Introduction:

Our research aims to assess and increase the total sales and discounts of meat products like beef, Turkey, chicken, pork and frozen meat/ meat dinners respectively as per age group by looking at the demographics dataframe per month.

Our analysis can be used to answer questions like:

1) What are the total sales of these meat products and how much discounts have been applied to these products per month as per different age groups ?

Packages Required:

- _completejourney*py:* Used to analyze data
- *Pandas:* Used to analyze and form dataframes
- *Numpy:* Used to form arrays, lists
- *Matplotlib:* Used to chart graphs and provide indepth analysis on the business problem

Data Preparation:

This sections contains all the procedures followed in getting the data analysis ready. Each step has been explained and the codes have been given.

Data Import

We are using the Complete Journey package for this analysis. The dataset *transactions* represents grocery store shopping transactions over one year from a group of 2,469 households. The dataset *products* contains product related information like department, product category, product type and brand. The dataset *demographics* consists of information related to different age groups belonging to different households buying these meat products present in the product_categories of products

Packages Import Code:

In [1]:
```
import pandas as pd
from completejourney_py import get_data
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.ticker as mtick
```

Below are the datasets used from CompleteJourney

In [2]:
```
cj_data = get_data()
demographics = cj_data['demographics']
demographics.head(5)
```

Out[2]:

	household_id	age	income	home_ownership	marital_status	household_size	household_comp	kid
0	1	65+	35-49K	Homeowner	Married	2	2 Adults No Kids	
1	1001	45-54	50-74K	Homeowner	Unmarried	1	1 Adult No Kids	
2	1003	35-44	25-34K	None	Unmarried	1	1 Adult No Kids	
3	1004	25-34	15-24K	None	Unmarried	1	1 Adult No Kids	
4	101	45-54	Under 15K	Homeowner	Married	4	2 Adults Kids	

In [3]:
```
products = cj_data['products']
products.head(5)
```

Out[3]:

	product_id	manufacturer_id	department	brand	product_category	product_type
0	25671	2	GROCERY	National	FRZN ICE	ICE - CRUSHED/CUBED
1	26081	2	MISCELLANEOUS	National	None	None
2	26093	69	PASTRY	Private	BREAD	BREAD:ITALIAN/FRENCH
3	26190	69	GROCERY	Private	FRUIT - SHELF STABLE	APPLE SAUCE
4	26355	69	GROCERY	Private	COOKIES/CONES	SPECIALTY COOKIES

In [4]:
```
transactions = cj_data['transactions']
transactions.head(5)
```

Out[4]:

	household_id	store_id	basket_id	product_id	quantity	sales_value	retail_disc	coupon_disc	c
0	900	330	31198570044	1095275	1	0.50	0.00	0.0	
1	900	330	31198570047	9878513	1	0.99	0.10	0.0	
2	1228	406	31198655051	1041453	1	1.43	0.15	0.0	
3	906	319	31198705046	1020156	1	1.50	0.29	0.0	
4	906	319	31198705046	1053875	2	2.78	0.80	0.0	

Data Description:

Transactions:

household_id -> Unique ID for each household
store_id -> Uniquely identifies each store

basket_id -> Uniquely identifies each purchase occasion
product_id -> Uniquely identifies each product
quantity -> Number of the product purchased during the visit
retail_disc -> Discount applied due to the retailer's loyalty card program
coupon_disc -> Discount applied due to a manufacturer coupon
coupon_match_disc -> Discount applied due to retailer's match of manufacturer coupon
week -> Week of the transaction; Ranges 1-53
transaction_timestamp -> Date and time of day when the transaction occurred

Products:

product_id -> Uniquely identifies each product
manufacturer_id -> Uniquely identifies each manufacturer
department -> Groups similar products together
brand -> Indicates private or national label brand
product_category -> Groups similar products together at lower level
product_type -> Groups similar products together at lowest level
package_size -> Indicates package size (not available for all products)

Demographics:

household_id -> Unique ID for each household
age -> Age Range of buyers
income -> Income range of buyers
home_ownership -> Rental/Owner of House
marital_status -> Marital Status of buyers
household_size -> Number of members in buyers house
household_comp -> Demographic description of members of the house
kids_count -> Number of kids in buyers house

Exploratory Data Analysis:

Here we have cumulated the retail, coupon and coupon match discount. We have also extracted month from the trasanction timestamp as it will be useful for plotting graphs in further analysis.

