Here is the background information on your task

You are part of retail analytics team and have been approached by your client, the Category Manager for Chips, who wants to better understand the types of customers who purchase Chips and their purchasing behaviour within the region.

Remember, our end goal is to form a strategy based on the findings to provide a clear recommendation to Julia the Category Manager so make sure your insights can have a commercial application.

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import re

import warnings
warnings.filterwarnings("ignore")
```

In [2]:

```
customers = pd.read_csv('.\\data\\QVI_purchase_behaviour.csv')
customers.head()
```

Out[2]:

	LYLTY_CARD_NBR	LIFESTAGE	PREMIUM_CUSTOMER
0	1000	YOUNG SINGLES/COUPLES	Premium
1	1002	YOUNG SINGLES/COUPLES	Mainstream
2	1003	YOUNG FAMILIES	Budget
3	1004	OLDER SINGLES/COUPLES	Mainstream
4	1005	MIDAGE SINGLES/COUPLES	Mainstream

In [3]:

```
transaction = pd.read_excel('.\\data\\QVI_transaction_data.xlsx')
transaction.head()
```

Out[3]:

	DATE	STORE_NBR	LYLTY_CARD_NBR	TXN_ID	PROD_NBR	PROD_NAME	PROD_QTY
0	43390	1	1000	1	5	Natural Chip Compny SeaSalt175g	2
1	43599	1	1307	348	66	CCs Nacho Cheese 175g	3
2	43605	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2
3	43329	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5
4	43330	2	2426	1038	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3

I don't like the title letters in the column names and the date as a number

In [4]:
```
customers.columns = customers.columns.str.lower()
transaction.columns = transaction.columns.str.lower()
```

In [5]:
```
start_date = pd.to_datetime('1899-12-30')
transaction['date'] = transaction['date'].apply(lambda x: start_date + pd.Timedelta
```

In [6]:
```
customers.info(), transaction.info()
```

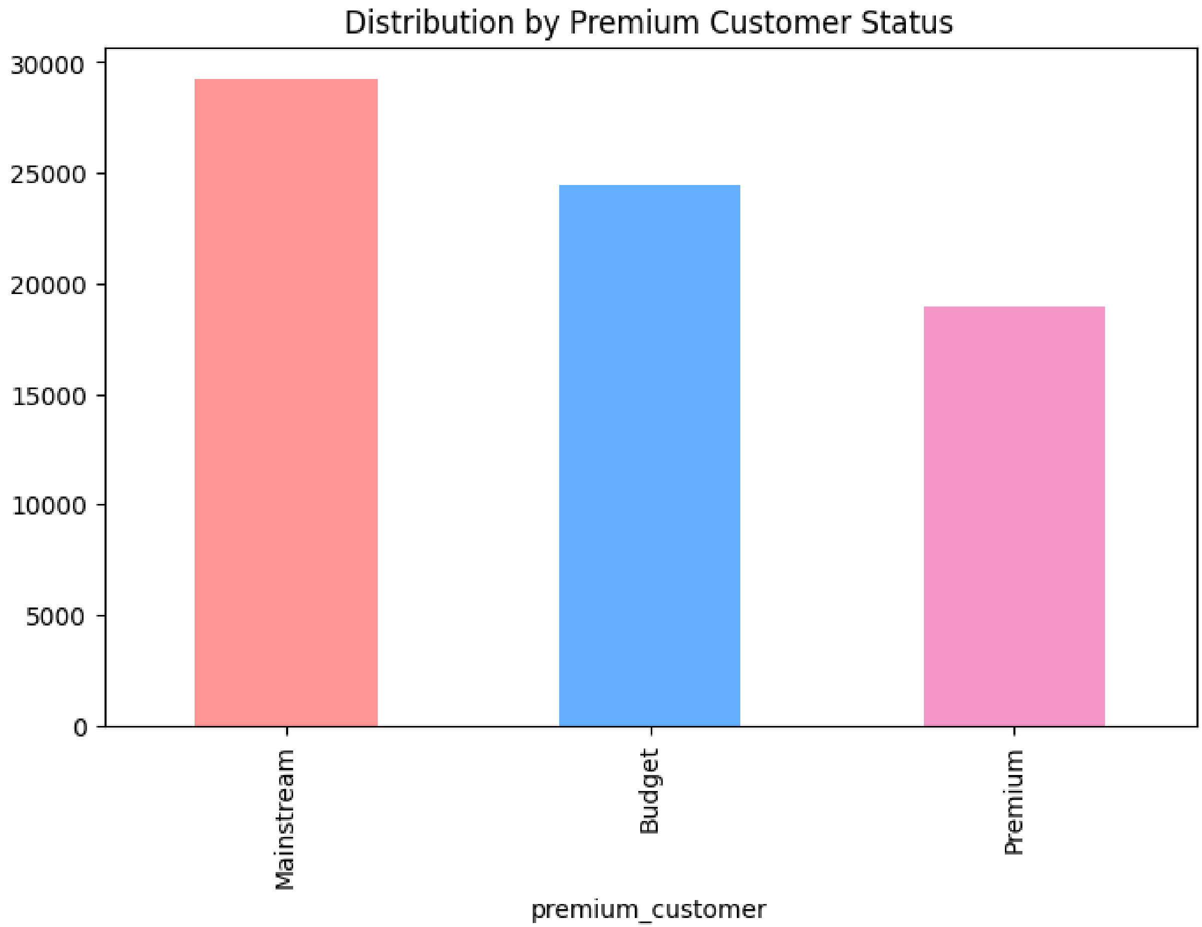
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 72637 entries, 0 to 72636
Data columns (total 3 columns):
 #   Column            Non-Null Count  Dtype 
---  ------            --------------  ----- 
 0   lylty_card_nbr    72637 non-null  int64 
 1   lifestage         72637 non-null  object
 2   premium_customer  72637 non-null  object
dtypes: int64(1), object(2)
memory usage: 1.7+ MB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 264836 entries, 0 to 264835
Data columns (total 8 columns):
 #   Column          Non-Null Count   Dtype         
---  ------          --------------   -----         
 0   date            264836 non-null  datetime64[ns]
 1   store_nbr       264836 non-null  int64         
 2   lylty_card_nbr  264836 non-null  int64         
 3   txn_id          264836 non-null  int64         
 4   prod_nbr        264836 non-null  int64         
 5   prod_name       264836 non-null  object        
 6   prod_qty        264836 non-null  int64         
 7   tot_sales       264836 non-null  float64       
dtypes: datetime64[ns](1), float64(1), int64(5), object(1)
memory usage: 16.2+ MB
```

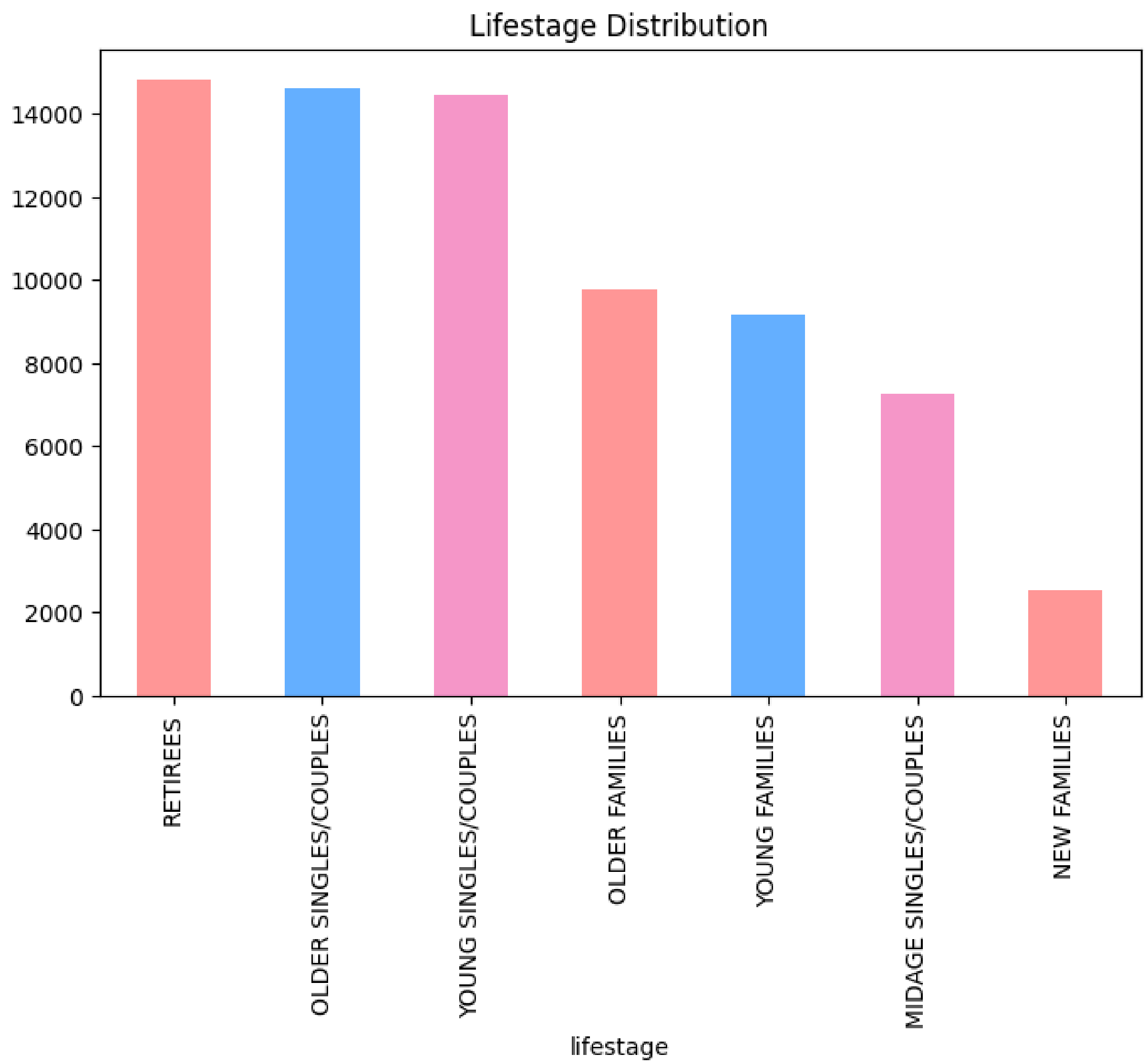
Out[6]: (None, None)

I want to see the distribution in the database with customers

In [7]:

```
# Plot distribution by Premium Customer Status
plt.figure(figsize=(8, 5))
customers.premium_customer.value_counts().plot(kind='bar', color=['#FF9999', '#66B3
plt.title('Distribution by Premium Customer Status')
plt.show()

# Plot Lifestage Distribution
plt.figure(figsize=(8, 5))
customers.lifestage.value_counts().plot(kind='bar', color=['#FF9999', '#66B3FF', '#
plt.title('Lifestage Distribution')
plt.show()
```


Distribution by Premium Customer Status
30000
25000
20000
15000
10000
5000
0
Mainstream
Budget
Premium
premium_customer



Let's look at the duplicates

In [8]:
```
transaction.duplicated().sum()
```

Out[8]: np.int64(1)

In [9]:
```
transaction.drop_duplicates(inplace=True)
transaction.duplicated().sum()
```

Out[9]: np.int64(0)

Add columns with customer types to the table with transactions

In [10]:
```
df = pd.merge(transaction, customers, on='lylty_card_nbr')
df.head()
```

Out[10]:

	date	store_nbr	lylty_card_nbr	txn_id	prod_nbr	prod_name	prod_qty	tot_sales
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0
1	2019-05-14	1	1307	348	66	CCs Nacho Cheese 175g	3	6.3
2	2019-05-20	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2	2.9
3	2018-08-17	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5	15.0
4	2018-08-18	2	2426	1038	108	Kettle Tortilla ChpsHny&Jlpno Chili 150g	3	13.8

