0.41	-0.69	-4.94
Grapes	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Autumn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Spring	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Summer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Raspberry	Average	-2.98	-0.50	0.00	-0.41	0.00	0.00	0.00	-0.25	-0.10	-0.35	-0.05	-27.27	-0.36	-0.79	-9.42
	Autumn	-2.51	-0.42	0.00	-0.34	0.00	0.00	0.00	-0.21	-0.08	-0.29	-0.05	-23.01	-0.31	-0.67	-7.95
	Winter	-2.98	-0.50	0.00	-0.41	0.00	0.00	0.00	-0.25	-0.10	-0.35	-0.05	-27.36	-0.36	-0.80	-9.45
	Spring	-3.56	-0.59	0.00	-0.49	0.00	-0.01	-0.01	-0.30	-0.12	-0.42	-0.07	-32.68	-0.43	-0.95	-11.29
	Summer	-2.97	-0.49	0.00	-0.41	0.00	0.00	0.00	-0.25	-0.10	-0.35	-0.05	-27.22	-0.36	-0.79	-9.40
Strawberry	Average	0.00	0.00	0.00	-0.08	-0.63	0.00	0.00	-0.13	-0.02	-0.15	-0.01	-12.78	-0.08	-0.25	-11.94
	Autumn	0.00	0.00	0.00	-0.06	-0.49	0.00	0.00	-0.10	-0.02	-0.12	0.00	-10.03	-0.06	-0.20	-9.37
	Winter	0.00	0.00	0.00	-0.08	-0.64	0.00	0.00	-0.13	-0.02	-0.15	-0.01	-13.00	-0.08	-0.26	-12.14
	Spring	0.00	0.00	0.00	-0.11	-0.86	-0.01	-0.01	-0.17	-0.03	-0.20	-0.01	-17.55	-0.11	-0.35	-16.40
	Summer	0.00	0.00	0.00	-0.08	-0.60	0.00	0.00	-0.12	-0.02	-0.14	-0.01	-12.25	-0.07	-0.24	-11.45

A8-2 - Expected loss in vitamin purchases due to seasonal price changes for income group less than 30 - 50K

Fruit	Season	Carotene (µg)	Retinol (µg)	Vitamin E (mg)	Vitamin K1 (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Tryptophan/60 (mg)	Niacin (mg)	Vitamin B6 (mg)	Folate (µg)	Pantothenate (mg)	Biotin (µg)	Vitamin C (mg)
Blackberry	Average	-1.66	-0.28	-0.10	0.00	0.00	0.00	-0.02	0.00	-0.02	0.00	-1.38	-0.01	-0.02	-0.28
	Autumn	-1.55	-0.26	-0.09	0.00	0.00	0.00	-0.02	0.00	-0.02	0.00	-1.28	-0.01	-0.02	-0.26
	Winter	-1.38	-0.24	-0.08	0.00	0.00	0.00	-0.02	0.00	-0.02	0.00	-1.15	-0.01	-0.01	-0.24
	Spring	-1.97	-0.34	-0.11	0.00	0.00	0.00	-0.02	0.00	-0.03	0.00	-1.63	-0.01	-0.02	-0.34
	Summer	-1.82	-0.31	-0.11	0.00	0.00	0.00	-0.02	0.00	-0.03	0.00	-1.51	-0.01	-0.02	-0.31
Blueberry	Average	-7.97	-1.14	-0.54	0.00	-0.02	-0.02	-0.17	-0.11	-0.28	-0.01	-4.55	-0.11	-0.85	-3.41
	Autumn	-7.41	-1.06	-0.50	0.00	-0.02	-0.02	-0.16	-0.11	-0.26	-0.01	-4.23	-0.11	-0.79	-3.17
	Winter	-8.87	-1.27	-0.60	0.00	-0.03	-0.03	-0.19	-0.13	-0.32	-0.01	-5.07	-0.13	-0.95	-3.80
	Spring	-8.94	-1.28	-0.60	0.00	-0.03	-0.03	-0.19	-0.13	-0.32	-0.01	-5.11	-0.13	-0.96	-3.83