In [17]:
```
discount_amount =(
 transactions['retail_disc'] + transactions['coupon_disc']  + transactions['coupon_mat
)
transactions['discount_amount'] = discount_amount
transactions['month'] =pd.DatetimeIndex(transactions['transaction_timestamp']).month
transactions.head(5)
```

Out[17]:

	household_id	store_id	basket_id	product_id	quantity	sales_value	retail_disc	coupon_disc	c
0	900	330	31198570044	1095275	1	0.50	0.00	0.0	
1	900	330	31198570047	9878513	1	0.99	0.10	0.0	
2	1228	406	31198655051	1041453	1	1.43	0.15	0.0	
3	906	319	31198705046	1020156	1	1.50	0.29	0.0	
4	906	319	31198705046	1053875	2	2.78	0.80	0.0	

In order to perfrom analysis of our business problem, we have created a sample_data that comprises of product categories of meat department of Regork such as Beef, Frozen meat/meat dinners, chicken, pork and turkey respectively. We created this sample data by first merging the transactions dataframe with the products dataframe and the demographics dataframe:-

In [49]:
```
df = transactions.merge(products, how = 'inner', on='product_id')
```

In [19]:
```
df1 = df.merge(demographics, how = 'inner', on='household_id')
df1.head(5)
```

Out[19]:

	household_id	store_id	basket_id	product_id	quantity	sales_value	retail_disc	coupon_disc	c
0	900	330	31198570044	1095275	1	0.50	0.00	0.0	
1	900	330	31541475196	1095275	1	0.25	0.25	0.0	
2	900	330	31672350129	1095275	1	0.25	0.25	0.0	
3	900	330	31883555076	1095275	1	0.50	0.00	0.0	
4	900	330	31944515097	1095275	1	0.50	0.00	0.0	

5 rows × 26 columns

Here we have sampled data to extract a select variety of meat products to further analyse and explore few business bottlenecks

In [23]:
```
sample_data = (
(df1['product_category'] == 'BEEF') |
(df1['product_category'] == 'PORK') |
(df1['product_category'] == 'CHICKEN') |
(df1['product_category'] == 'FRZN MEAT/MEAT DINNERS') |
(df1['product_category'] == 'TURKEY')
)
```

In [24]:
```
chart1_data =  df1[sample_data]
chart1_data.head(5)
```

Out[24]:

	household_id	store_id	basket_id	product_id	quantity	sales_value	retail_disc	coupon_disc
97	900	330	31541476673	844179	1	3.65	1.84	0.0
98	900	330	31981190533	844179	1	3.29	1.66	0.0
99	900	330	32161361324	844179	1	4.04	0.00	0.0
100	900	330	40788395530	844179	1	5.19	0.00	0.0
119	900	330	33836400628	1083219	1	6.49	0.00	0.0