In [11]:
```
df.shape, transaction.shape, customers.shape
```

Out[11]:
```
((264835, 10), (264835, 8), (72637, 3))
```

We only need chips

In [12]:
```
# regex to find chips and crisps and 'RRD' products in product name
chips_products = df[df['prod_name'].str.contains(r'\b(Chips?)\b|\b(Chps?)\b|\b(red)
```

Add a few necessary columns such as brand and weight

In [13]:
```
chips_products['brand'] = chips_products['prod_name'].str.split().str[0]
```

In [14]:
```
chips_products['weight'] = chips_products['prod_name'].str[-4:]
```

In [15]:
```
chips_products[['prod_qty', 'tot_sales']].describe()
```

Out[15]:

	prod_qty	tot_sales
count	101986.000000	101986.000000
mean	1.907154	6.738020
std	0.943519	3.733085
min	1.000000	1.700000
25%	2.000000	5.400000
50%	2.000000	6.600000
75%	2.000000	7.800000
max	200.000000	650.000000

I see an outlier in the data, let's take a closer look

In [16]:
```
chips_products[chips_products['prod_qty'] == 200]
```

Out[16]:

	date	store_nbr	lylty_card_nbr	txn_id	prod_nbr	prod_name	prod_qty	tot_sales
69762	2018-08-19	226	226000	226201	4	Dorito Corn Chp Supreme 380g	200	650.0
69763	2019-05-20	226	226000	226210	4	Dorito Corn Chp Supreme 380g	200	650.0

In [17]:
```
chips_products = chips_products[chips_products['lylty_card_nbr'] != 226000]
```

In [18]:
```
chips_products[['prod_qty', 'tot_sales']].describe()
```

Out[18]:

	prod_qty	tot_sales
count	101984.000000	101984.000000
mean	1.903269	6.725405
std	0.347382	2.412724
min	1.000000	1.700000
25%	2.000000	5.400000
50%	2.000000	6.600000
75%	2.000000	7.800000
max	5.000000	29.500000

In [19]:
```
chips_products.brand.unique()
```

Out[19]:
```
array(['Natural', 'Smiths', 'Doritos', 'Thins', 'Red', 'Dorito',
       'Tyrrells', 'Cobs', 'French', 'Pringles', 'RRD', 'WW', 'Snbts',
       'Sunbites'], dtype=object)
```

Many identical brands are recorded differently let's combine them

In [20]:
```
chips_products['brand'] = chips_products['brand'].replace('Dorito', 'Doritos')
```

In [21]:
```
chips_products['brand'] = chips_products['brand'].replace('Red', 'RRD')
```

In [22]:
```
chips_products['brand'] = chips_products['brand'].replace('Snbts', 'Sunbites')
```

In [23]:
```
chips_products['weight'].unique()
```

Out[23]:
```
array(['175g', '170g', '330g', '150g', '150G', '380g', '165g', '110g',
       '134g', '200g', '160g', ' 90g'], dtype=object)
```

In [24]:
```
chips_products['weight'] = chips_products['weight'].replace('150G', '150g')
```

In [25]:
```
chips_products.head()
```

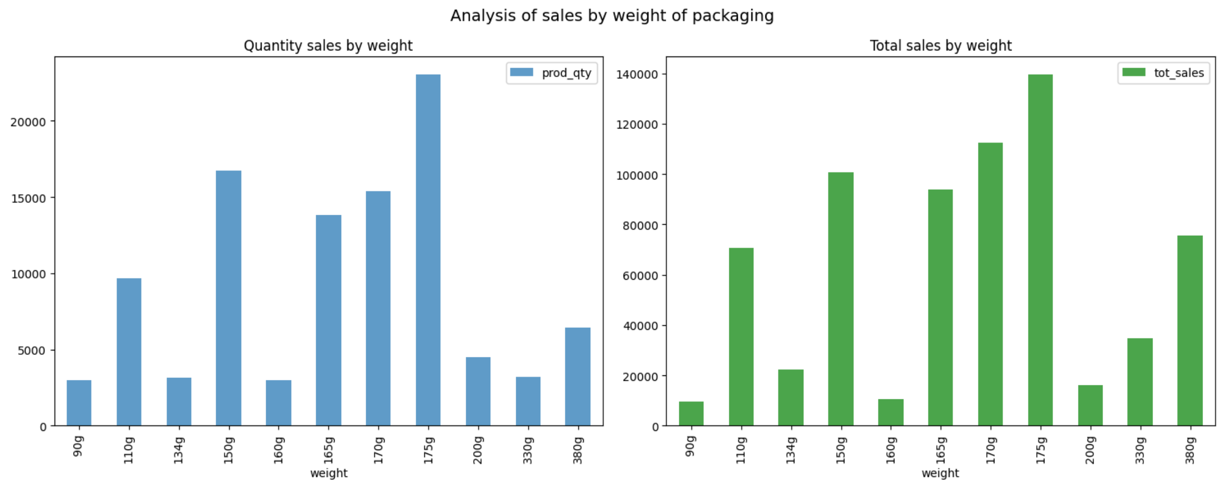
Out[25]:

	date	store_nbr	lylty_card_nbr	txn_id	prod_nbr	prod_name	prod_qty	tot_sales
0	2018-10-17	1	1000	1	5	Natural Chip Compny SeaSalt175g	2	6.0
2	2019-05-20	1	1343	383	61	Smiths Crinkle Cut Chips Chicken 170g	2	2.9
3	2018-08-17	2	2373	974	69	Smiths Chip Thinly S/Cream&Onion 175g	5	15.0
6	2019-05-16	4	4149	3333	16	Smiths Crinkle Chips Salt & Vinegar 330g	1	5.7
8	2018-08-20	5	5026	4525	42	Doritos Corn Chip Mexican Jalapeno 150g	1	3.9

What volume of packaging is sold more?

In [26]:

```
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(15, 6))


chips_products.groupby(['weight']).agg({'prod_qty':'count'}).sort_index().plot(
    kind='bar',
    alpha=0.7,
    ax=ax1
)
ax1.set_title('Quantity sales by weight')


chips_products.groupby(['weight']).agg({'tot_sales':'sum'}).sort_index().plot(
    kind='bar',
    color='green',
    alpha=0.7,
    ax=ax2
)
ax2.set_title('Total sales by weight')


plt.suptitle('Analysis of sales by weight of packaging', fontsize=14)
plt.tight_layout()
plt.show()
```



How many brands produce their products in each weight?

In [27]:
```
chips_products.groupby('weight').agg({'brand': 'nunique'}).sort_values('brand', asc
```

Out[27]:

weight	brand
175g	4
150g	2
170g	2
380g	2
165g	2
90g	1
110g	1
134g	1
160g	1
200g	1
330g	1

In [28]:
```
chips_products.groupby('weight')['brand'].unique()
```

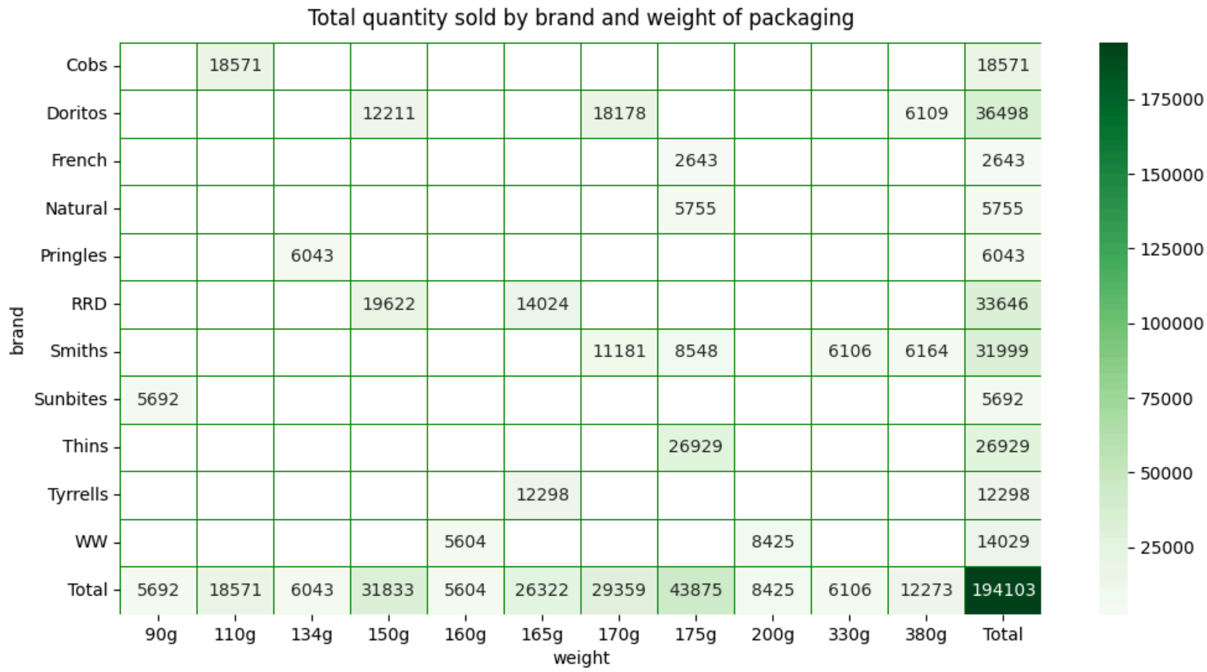
Out[28]:
```
weight
 90g                          [Sunbites]
110g                              [Cobs]
134g                          [Pringles]
150g                      [Doritos, RRD]
160g                                [WW]
165g                     [Tyrrells, RRD]
170g                   [Smiths, Doritos]
175g     [Natural, Smiths, Thins, French]
200g                                [WW]
330g                            [Smiths]
380g                   [Doritos, Smiths]
Name: brand, dtype: object
```

In [29]:
```python
chips_products.groupby('weight')['prod_qty'].agg(['mean', 'sum']).sort_values('sum'
```

Out[29]:

weight	mean	sum
175g	1.902645	43875
150g	1.900705	31833
170g	1.904821	29359
165g	1.900643	26322
110g	1.915919	18571
380g	1.912874	12273
200g	1.883523	8425
330g	1.909916	6106
134g	1.914159	6043
90g	1.892287	5692
160g	1.886869	5604

In [30]:
```python
pivot_brand_weight = chips_products.pivot_table(
    index='brand',
    columns='weight',
    values='prod_qty',
    aggfunc='sum',
    margins=True,
    margins_name='Total'
)
plt.figure(figsize=(12, 6))
plt.title('Total quantity sold by brand and weight of packaging',pad=10)

sns.heatmap(pivot_brand_weight, annot=True, fmt='.0f', cmap='Greens', linewidths=0.
```



Let's make a column with a weight category.