	Summer	-6.86	-0.98	-0.46	0.00	-0.02	-0.02	-0.15	-0.10	-0.25	0.00	-3.92	-0.10	-0.74	-2.94
Cherries	Average	-40.45	-6.74	-0.31	0.00	-0.07	0.00	-0.44	-0.20	-0.63	-0.22	-7.00	-0.55	-0.92	-6.56
	Autumn	-29.36	-4.89	-0.22	0.00	-0.05	0.00	-0.32	-0.14	-0.46	-0.16	-5.08	-0.40	-0.67	-4.76
	Winter	-34.88	-5.81	-0.26	0.00	-0.06	0.00	-0.38	-0.17	-0.55	-0.19	-6.03	-0.47	-0.79	-5.66
	Spring	-77.37	-12.89	-0.59	0.00	-0.13	0.00	-0.84	-0.38	-1.21	-0.42	-13.38	-1.05	-1.76	-12.55
	Summer	-37.52	-6.25	-0.28	0.00	-0.06	0.00	-0.41	-0.18	-0.59	-0.20	-6.49	-0.51	-0.85	-6.08
Grapes	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Autumn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Spring	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Summer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Raspberry	Average	-2.40	-0.40	-0.33	0.00	0.00	0.00	-0.20	-0.08	-0.28	-0.04	-22.03	-0.29	-0.64	-7.61
	Autumn	-1.92	-0.32	-0.26	0.00	0.00	0.00	-0.16	-0.06	-0.22	-0.04	-17.57	-0.23	-0.51	-6.07
	Winter	-2.55	-0.43	-0.35	0.00	0.00	0.00	-0.21	-0.09	-0.30	-0.05	-23.38	-0.31	-0.68	-8.08
	Spring	-2.98	-0.50	-0.41	0.00	0.00	0.00	-0.25	-0.10	-0.35	-0.05	-27.28	-0.36	-0.79	-9.42
	Summer	-2.29	-0.38	-0.31	0.00	0.00	0.00	-0.19	-0.08	-0.27	-0.04	-20.97	-0.28	-0.61	-7.25
Strawberry	Average	0.00	0.00	-0.08	-0.59	0.00	0.00	-0.12	-0.02	-0.14	-0.01	-11.90	-0.07	-0.23	-11.12
	Autumn	0.00	0.00	-0.06	-0.43	0.00	0.00	-0.09	-0.01	-0.10	0.00	-8.74	-0.05	-0.17	-8.17
	Winter	0.00	0.00	-0.07	-0.56	0.00	0.00	-0.11	-0.02	-0.13	-0.01	-11.39	-0.07	-0.22	-10.65
	Spring	0.00	0.00	-0.10	-0.80	-0.01	-0.01	-0.16	-0.03	-0.19	-0.01	-16.36	-0.10	-0.32	-15.28
	Summer	0.00	0.00	-0.08	-0.62	0.00	0.00	-0.12	-0.02	-0.14	-0.01	-12.62	-0.08	-0.25	-11.79

A8-3 - Expected loss in vitamin purchases due to seasonal price changes for income group greater than 50K

Fruit	Season	Carotene (µg)	Retinol (µg)	Vitamin E (mg)	Vitamin K1 (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Tryptophan/60 (mg)	Niacin (mg)	Vitamin B6 (mg)	Folate (µg)	Pantothenate (mg)	Biotin (µg)	Vitamin C (mg)
Blackberry	Average	-4.78	-0.82	-0.28	0.00	0.00	-0.01	-0.06	-0.01	-0.07	-0.01	-3.96	-0.03	-0.05	-0.82
	Autumn	-4.20	-0.72	-0.24	0.00	0.00	-0.01	-0.05	-0.01	-0.06	-0.01	-3.48	-0.03	-0.04	-0.72
	Winter	-4.52	-0.77	-0.26	0.00	0.00	-0.01	-0.06	-0.01	-0.07	-0.01	-3.75	-0.03	-0.04	-0.77