5 rows × 26 columns

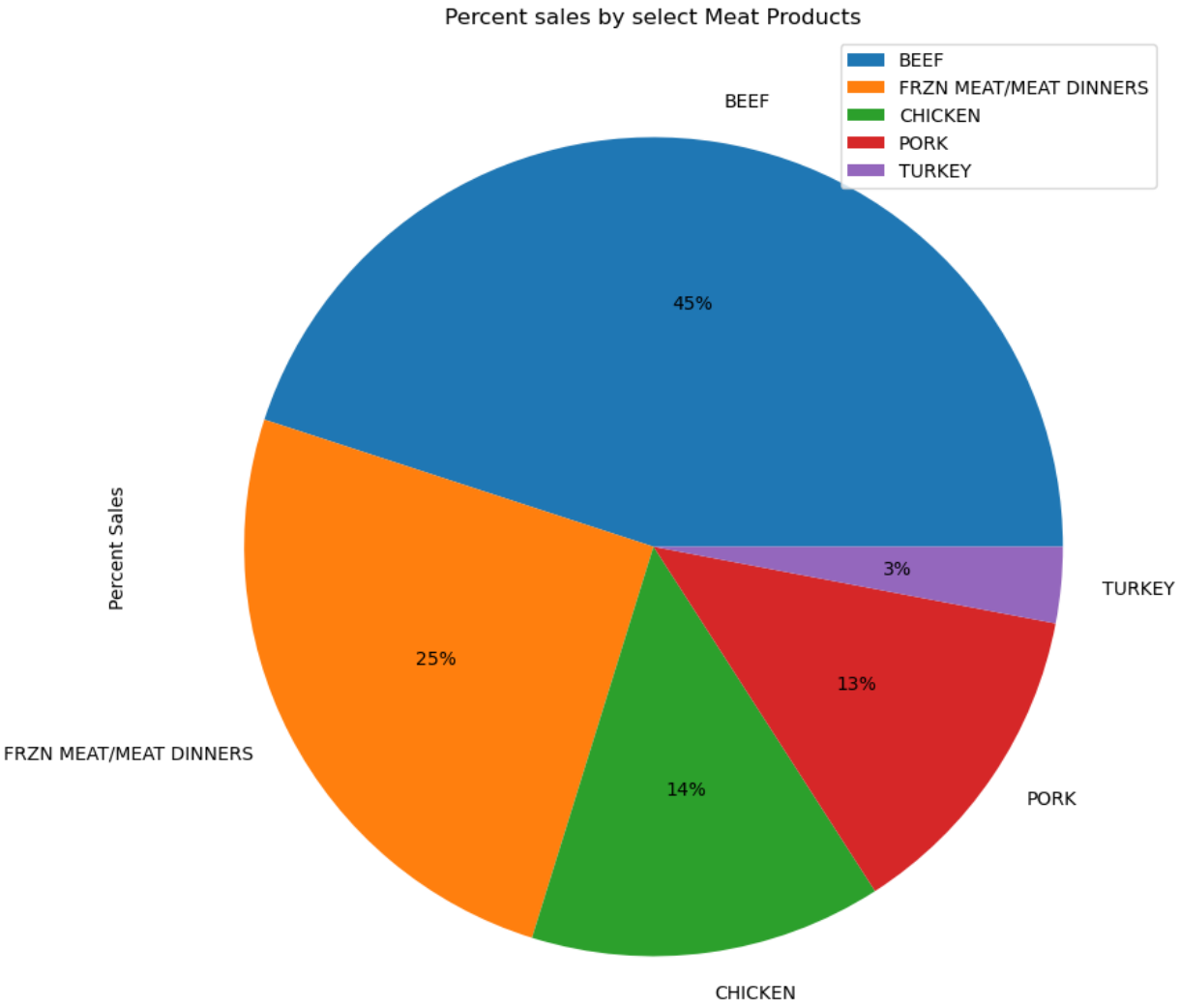
We have aggregated the sales value per meat product and represented it as a Pie-Chart to show total sales percentages per product

In [25]:
```
chart1 = (
chart1_data.groupby('product_category')
           .agg({'sales_value':'sum'})
           .sort_values(by = 'sales_value' , ascending = False)
)
chart1
```

Out[25]:

	sales_value
product_category	
BEEF	95891.09
FRZN MEAT/MEAT DINNERS	53788.33
CHICKEN	29628.13
PORK	27499.72
TURKEY	6400.02

In [50]:
```
chart1.plot(kind = 'pie', subplots = True, ylabel = 'Percent Sales', autopct = '%1.0f%
plt.title('Percent sales by select Meat Products')
plt.legend(loc = 'upper right')
plt.show()
```



As we can infer from the pie chart representation mentioned above, *Beef* has the most percentage of sales(45 %), followed by frzn meat/Frzn dinners(25%), then chicken(14%) , pork (13%) and turkey(3%) respectively.