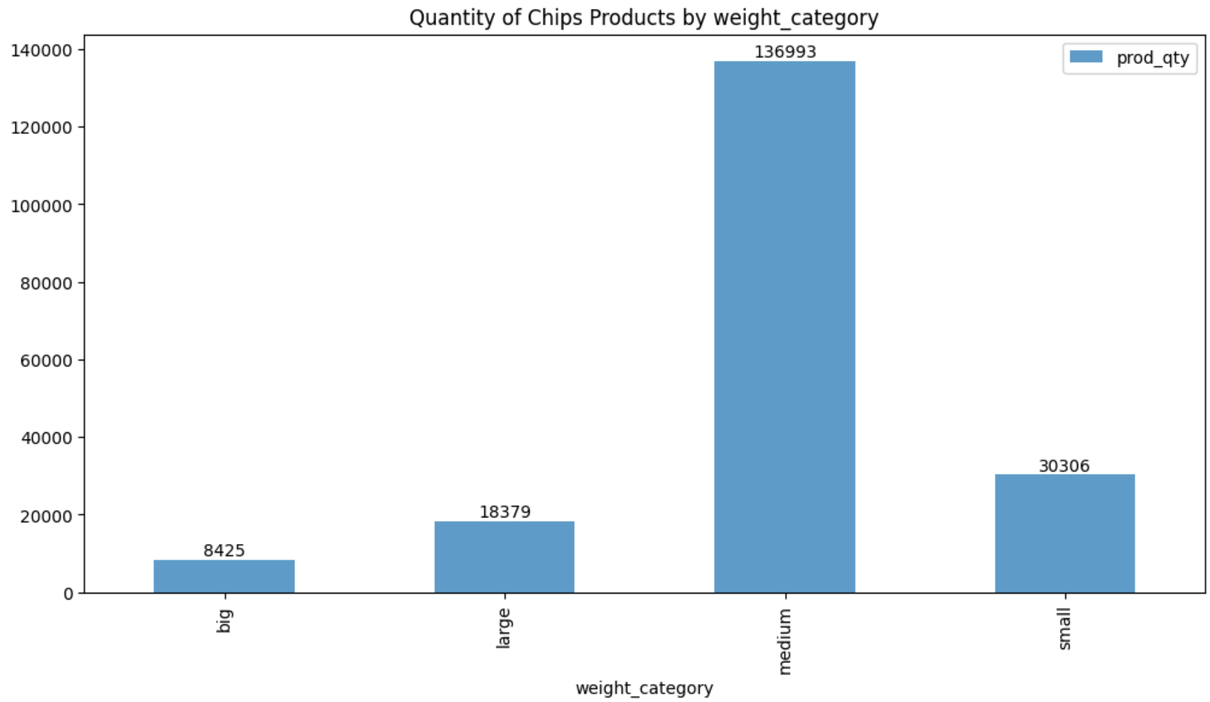
In [31]:
```
conditions = [
    chips_products['weight'].isin([' 90g', '110g', '134g']),
    chips_products['weight'].isin(['150g', '160g', '165g', '175g', '170g']),
    chips_products['weight'].isin(['200g']),
    chips_products['weight'].isin(['330g', '380g'])
]

choices = ['small', 'medium', 'big', 'large']


chips_products['weight_category'] = np.select(conditions, choices, default='unknown


chips_products.groupby('weight_category')['weight'].unique()
```

Out[31]:
```
weight_category
big                                [200g]
large                        [330g, 380g]
medium    [175g, 170g, 150g, 165g, 160g]
small                  [110g, 134g,  90g]
Name: weight, dtype: object
```

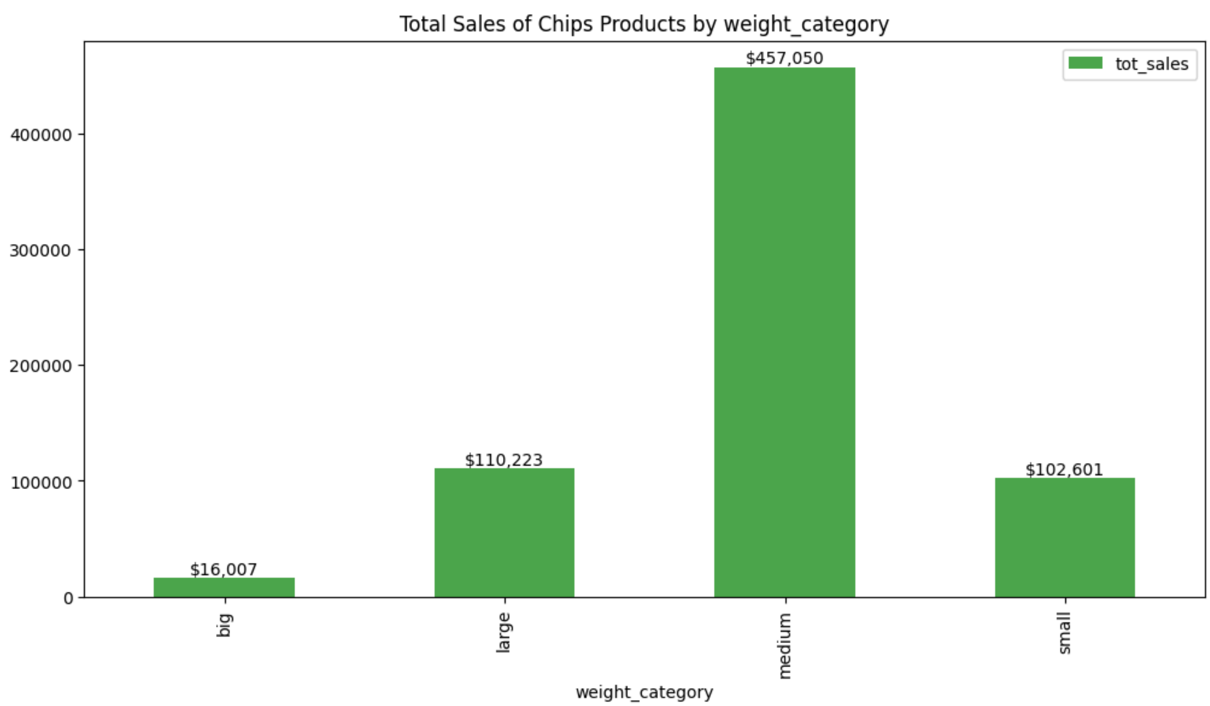
In [32]:
```
plt.figure(figsize=(12, 6))
ax = chips_products.groupby(['weight_category']).agg({'prod_qty':'sum'}).sort_index
plt.title('Quantity of Chips Products by weight_category')

# Add values over columns
for i, v in enumerate(chips_products.groupby(['weight_category']).agg({'prod_qty':'
    ax.text(i, v, str(int(v)), ha='center', va='bottom')

plt.show()
```

```python
plt.figure(figsize=(12, 6))
ax = chips_products.groupby(['weight_category']).agg({'tot_sales':'sum'}).sort_inde
plt.title('Total Sales of Chips Products by weight_category')

# Add values over columns
for i, v in enumerate(chips_products.groupby(['weight_category']).agg({'tot_sales':
    ax.text(i, v, f'${int(v):,}', ha='center', va='bottom')

plt.show()
```

```
<Figure size 1200x600 with 0 Axes>
```




```
<Figure size 1200x600 with 0 Axes>
```



In [33]:
```python
chips_products.groupby('weight_category').agg({'brand': 'nunique'}).sort_values('br
```

Out[33]:

	brand
weight_category	
medium	8
small	3
large	2
big	1

In [34]:
```
pivot_brand_weight_qty= chips_products.pivot_table(
    index='brand',
    columns='weight',
    values='prod_qty',
    aggfunc='sum'
)
perc_pivot_brand_weight_qty = pivot_brand_weight_qty.div(pivot_brand_weight_qty.sum
perc_pivot_brand_weight_qty.sum(axis=0).sort_values(ascending=False)
```

Out[34]:
```
weight
175g    22.603978
150g    16.400056
170g    15.125475
165g    13.560841
110g     9.567601
380g     6.322932
200g     4.340479
330g     3.145753
134g     3.113296
 90g     2.932464
160g     2.887127
dtype: float64
```

In [35]:
```
pivot_brand_weight_sale= chips_products.pivot_table(
    index='brand',
    columns='weight',
    values='tot_sales',
    aggfunc='sum'
)
perc_pivot_brand_weight_sale = pivot_brand_weight_sale.div(pivot_brand_weight_sale.
perc_pivot_brand_weight_sale.sum(axis=0).sort_values(ascending=False)
```

Out[35]:
```
weight
175g    20.366499
170g    16.387093
150g    14.666758
165g    13.664037
380g    10.995975
110g    10.288887
330g     5.074359
134g     3.259357
200g     2.333850
160g     1.552391
 90g     1.410793
dtype: float64
```

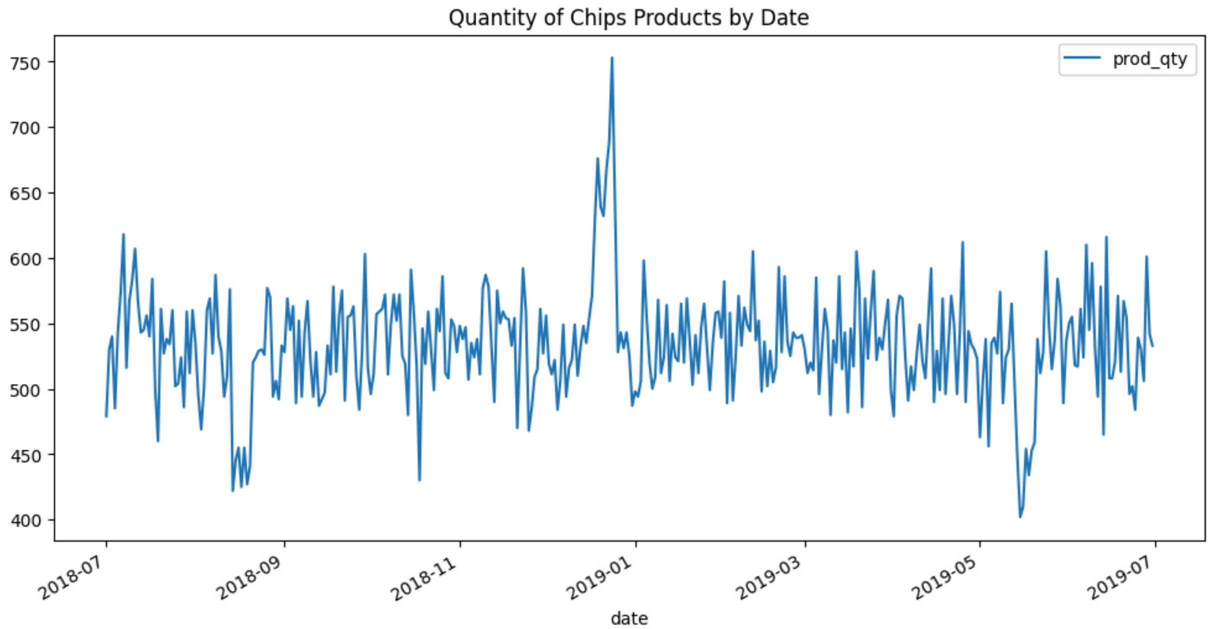
Let's look at the dynamics of sales over time.