	Spring	-5.76	-0.98	-0.33	0.00	0.00	-0.01	-0.07	-0.01	-0.08	-0.01	-4.77	-0.04	-0.06	-0.98
	Summer	-4.80	-0.82	-0.28	0.00	0.00	-0.01	-0.06	-0.01	-0.07	-0.01	-3.98	-0.03	-0.05	-0.82
Blueberry	Average	-9.42	-1.35	-0.63	0.00	-0.03	-0.03	-0.20	-0.13	-0.34	-0.01	-5.38	-0.13	-1.01	-4.04
	Autumn	-8.00	-1.14	-0.54	0.00	-0.02	-0.02	-0.17	-0.11	-0.29	-0.01	-4.57	-0.11	-0.86	-3.43
	Winter	-10.70	-1.53	-0.72	0.00	-0.03	-0.03	-0.23	-0.15	-0.38	-0.01	-6.11	-0.15	-1.15	-4.58
	Spring	-11.09	-1.58	-0.74	0.00	-0.03	-0.03	-0.24	-0.16	-0.40	-0.01	-6.33	-0.16	-1.19	-4.75
	Summer	-8.33	-1.19	-0.56	0.00	-0.02	-0.02	-0.18	-0.12	-0.30	-0.01	-4.76	-0.12	-0.89	-3.57
Cherries	Average	-37.39	-6.23	-0.28	0.00	-0.06	0.00	-0.40	-0.18	-0.59	-0.20	-6.47	-0.51	-0.85	-6.06
	Autumn	-22.58	-3.76	-0.17	0.00	-0.04	0.00	-0.24	-0.11	-0.35	-0.12	-3.91	-0.31	-0.51	-3.66
	Winter	-35.19	-5.87	-0.27	0.00	-0.06	0.00	-0.38	-0.17	-0.55	-0.19	-6.09	-0.48	-0.80	-5.71
	Spring	-100.93	-16.82	-0.76	0.00	-0.16	-0.01	-1.09	-0.49	-1.58	-0.55	-17.46	-1.36	-2.29	-16.37
	Summer	-33.70	-5.62	-0.25	0.00	-0.05	0.00	-0.36	-0.16	-0.53	-0.18	-5.83	-0.46	-0.76	-5.46
Grapes	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Autumn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Winter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Spring	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Summer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Raspberry	Average	-2.36	-0.39	-0.32	0.00	0.00	0.00	-0.20	-0.08	-0.27	-0.04	-21.59	-0.29	-0.63	-7.46
	Autumn	-1.70	-0.28	-0.23	0.00	0.00	0.00	-0.14	-0.06	-0.20	-0.03	-15.59	-0.21	-0.45	-5.39
	Winter	-2.47	-0.41	-0.34	0.00	0.00	0.00	-0.21	-0.08	-0.29	-0.05	-22.68	-0.30	-0.66	-7.83
	Spring	-3.15	-0.52	-0.43	0.00	-0.01	-0.01	-0.26	-0.10	-0.37	-0.06	-28.84	-0.38	-0.84	-9.96
	Summer	-2.37	-0.40	-0.32	0.00	0.00	0.00	-0.20	-0.08	-0.28	-0.04	-21.73	-0.29	-0.63	-7.51
Strawberry	Average	0.00	0.00	-0.11	-0.88	-0.01	-0.01	-0.18	-0.03	-0.21	-0.01	-17.95	-0.11	-0.35	-16.77
	Autumn	0.00	0.00	-0.08	-0.61	0.00	0.00	-0.12	-0.02	-0.14	-0.01	-12.45	-0.08	-0.24	-11.64
	Winter	0.00	0.00	-0.11	-0.85	-0.01	-0.01	-0.17	-0.03	-0.20	-0.01	-17.21	-0.10	-0.34	-16.08
	Spring	0.00	0.00	-0.17	-1.29	-0.01	-0.01	-0.26	-0.04	-0.30	-0.01	-26.13	-0.16	-0.51	-24.42
	Summer	0.00	0.00	-0.12	-0.96	-0.01	-0.01	-0.19	-0.03	-0.22	-0.01	-19.45	-0.12	-0.38	-18.17