ANALYSIS-1:

After finding out the total_sales of different selected meat categories, we have grouped the chart1_data by age and product_category in order to find its total sales value and discount_amount and store the result in chart2_data dataframe.

In [29]:
```
Chart2_data = (
chart1_data.groupby(['product_category','age'], as_index = False)
           .agg({'sales_value':'sum','discount_amount':'sum'})
           .sort_values(by = 'sales_value', ascending = False)
)
Chart2_data.head(5)
```

Out[29]:

	product_category	age	sales_value	discount_amount
3	BEEF	45-54	36485.25	7807.84
2	BEEF	35-44	27123.92	6206.93
15	FRZN MEAT/MEAT DINNERS	45-54	18891.90	6070.33
14	FRZN MEAT/MEAT DINNERS	35-44	15892.64	4648.67
1	BEEF	25-34	14737.40	2598.51

In [30]:
```
sales_per_age = Chart2_data.drop('discount_amount' , axis='columns')
```

We pivot the data inorder to plot sales value of selected meat products against age groups.

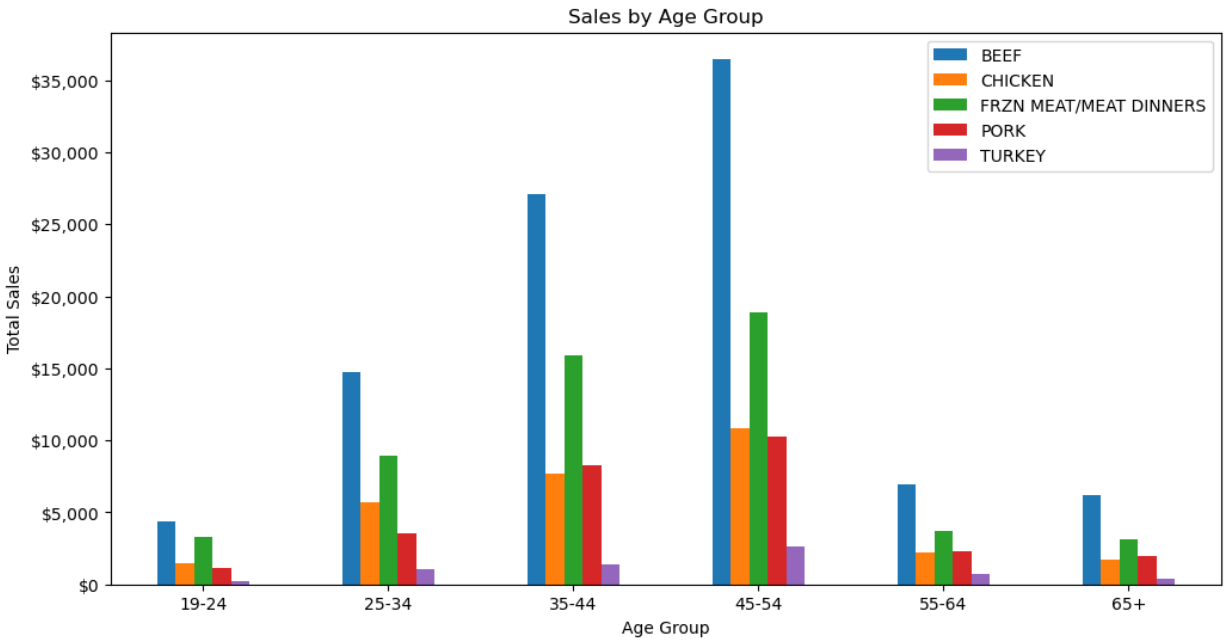
In [31]:
```
sales_per_age.pivot(index='age', columns='product_category', values='sales_value')
```