In [36]:
```python
# Create a full range of dates
full_date_range = pd.date_range(start=chips_products['date'].min(),
                               end=chips_products['date'].max(),
                               freq='D')

# find missing dates
missing_dates = full_date_range[~full_date_range.isin(chips_products['date'])]

print(f"Number of missing dates: {len(missing_dates)}")
if len(missing_dates) > 0:
    print("\nMissing dates:")
    print(missing_dates)
```

```
Number of missing dates: 1

Missing dates:
DatetimeIndex(['2018-12-25'], dtype='datetime64[ns]', freq='D')
```

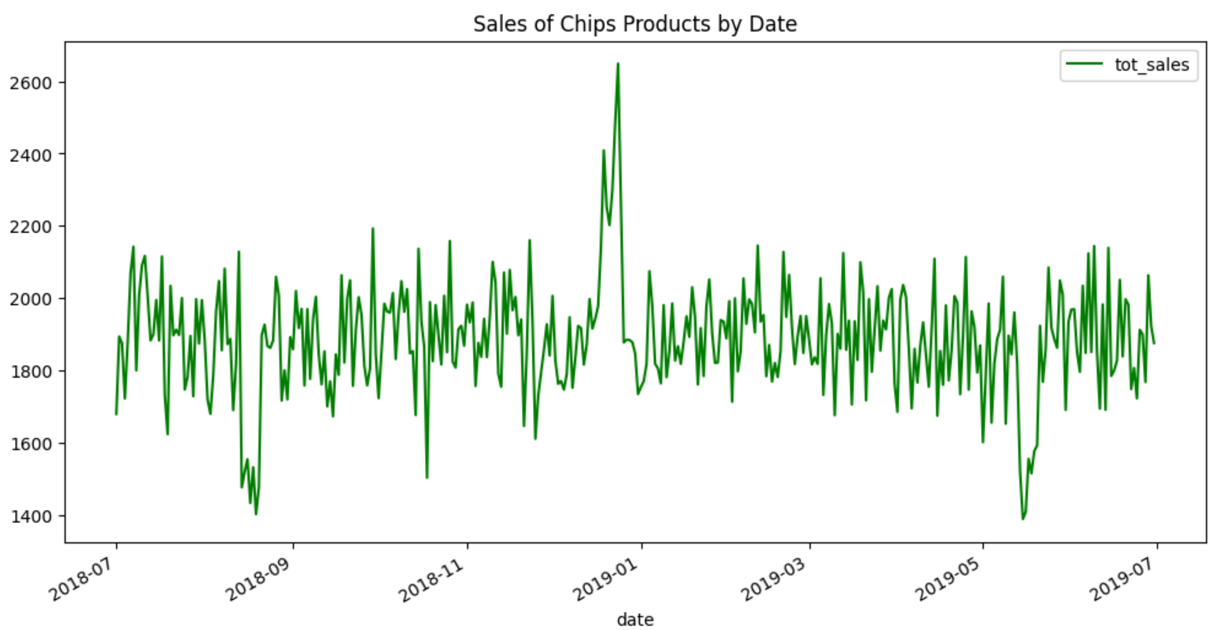
In [37]:
```python
chips_products.groupby(['date']).agg({'prod_qty':'sum'}).sort_index().plot(figsize=
```

Out[37]:
```
<Axes: title={'center': 'Quantity of Chips Products by Date'}, xlabel='date'>
```



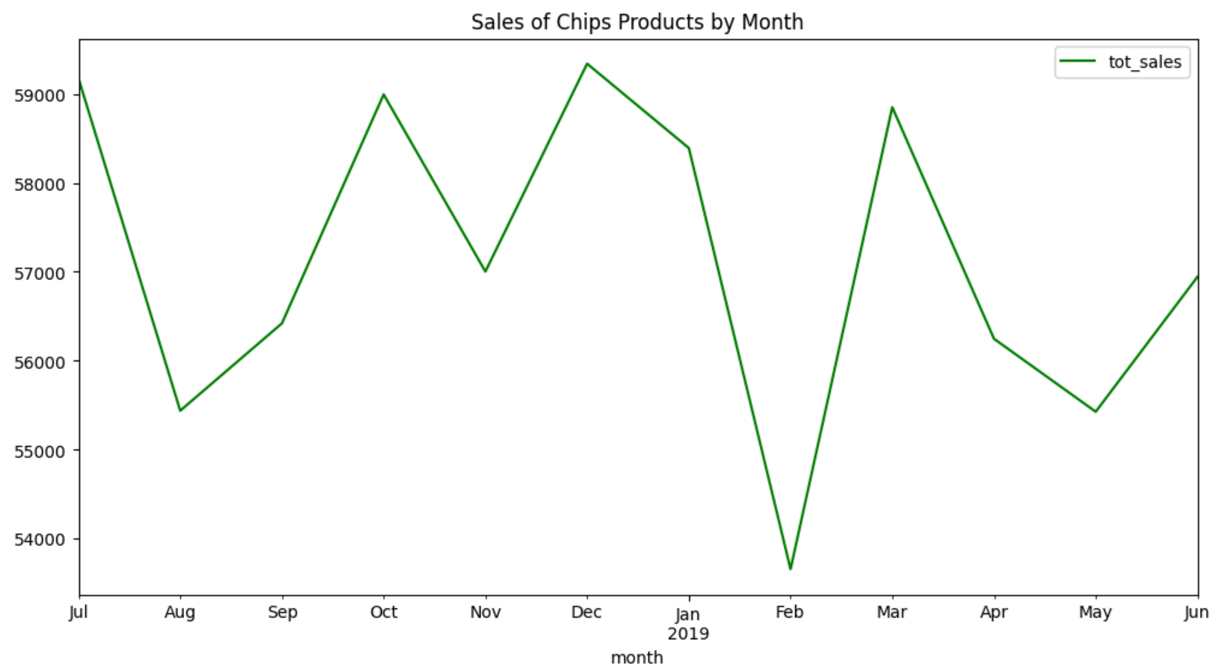
In [38]:
```
chips_products.groupby(['date']).agg({'tot_sales':'sum'}).sort_index().plot(figsize
```

Out[38]:
```
<Axes: title={'center': 'Sales of Chips Products by Date'}, xlabel='date'>
```



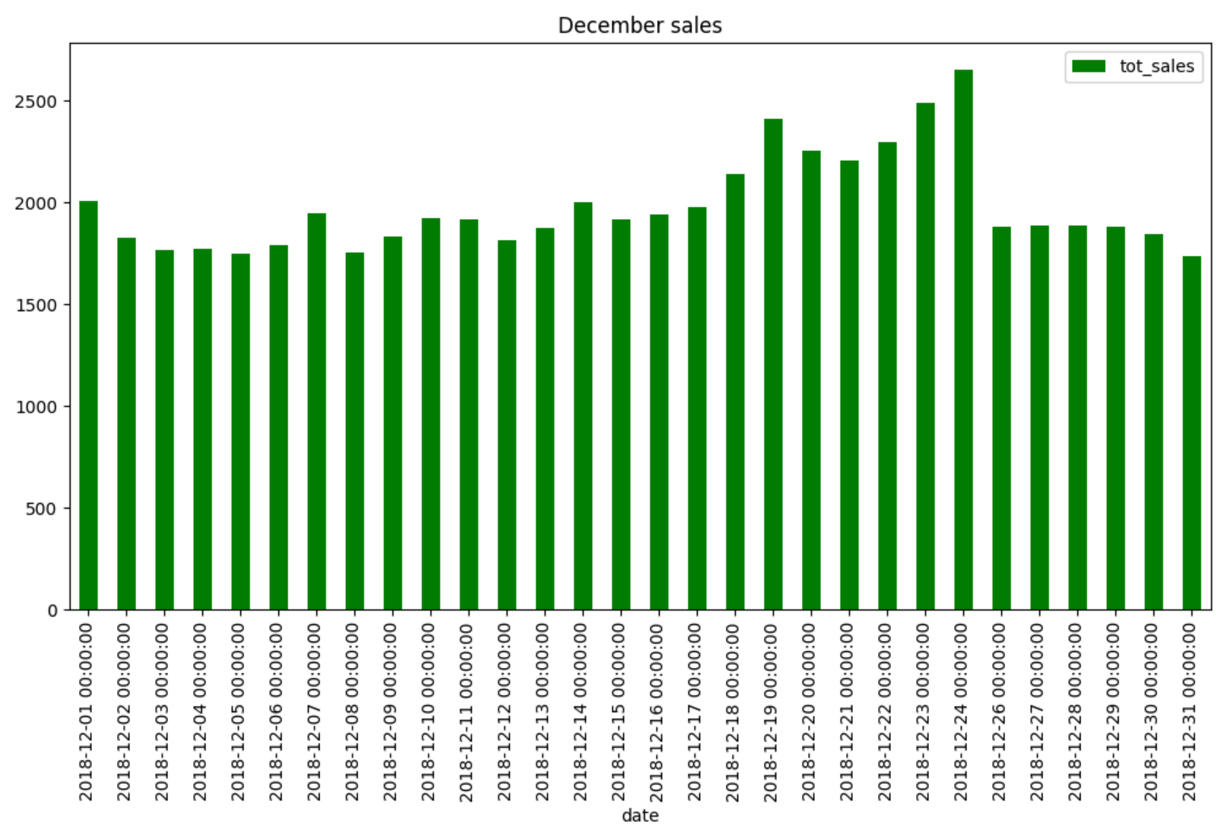
In [39]:
```
chips_products['month'] = chips_products['date'].dt.to_period('M')
```

In [40]:
```
chips_products.groupby(['month']).agg({'tot_sales':'sum'}).sort_index().plot(figsiz
```



In [41]:
```
december_sales = chips_products[chips_products['month'] == '2018-12'].groupby(['dat
december_sales.plot(figsize=(12, 6), kind='bar', x='date', y='tot_sales', color='gr
```

Out[41]: <Axes: title={'center': 'December sales'}, xlabel='date'>



We have a gap in the data for 2018-12-25 and then a suspicious decline in sales from the 26th.

In [42]:
```
december_sales.groupby(['date']).agg({'tot_sales':'sum'}).sort_index()
```

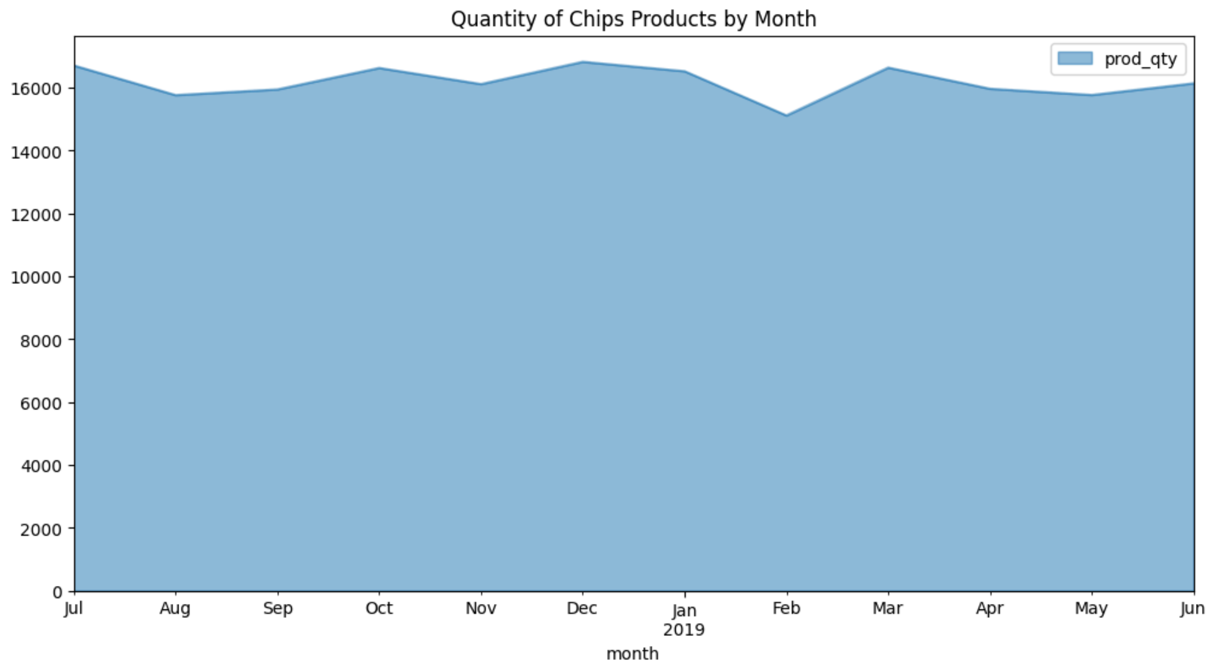
Out[42]:

date	tot_sales
2018-12-01	2006.3
2018-12-02	1827.2
2018-12-03	1762.8
2018-12-04	1770.6
2018-12-05	1746.7
2018-12-06	1789.8
2018-12-07	1947.3
2018-12-08	1751.9
2018-12-09	1833.9
2018-12-10	1923.2
2018-12-11	1916.9
2018-12-12	1816.1
2018-12-13	1871.0
2018-12-14	1997.4
2018-12-15	1915.6
2018-12-16	1942.8
2018-12-17	1977.9
2018-12-18	2140.6
2018-12-19	2409.0
2018-12-20	2252.6
2018-12-21	2202.0
2018-12-22	2298.1
2018-12-23	2487.1
2018-12-24	2649.0
2018-12-26	1877.2
2018-12-27	1884.8
2018-12-28	1884.0
2018-12-29	1877.9
2018-12-30	1846.5

	tot_sales
date	
2018-12-31	1734.4

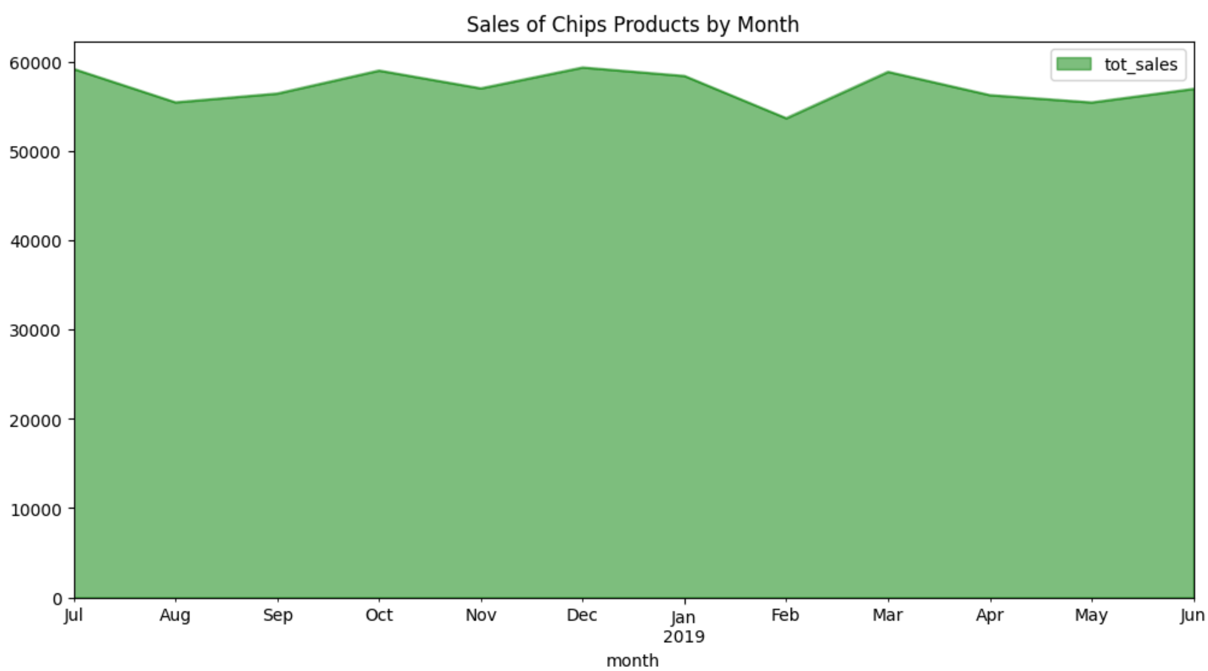
In [43]:
```
chips_products.groupby(['month']).agg({'prod_qty':'sum'}).sort_index().plot(figsize
```

Out[43]: <Axes: title={'center': 'Quantity of Chips Products by Month'}, xlabel='month'>



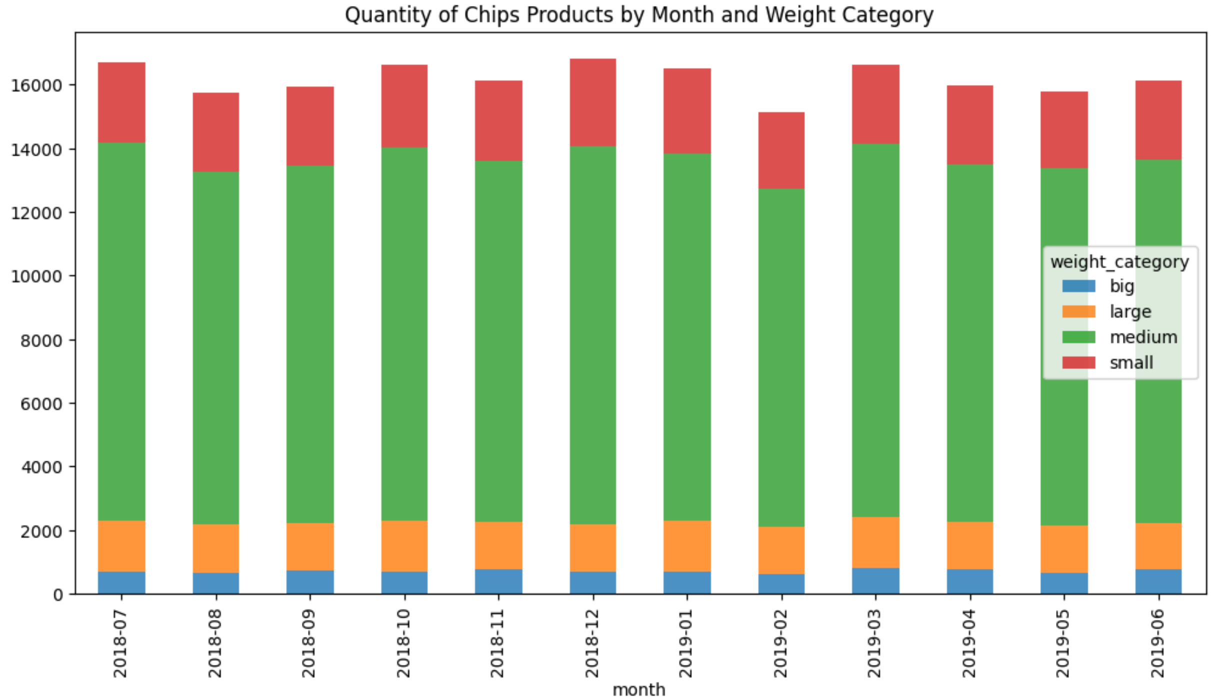
In [44]:
```
chips_products.groupby(['month']).agg({'tot_sales':'sum'}).sort_index().plot(figsiz
```

Out[44]: <Axes: title={'center': 'Sales of Chips Products by Month'}, xlabel='month'>



In [45]:
```python
chips_products.pivot_table(index='month', columns='weight_category', values='prod_q
    .plot(figsize=(12, 6), kind='bar', stacked=True, alpha=0.8, title='Quantity of
```

Out[45]:
```
<Axes: title={'center': 'Quantity of Chips Products by Month and Weight Categor
y'}, xlabel='month'>
```



Let's see how each brand is sold.

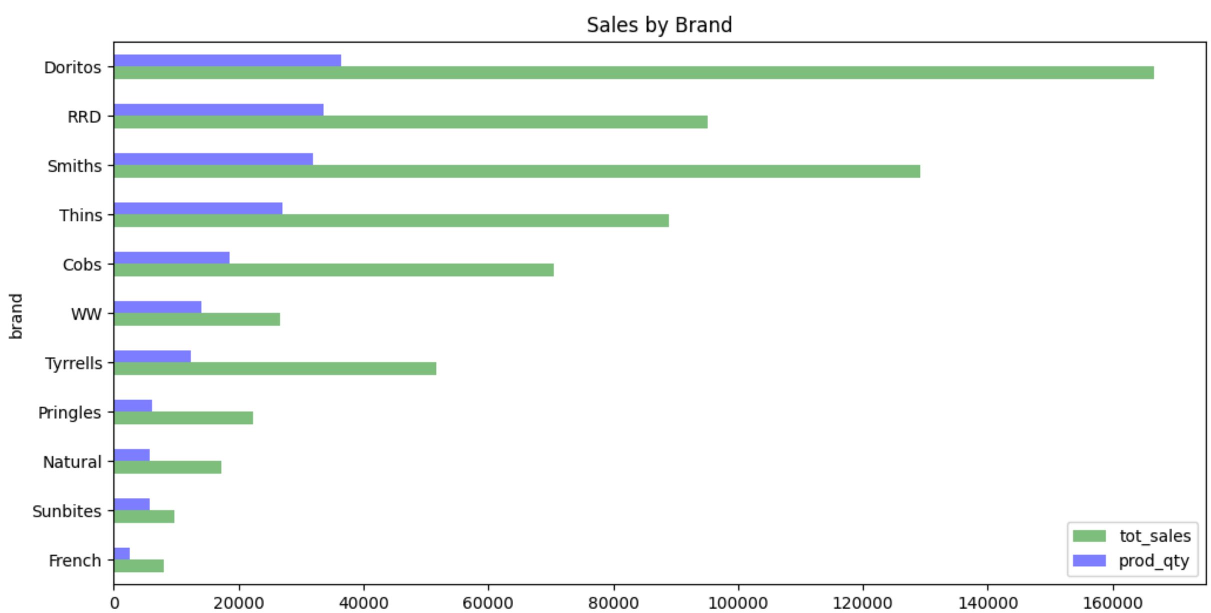
In [46]:
```python
chips_products.groupby(['brand']).agg({'tot_sales':['sum','mean'], 'prod_qty':['sum
    .sort_values(by=('tot_sales', 'sum'), ascending=False)
```

Out[46]:

	tot_sales		prod_qty	
	sum	mean	sum	mean
brand				
Doritos	166649.3	8.744781	36498	1.915202
Smiths	129237.8	7.659898	31999	1.896574
RRD	95046.0	5.345970	33646	1.892457
Thins	88852.5	6.312789	26929	1.913250
Cobs	70569.8	7.280491	18571	1.915919
Tyrrells	51647.4	8.017293	12298	1.909034
WW	26655.1	3.581231	14029	1.884858
Pringles	22355.4	7.081216	6043	1.914159
Natural	17265.0	5.679276	5755	1.893092
Sunbites	9676.4	3.216888	5692	1.892287
French	7929.0	5.591678	2643	1.863893

In [47]:
```
chips_products.groupby(['brand']).agg({'tot_sales':'sum', 'prod_qty':'sum'})\
    .sort_values(by='prod_qty')\
    .plot(figsize=(12, 6),kind='barh',alpha=0.5, color=[ 'green', 'blue'], title='S
```

Out[47]:
```
<Axes: title={'center': 'Sales by Brand'}, ylabel='brand'>
```



Who is buying more chips?

In [48]:
```
# sales by lifestage category
chips_products.groupby(['lifestage']).agg(
```

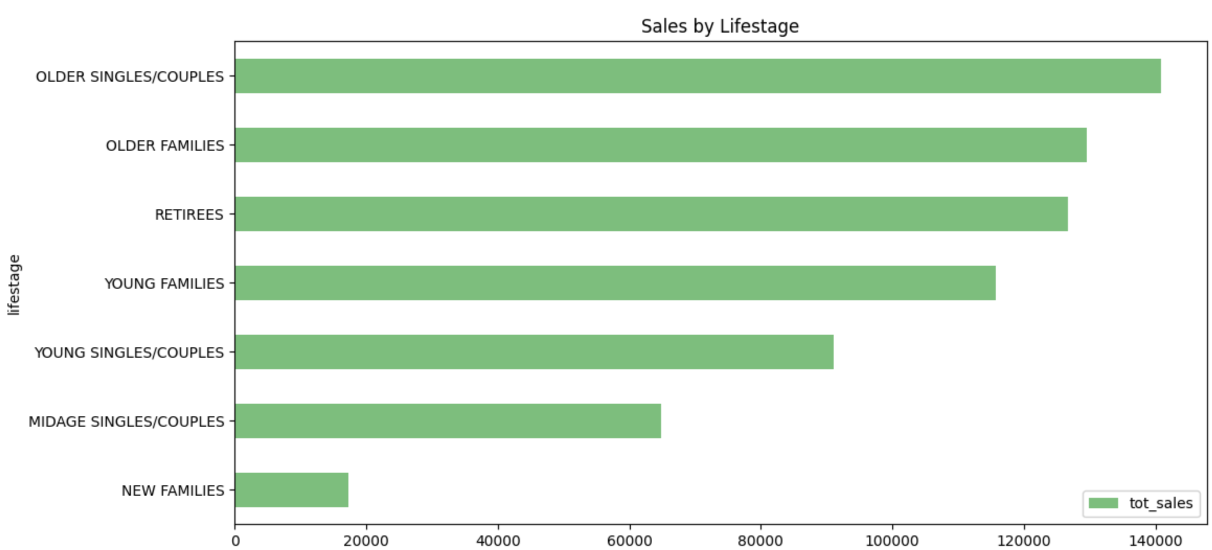
```
    total_sales=('tot_sales', 'sum'),
    average_sales =('tot_sales','mean'),
    total_qty=('prod_qty', 'sum'),
    average_qty=('prod_qty', 'mean'),
    count_sales=('tot_sales', 'count')).sort_values(by='count_sales', ascending=Fal
```