Out[31]:

product_category	BEEF	CHICKEN	FRZN MEAT/MEAT DINNERS	PORK	TURKEY
age					
19-24	4398.12	1468.80	3280.73	1145.54	192.38
25-34	14737.40	5709.52	8895.85	3522.98	1082.17
35-44	27123.92	7707.99	15892.64	8251.48	1398.59
45-54	36485.25	10824.64	18891.90	10283.93	2623.75
55-64	6955.92	2216.58	3729.84	2334.18	695.23
65+	6190.48	1700.60	3097.37	1961.61	407.90

In [32]:
```
tick_format = mtick.StrMethodFormatter('${x:,.0f}')
```

In [34]:
```
(
sales_per_age.pivot(index='age', columns='product_category', values='sales_value')
             .plot(kind = 'bar', figsize = (12,6) )
             .yaxis.set_major_formatter(tick_format)
)
plt.xlabel('Age Group')
plt.ylabel('Total Sales')
plt.title('Sales by Age Group')
plt.legend(loc = 'upper right')
plt.xticks(rotation=0)
plt.show()
```



As per the graph, we can observe that Beef is the most preffered meat across all age groups followed by frozen meat and chicken. The age group 45-54 contribute the maximum sale for the selected meat products. Similarly, age group 19-24 are the lowest contributors to the sale. It can also be observed that all age groups have a similar trend in meat product purchase with an acceptable error in margin.

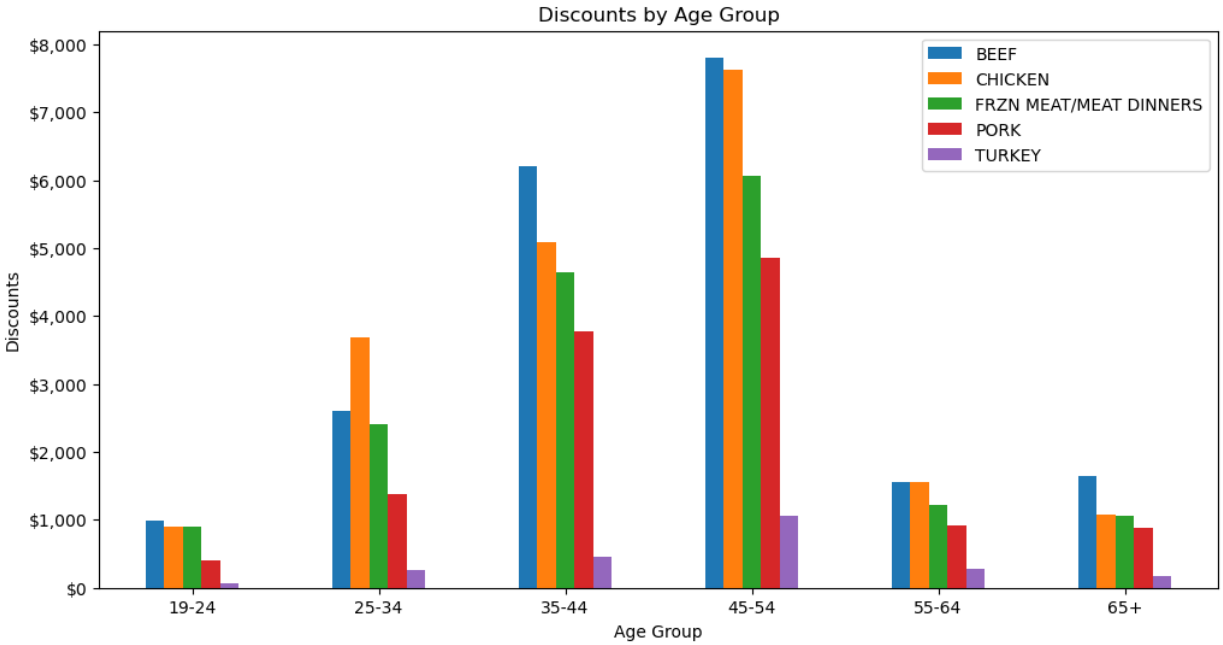
In [35]:
```
discount_per_age = Chart2_data.drop('sales_value' , axis='columns')
```