Out[48]:

lifestage	total_sales	average_sales	total_qty	average_qty	count_sales
OLDER SINGLES/COUPLES	140775.55	6.815898	39481	1.911543	20654
OLDER FAMILIES	129463.70	6.694436	37657	1.947205	19339
RETIREES	126699.10	6.772094	35295	1.886525	18709
YOUNG FAMILIES	115676.20	6.695774	33543	1.941595	17276
YOUNG SINGLES/COUPLES	91033.50	6.588514	25158	1.820800	13817
MIDAGE SINGLES/COUPLES	64854.00	6.759145	18176	1.894320	9595
NEW FAMILIES	17381.65	6.700713	4793	1.847726	2594

In [49]:
```
chips_products.groupby(['lifestage']).agg({'tot_sales':'sum'})\
    .sort_values(by='tot_sales')\
    .plot(figsize=(12, 6),kind='barh',alpha=0.5, color='green', title='Sales by Lif
```

Out[49]: <Axes: title={'center': 'Sales by Lifestage'}, ylabel='lifestage'>



In [50]:
```
unique_clients_by_lifestage = chips_products.groupby(['lifestage']).agg(
    cnt_clients= ('lylty_card_nbr', 'nunique'),
    total_sales= ('tot_sales', 'sum'),
    mean_sales= ('tot_sales', 'mean'),
    count_sales= ('tot_sales', 'count')).reset_index()

unique_clients_by_lifestage['count_by_clients'] = unique_clients_by_lifestage['coun
```

```
unique_clients_by_lifestage['sum_by_clients'] = unique_clients_by_lifestage['total_
unique_clients_by_lifestage
```

Out[50]:

	lifestage	cnt_clients	total_sales	mean_sales	count_sales	count_by_clients	sun
0	MIDAGE SINGLES/COUPLES	4977	64854.00	6.759145	9595	1.927868	
1	NEW FAMILIES	1642	17381.65	6.700713	2594	1.579781	
2	OLDER FAMILIES	7473	129463.70	6.694436	19339	2.587850	
3	OLDER SINGLES/COUPLES	10538	140775.55	6.815898	20654	1.959954	
4	RETIREES	10259	126699.10	6.772094	18709	1.823667	
5	YOUNG FAMILIES	6963	115676.20	6.695774	17276	2.481114	
6	YOUNG SINGLES/COUPLES	8718	91033.50	6.588514	13817	1.584882	

In [51]:
```
pivot_brand_weight = chips_products.pivot_table(
    index='lifestage',
    columns='weight',
    values='tot_sales',
    aggfunc='sum'

)
plt.figure(figsize=(12, 6))
plt.title('Total quantity sold by brand and weight of packaging',pad=10)

sns.heatmap(pivot_brand_weight, annot=True, fmt='.0f', cmap='Greens', linewidths=0.
```

In [52]:
```
customers_df = chips_products.groupby(['premium_customer']).agg({'lylty_card_nbr':'
customers_df['sum_by_clients'] = customers_df['tot_sales'] / customers_df['lylty_ca
```

```
customers_df
```

Out[52]:

	premium_customer	lylty_card_nbr	tot_sales	sum_by_clients
0	Budget	17451	241698.65	13.850132
1	Mainstream	19836	264108.80	13.314620
2	Premium	13283	180076.25	13.556896

In [53]:

```
# sales by customer status
chips_products.groupby(['premium_customer']).agg(
    total_sales=('tot_sales', 'sum'),
    average_sales =('tot_sales','mean'),
    total_qty=('prod_qty', 'sum'),
    average_qty=('prod_qty', 'mean'),
    count_sales=('tot_sales', 'count')).sort_values(by='count_sales', ascending=Fal
```

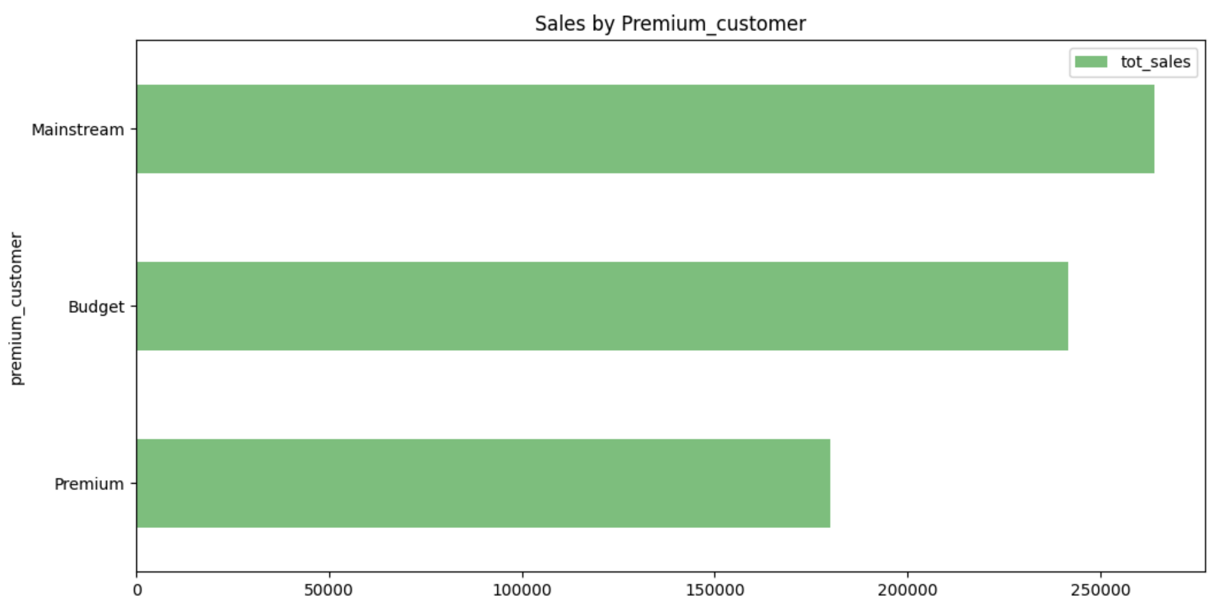
Out[53]:

premium_customer	total_sales	average_sales	total_qty	average_qty	count_sales
Mainstream	264108.80	6.806051	73774	1.901147	38805
Budget	241698.65	6.671782	69023	1.905292	36227
Premium	180076.25	6.681369	51306	1.903606	26952

In [54]:

```
chips_products.groupby(['premium_customer']).agg({'tot_sales':'sum'})\
    .sort_values(by='tot_sales')\
    .plot(figsize=(12, 6),kind='barh',alpha=0.5, color='green', title='Sales by Pre
```

Out[54]: `<Axes: title={'center': 'Sales by Premium_customer'}, ylabel='premium_customer'>`



In [55]:

```
# sales by brand
chips_products.groupby(['brand']).agg(
    total_sales=('tot_sales', 'sum'),
```

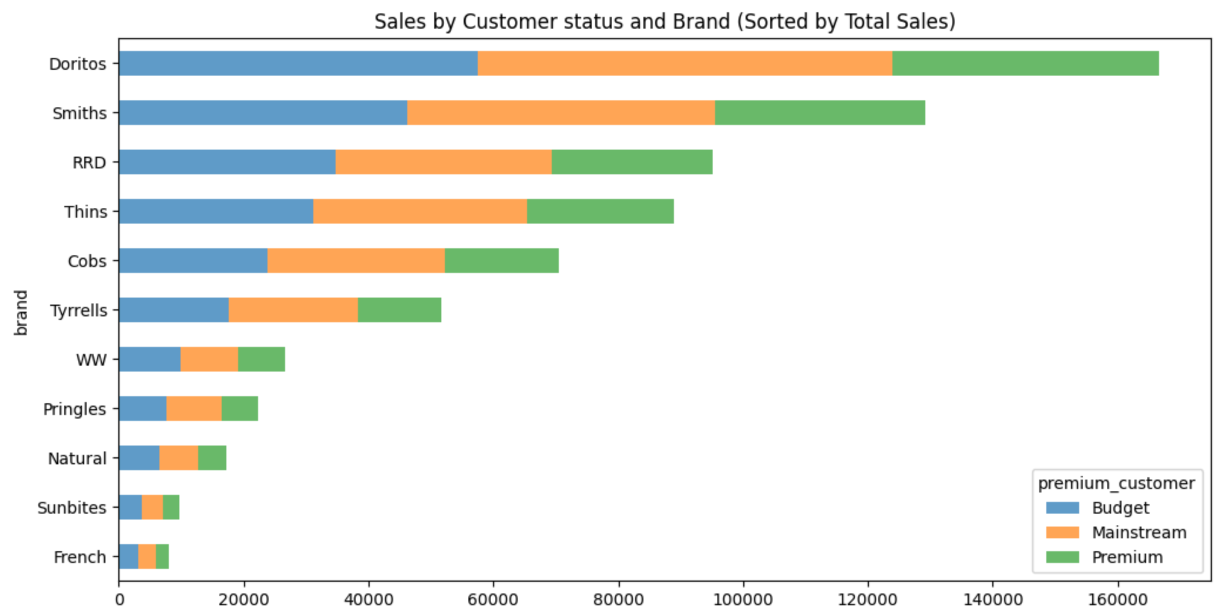
```
    average_sales =('tot_sales','mean'),
    total_qty=('prod_qty', 'sum'),
    average_qty=('prod_qty', 'mean'),
    count_sales = ('tot_sales', 'count')).sort_values(by='count_sales', ascending=F
```

Out[55]:

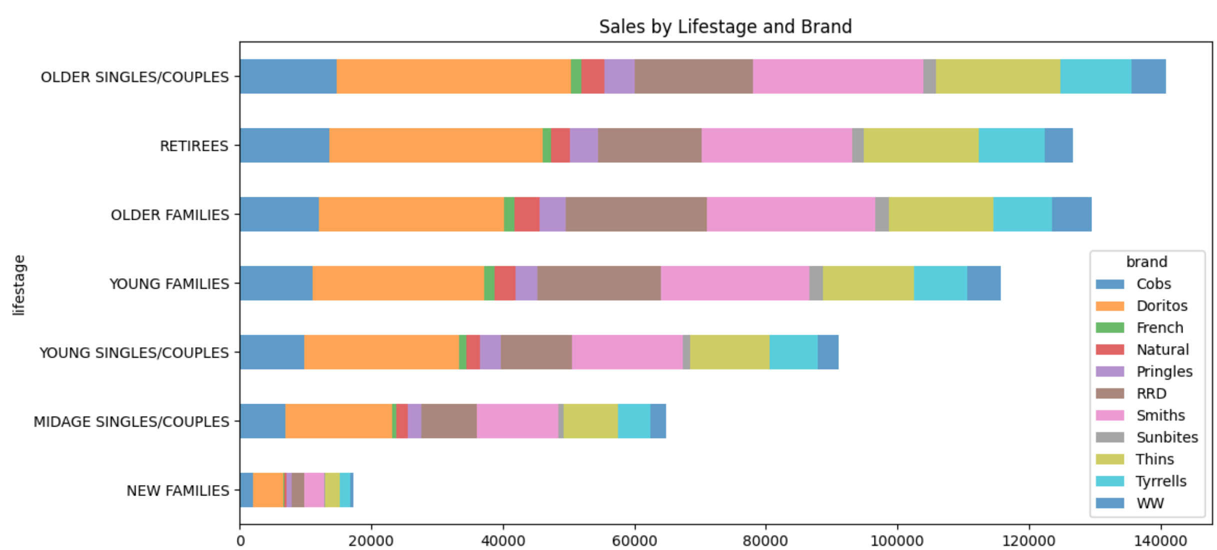
brand	total_sales	average_sales	total_qty	average_qty	count_sales
Doritos	166649.3	8.744781	36498	1.915202	19057
RRD	95046.0	5.345970	33646	1.892457	17779
Smiths	129237.8	7.659898	31999	1.896574	16872
Thins	88852.5	6.312789	26929	1.913250	14075
Cobs	70569.8	7.280491	18571	1.915919	9693
WW	26655.1	3.581231	14029	1.884858	7443
Tyrrells	51647.4	8.017293	12298	1.909034	6442
Pringles	22355.4	7.081216	6043	1.914159	3157
Natural	17265.0	5.679276	5755	1.893092	3040
Sunbites	9676.4	3.216888	5692	1.892287	3008
French	7929.0	5.591678	2643	1.863893	1418