In [36]:
```
discount_per_age.pivot(index='age', columns='product_category', values='discount_amour
```

Out[36]:

product_category	BEEF	CHICKEN	FRZN MEAT/MEAT DINNERS	PORK	TURKEY
age					
19-24	980.10	892.89	905.85	406.74	73.22
25-34	2598.51	3679.59	2404.74	1377.98	254.68
35-44	6206.93	5095.66	4648.67	3778.06	462.02
45-54	7807.84	7629.53	6070.33	4858.41	1061.54
55-64	1562.44	1557.55	1220.74	911.41	283.39
65+	1636.92	1070.66	1056.96	873.55	180.18

In [37]:
```
(
discount_per_age.pivot(index='age', columns='product_category', values='discount_amour
                .plot(kind = 'bar', figsize = (12,6) )
                .yaxis.set_major_formatter(tick_format)
)
plt.xlabel('Age Group')
plt.ylabel('Discounts')
plt.title('Discounts by Age Group')
plt.legend(loc = 'upper right')
plt.xticks(rotation=0)
plt.show()
```



Here we see the distribution of discounts for each of the selected meat products by age group. We can infer that there is a similar trend in availing discounts as it was observed in the total sales graph where age_groups 45-54 availed the most amounts of discounts on selected meat products.

A secondary observation is that total amount spent on chicken discounts does not translate to total sales of the chicken product. The store is spending almost equivalent amount in chicken discounts as it is spending for beef discounts but, the actual chicken sales is always observed to be between 25-30% of total beef sales.

ANALYSIS-2:

We further proceed with analysing meat sale and discounts availed on selected meat products to identify any seasonsal trends.
For this have grouped the chart1_data by month and product_category in order to find its total sales value and discount_amount and store the result in chart3_data dataframe.

In [38]:
```
Chart3_data = (
chart1_data.groupby(['product_category','month'], as_index = False)
           .agg({'sales_value':'sum','discount_amount':'sum'})
           .sort_values(by = 'month')
)
Chart3_data.head(5)
```

Out[38]:

	product_category	month	sales_value	discount_amount
0	BEEF	1	7526.43	1582.84
24	FRZN MEAT/MEAT DINNERS	1	4226.74	1230.30
36	PORK	1	2289.05	930.76
12	CHICKEN	1	2595.37	1562.36
48	TURKEY	1	370.02	176.20

In [39]:
```
sales_per_age_month = Chart3_data.drop('discount_amount' , axis='columns')
```

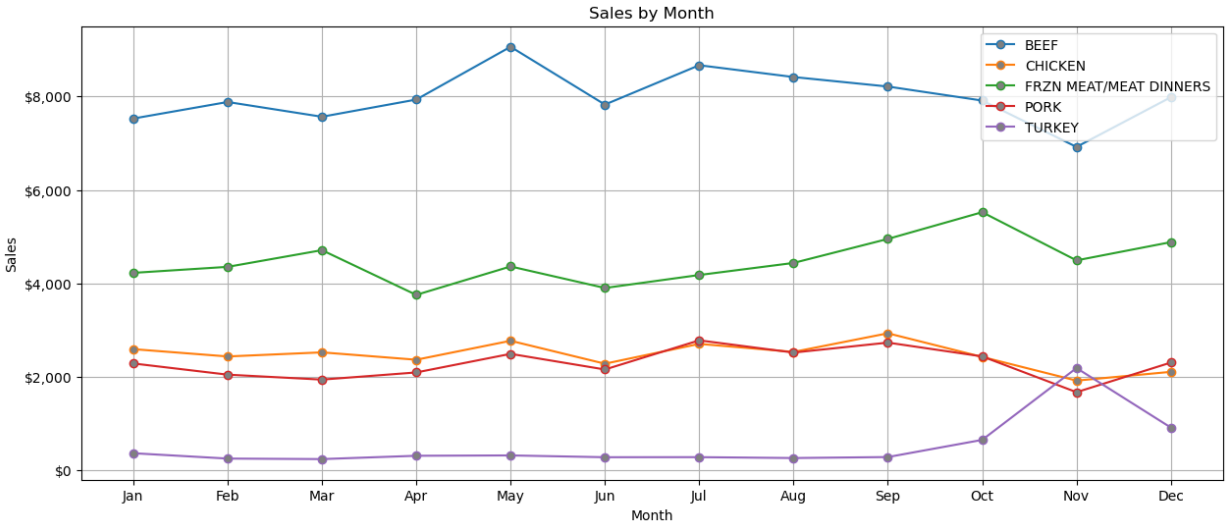
In [40]:
```
month = [1,2,3,4,5,6,7,8,9,10,11,12]
cal_month = ['Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec']
```