In [56]:

```
pivot_brand_customer = chips_products.pivot_table(
    index='brand',
    columns='premium_customer',
    values='tot_sales',
    aggfunc='sum'
)

# Sort by premium_customer
pivot_sorted = pivot_brand_customer.sort_values(by=pivot_brand_customer.columns.tol
                               ascending=True,
                               axis=0)         # sort by index (rows)


pivot_sorted.plot(
    figsize=(12, 6),
    kind='barh',
    stacked=True,
    alpha=0.7,
    title='Sales by Customer status and Brand (Sorted by Total Sales)'
)
plt.show()
```



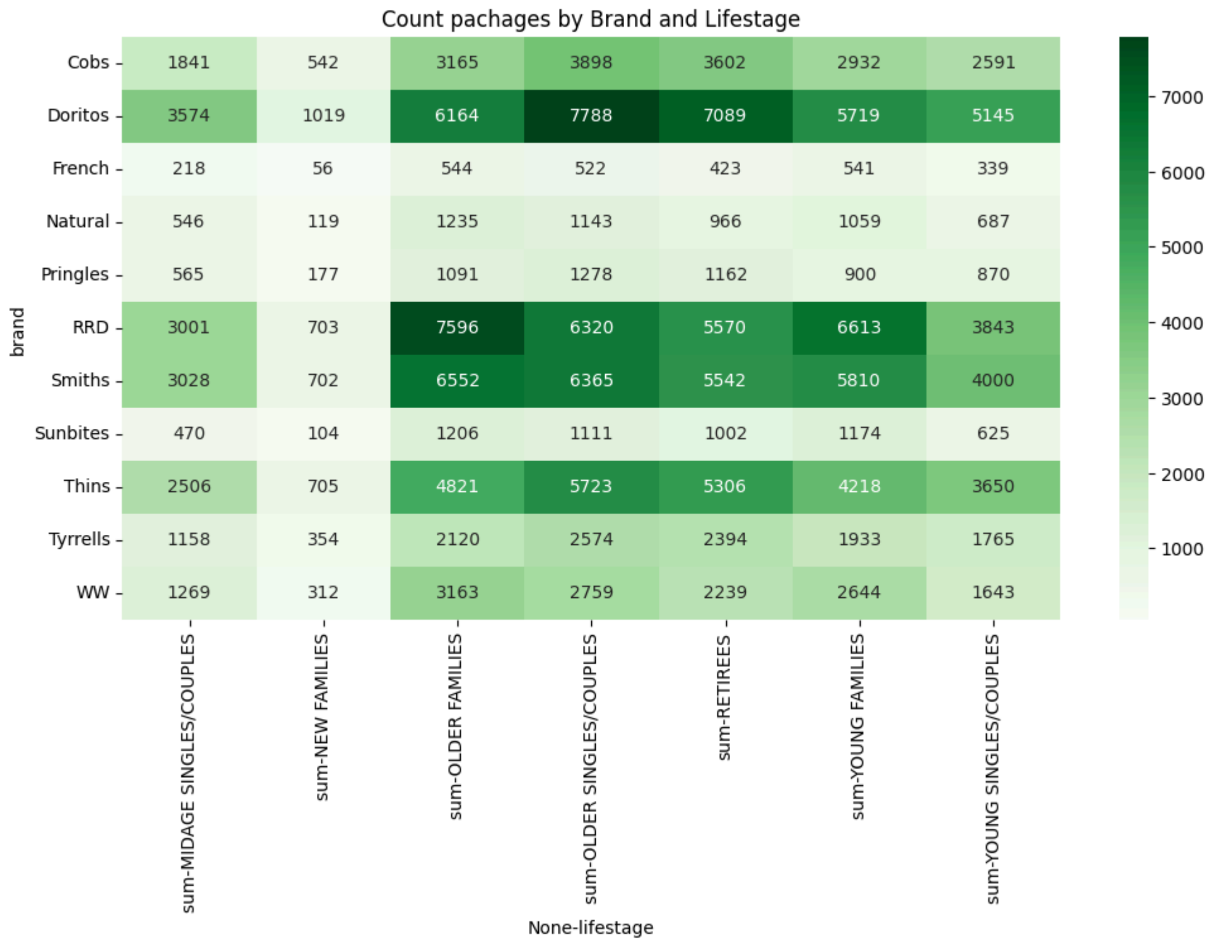
In [57]:
```
pivot_lifestage_brand = chips_products.pivot_table(index='lifestage', columns='bran

pivot_2_sorted = pivot_lifestage_brand.sort_values(by=pivot_lifestage_brand.columns
                                                   ascending=True,
                                                   axis=0)

pivot_2_sorted.plot(
    figsize=(12, 6),
    kind='barh',
    stacked=True,
    alpha=0.7,
    title='Sales by Lifestage and Brand'
)
plt.show()
```



In [58]:
```
pivot_brands_lifestage_qty = chips_products.pivot_table(
    index='brand',
    columns='lifestage',
    values='prod_qty',
```

```
    aggfunc={'sum'}
)
```

In [59]:
```
plt.figure(figsize=(12, 6))
sns.heatmap(pivot_brands_lifestage_qty, annot=True, fmt='.0f', cmap='Greens', cbar=
plt.title('Count pachages by Brand and Lifestage');
```



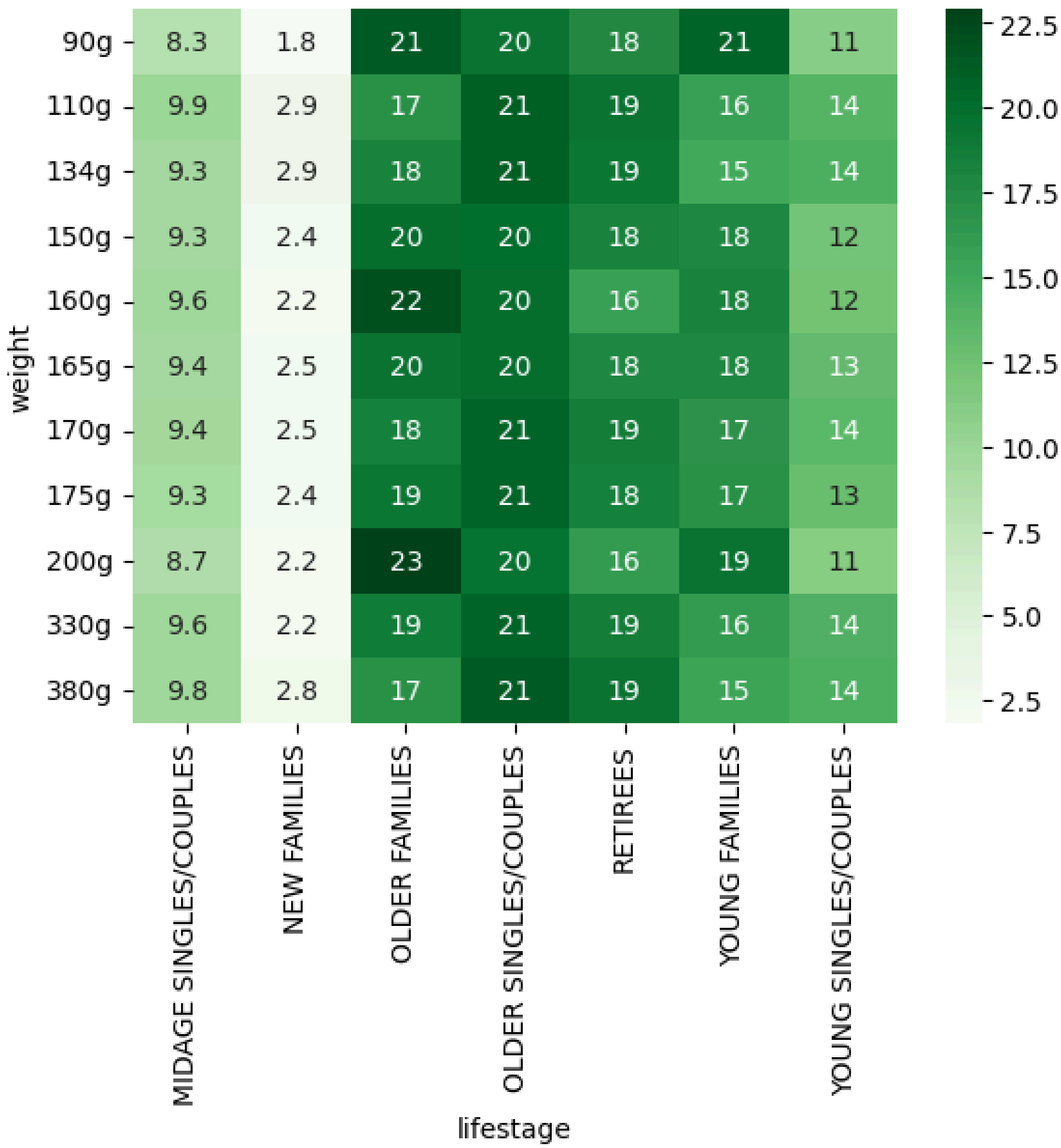
brand	sum-MIDAGE SINGLES/COUPLES	sum-NEW FAMILIES	sum-OLDER FAMILIES	sum-OLDER SINGLES/COUPLES	sum-RETIREES	sum-YOUNG FAMILIES	sum-YOUNG SINGLES/COUPLES
Cobs	1841	542	3165	3898	3602	2932	2591
Doritos	3574	1019	6164	7788	7089	5719	5145
French	218	56	544	522	423	541	339
Natural	546	119	1235	1143	966	1059	687
Pringles	565	177	1091	1278	1162	900	870
RRD	3001	703	7596	6320	5570	6613	3843
Smiths	3028	702	6552	6365	5542	5810	4000
Sunbites	470	104	1206	1111	1002	1174	625
Thins	2506	705	4821	5723	5306	4218	3650
Tyrrells	1158	354	2120	2574	2394	1933	1765
WW	1269	312	3163	2759	2239	2644	1643