In [41]:
```
sales_per_age_month.pivot(index='month', columns='product_category', values='sales_val
```

Out[41]:

product_category	BEEF	CHICKEN	FRZN MEAT/MEAT DINNERS	PORK	TURKEY
month					
1	7526.43	2595.37	4226.74	2289.05	370.02
2	7880.00	2439.02	4355.02	2050.02	255.57
3	7564.62	2526.56	4712.09	1944.06	244.62
4	7931.99	2368.85	3755.84	2097.26	315.50
5	9060.43	2774.23	4363.50	2494.46	323.02
6	7824.89	2283.79	3903.16	2160.52	284.43
7	8666.24	2708.10	4180.86	2783.53	285.93
8	8413.83	2536.11	4438.83	2522.04	267.24
9	8210.62	2934.48	4952.00	2735.31	288.13
10	7910.94	2429.09	5523.71	2439.95	655.20
11	6919.34	1922.64	4493.33	1675.42	2191.22
12	7981.76	2109.89	4883.25	2308.10	919.14

In [42]:
```
(
sales_per_age_month.pivot(index='month', columns='product_category', values='sales_val
                   .plot(kind = 'line', figsize  = (15,6), marker = 'o', markerfacecol
                   .yaxis.set_major_formatter(tick_format)
)
plt.xlabel('Month')
plt.ylabel('Sales')
plt.title('Sales by Month')
plt.legend(loc = 'upper right')
plt.grid()
plt.xticks(month,cal_month,rotation=0)
plt.show()
```



From the above graph, we observed that most of meat products have a regular trend throughout the year with one exception of Turkey which spiked in sales during the *Thanksgiving Month(Nov)* where all other meat products observe a dip in sales.

In [43]:
```
discount_per_age_month = Chart3_data.drop('sales_value' , axis='columns')
```

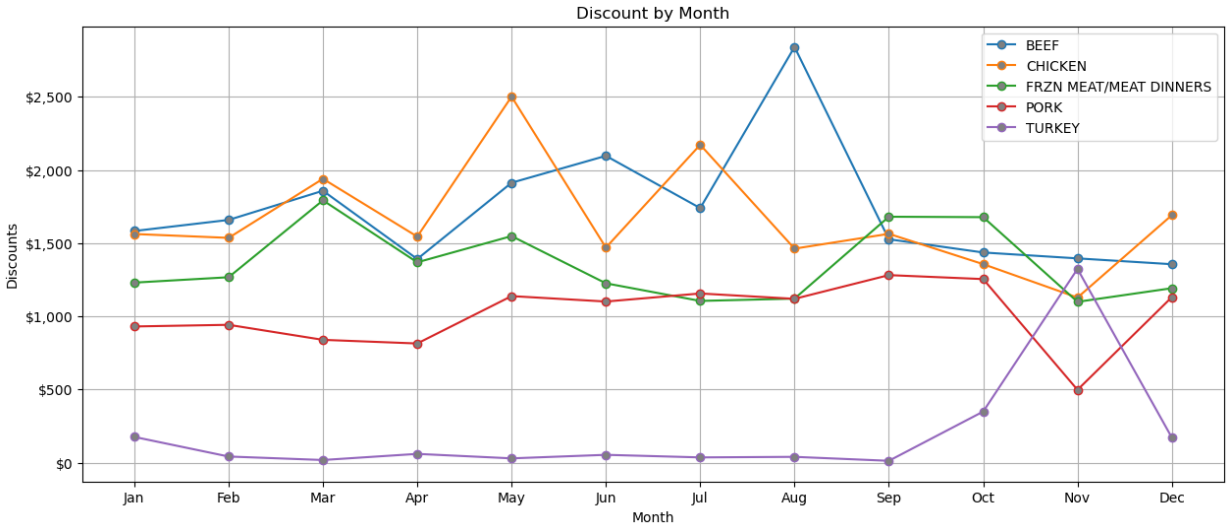
In [44]:
```
discount_per_age_month.pivot(index='month', columns='product_category', values='discou
```

Out[44]:

month	BEEF	CHICKEN	FRZN MEAT/MEAT DINNERS	PORK	TURKEY
1	1582.84	1562.36	1230.30	930.76	176.20
2	1658.53	1535.91	1267.12	942.03	42.29
3	1857.70	1939.47	1792.08	839.38	18.48
4	1391.49	1544.66	1369.00	814.49	60.28
5	1912.50	2500.85	1548.07	1138.15	29.75
6	2096.29	1469.33	1225.56	1101.04	53.85
7	1739.20	2171.88	1105.18	1156.06	36.27
8	2839.91	1462.30	1121.04	1119.49	40.06
9	1526.49	1563.62	1680.31	1281.54	12.99
10	1436.02	1356.42	1677.48	1254.43	349.34
11	1395.77	1128.18	1098.99	497.90	1323.66
12	1356.00	1690.90	1192.16	1130.88	171.86

In [45]:
```
(
discount_per_age_month.pivot(index='month', columns='product_category', values='discou
                      .plot(kind = 'line', figsize  = (15,6), marker = 'o', markerface
                      .yaxis.set_major_formatter(tick_format)
)
plt.xlabel('Month')
plt.ylabel('Discounts')
```

```
plt.title('Discount by Month')
plt.legend(loc = 'upper right')
plt.grid()
plt.xticks(month,cal_month,rotation=0)
plt.show()
```



From this graph we observe that distributions availed on Beef and Chicken is the highest throughout the year. As we can see in the Thanksgiving month the spike in discounts is analogous to the sales trend and we can say that stores idea of promoting discounts on Turkey in the month of Nov is working.

When we compare the overall sales with the discounts availed throughout the year, it can be infered that the store has tried to promote chicken sales by pushing more discounts in the month of March, May and July but the attempts to increase sales were unsuccessful. The store should reduce the amount of discounts on chicken products and redistribute the discount budget for Pork throughout the year and Turkey in the month of November.

Summary:

The above data analysis has helped us in solving our business problem in an effective way and thus, the solution proposed for our analysis are as follows:-

- ***The store should ensure good relations with their vendors who provide Beef, Frozen meat as these are the highest selling selected meat products and a zero inventory for these products would result in loss of sale.***
- ***The store is spending high amounts in discounts in order to promote chicken sales which can clearly be observed that it is not working, as Chicken sales is always 25-30% of Beef sales.***
- ***The excess amounts being spent in Chicken discounts can be better utilized by promoting discounts on Pork throughout the year and on Turkey in the month of November, as they show higher potential to contribute to net sales.***

Limitations:

Since the data set has product category at a granular level rather than a generalized level we could only select a few products in the meat category as selecting all categories was causing cluttering in the visualization.