In [60]:
```
pivot = chips_products.pivot_table(
    index='brand',
    columns='premium_customer',
    values='tot_sales',
    aggfunc='sum',

)

pivot_2 = chips_products.pivot_table(
    index='brand',
    columns='lifestage',
    values='tot_sales',
    aggfunc='sum',

)

pivot_3 = chips_products.pivot_table(
    index='weight',
    columns='lifestage',
    values='tot_sales',
```

```
    aggfunc='sum',

)

percentage_total = pivot.div(pivot.sum().sum()) * 100
percentage_by_column = pivot.apply(lambda x: x/x.sum() * 100)
percentage_by_row = pivot.apply(lambda x: x/x.sum() * 100, axis=1)

percentage_total = percentage_total.round(2)
percentage_by_column = percentage_by_column.round(2)
percentage_by_row = percentage_by_row.round(2)


percentage_total_2 = pivot_2.div(pivot_2.sum().sum()) * 100
percentage_by_column_2 = pivot_2.apply(lambda x: x/x.sum() * 100)
percentage_by_row_2 = pivot_2.apply(lambda x: x/x.sum() * 100, axis=1)

percentage_total_2 = percentage_total_2.round(2)
percentage_by_column_2 = percentage_by_column_2.round(2)
percentage_by_row_2 = percentage_by_row_2.round(2)

percentage_total_3 = pivot_3.div(pivot_3.sum().sum()) * 100
percentage_by_column_3 = pivot_3.apply(lambda x: x/x.sum() * 100)
percentage_by_row_3 = pivot_3.apply(lambda x: x/x.sum() * 100, axis=1)

percentage_total_3 = percentage_total_3.round(2)
percentage_by_column_3 = percentage_by_column_3.round(2)
percentage_by_row_3 = percentage_by_row_3.round(2)
```

In [61]:
```
sns.heatmap(percentage_by_row_3, annot=True, cmap='Greens')
```

Out[61]: <Axes: xlabel='lifestage', ylabel='weight'>



In [62]:
```
percentage_total.sum(axis=1).sort_values(ascending=False)
```

Out[62]:
```
brand
Doritos      24.30
Smiths       18.85
RRD          13.86
Thins        12.95
Cobs         10.30
Tyrrells      7.53
WW            3.88
Pringles      3.26
Natural       2.51
Sunbites      1.41
French        1.15
dtype: float64
```

In [63]:
```
percentage_total.sum(axis=0).sort_values(ascending=False)
```

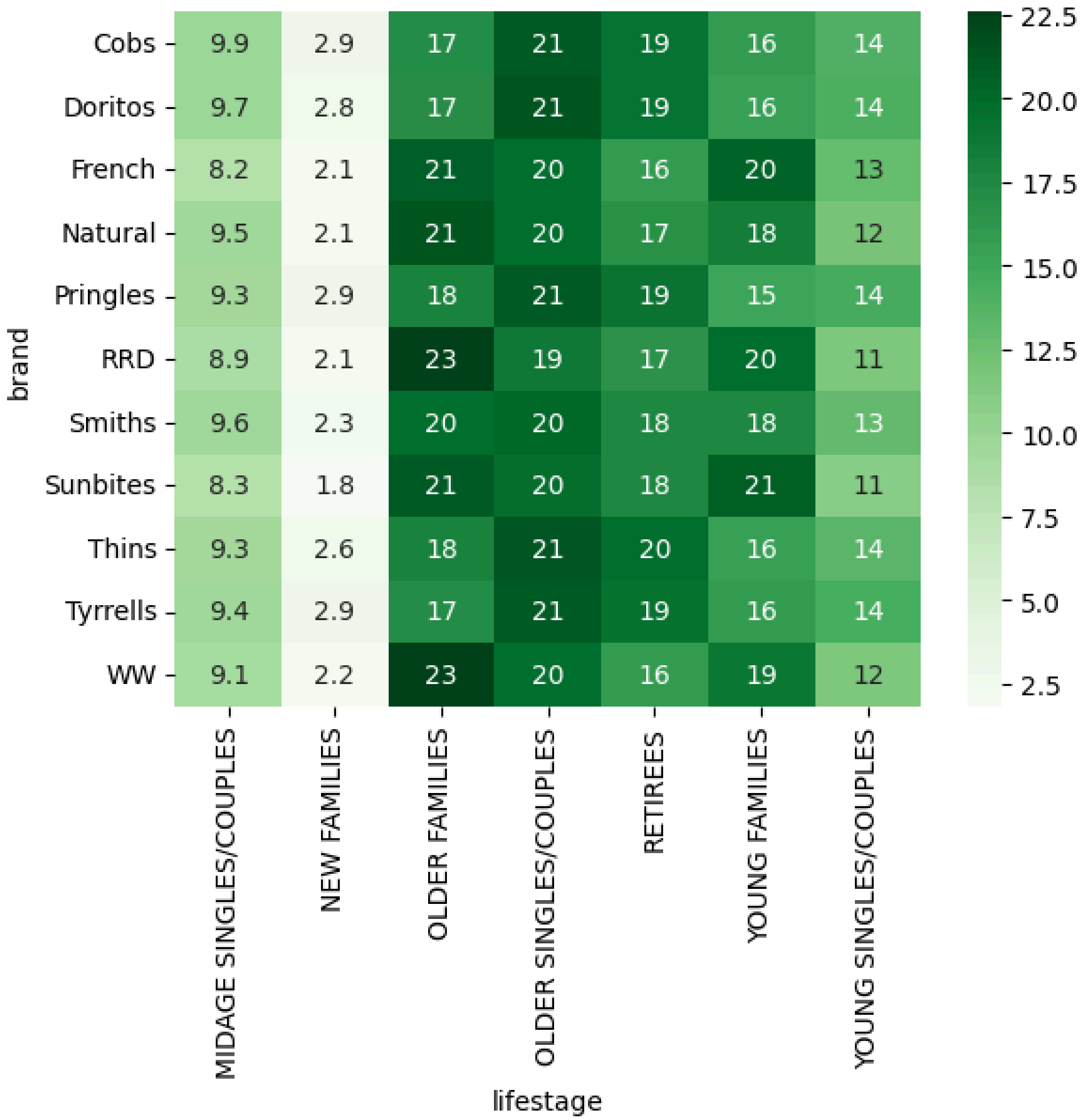
Out[63]:
```
premium_customer
Mainstream    38.50
Budget        35.23
Premium       26.27
dtype: float64
```

In [64]:
```
percentage_total_2.sum(axis=0).sort_values(ascending=False)
```

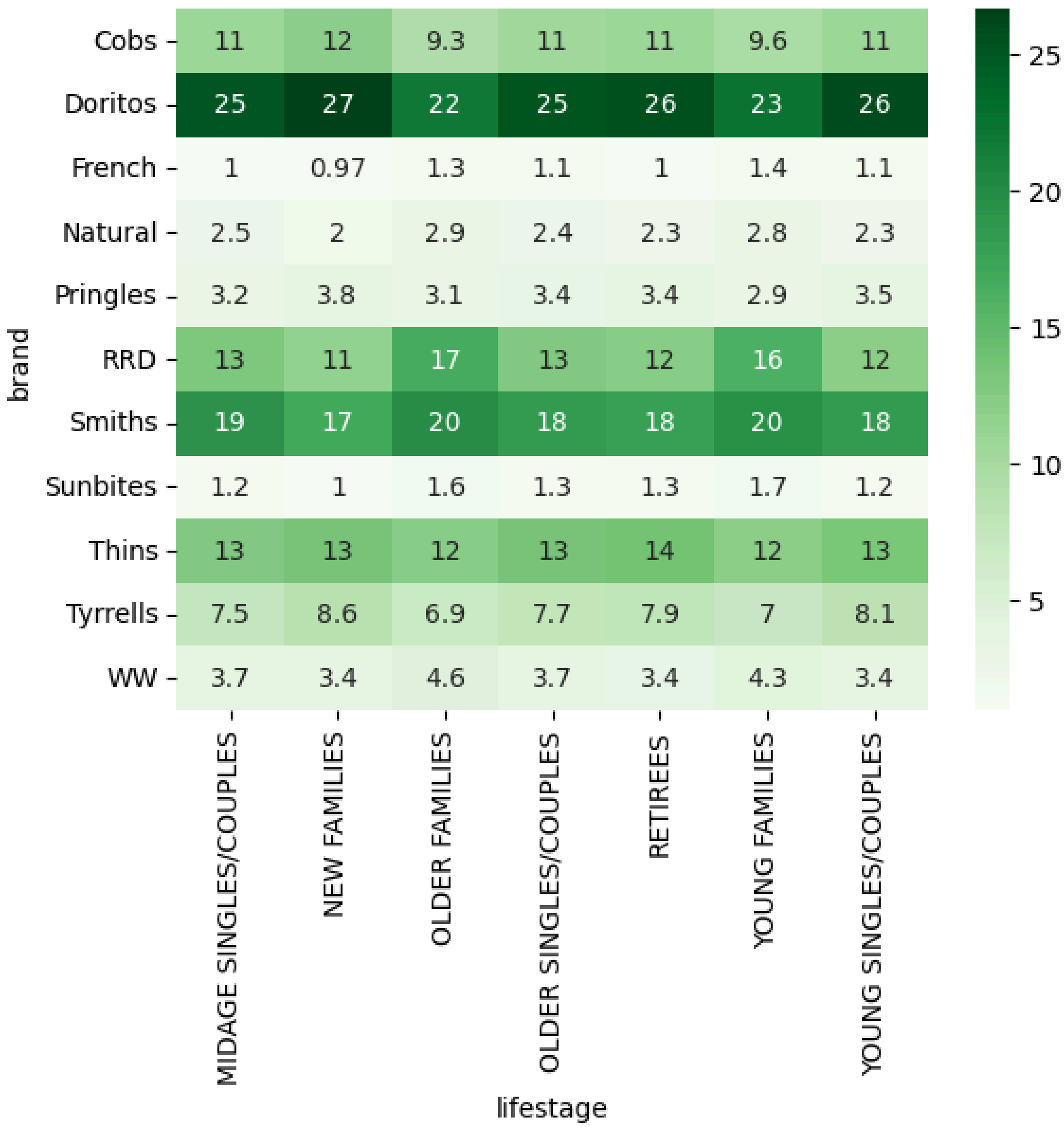
Out[64]:
```
lifestage
OLDER SINGLES/COUPLES     20.53
OLDER FAMILIES            18.88
RETIREES                  18.49
YOUNG FAMILIES            16.87
YOUNG SINGLES/COUPLES     13.28
MIDAGE SINGLES/COUPLES     9.47
NEW FAMILIES               2.55
dtype: float64
```

In [65]:
```
sns.heatmap(percentage_by_row_2, annot=True, cmap='Greens')
```

Out[65]:
```
<Axes: xlabel='lifestage', ylabel='brand'>
```




```
In [66]: sns.heatmap(percentage_by_column_2, annot=True, cmap='Greens')

Out[66]: <Axes: xlabel='lifestage', ylabel='brand'>
```



In [67]:
```
chips_products.to_csv('.\\data\\QVI_chips_products_result.csv', index=False)
```

Results

More than all sales in medium-sized packs. Top 5 weights by sales amount:

- 175g - 20.3%
- 170g - 16.3%
- 150g - 14.6%
- 165g - 13.6%
- 380g - 10.9%

Before Christmas, sales increase, after Christmas in February there was a noticeable decline. At Christmas, the stores did not work.

Purchases do not differ in customer status, but more sales to groups with Mainstream status due to the fact that there are more of them.

Older families and young families have similar preferences and they differ from the preferences of other groups. These two groups spend more on chips per customer, and made an average of 2.5 purchases per customer per year. They are also more inclined to buy brands such as RRD and Smith.

The main clients of chips are old and young families, pensioners and old single people. Full distribution of sales by groups:

- OLDER SINGLES/COUPLES - 20.53%
- OLDER FAMILIES - 18.88%
- RETIREES - 18.49%
- YOUNG FAMILIES - 16.87%
- YOUNG SINGLES/COUPLES - 13.28%
- MIDAGE SINGLES/COUPLES - 9.47%
- NEW FAMILIES - 2.55%

Top 5 brands in terms of sales:

- Doritos - 24.30%
- Smiths - 18.85%
- RRD - 13.86%
- Thins - 12.95%
- Cobs - 10.30%

Recommendation

- Arrange shelves with chips closer to the goods that are inherent in shopping for couples.
- Offer chips as a complement to family packs.
- Make themed stands for watching movies with drinks and chips.