Descrição do problema

Para este desafio é disponibilizado o histórico de compras dos clientes ao longo do tempo da empresa H&M Group, juntamente com metadados de surporte. O desafio consiste em prever quais artigos cada cliente comprará no período de 7 dias imediatamente após o términio dos dados de treinamento. O cliente que não fez nenhuma compra durante esse período é excluído da pontuação.

O conjunto de dados contém 4 arquivos csv (articles.cvs, customers.cvs, transactions_train.cvs, sample_submission.cvs) e uma pasta com várias subpastas, cada uma com um número diferente de imagens.

O desafio deixa em aberto como será feita a analise e utilizaçãop dos dados para atingir o objetivo.

Aplicação

In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
import matplotlib.pyplot as plt
sns.set_theme(style="ticks", palette="pastel")
```

In [2]:

```
transactions = pd.read_csv('data/transactions_train.csv')
```

In [28]:

```
articles = pd.read_csv('data/articles.csv')
```

In [29]:

```
customers = pd.read_csv('data/customers.csv')
```

Analise dos dados

In [5]:

```
#IQR (Intervalo Interquartil)
def interval_interquartil(dt, col):
  Q1=dt[col].quantile(0.25)
  Q3=dt[col].quantile(0.75)
  IQR=Q3-Q1
  whisker_width = 1.5
  return dt[(dt[col] < Q1 - whisker_width*IQR) | (dt[col] > Q3 + whisker_width*IQR)]

def not_interval_interquartil(dt, col):
  Q1=dt[col].quantile(0.25)
  Q3=dt[col].quantile(0.75)
  IQR=Q3-Q1
  whisker_width = 1.5
  return dt[(dt[col] > Q1 - whisker_width*IQR) & (dt[col] < Q3 + whisker_width*IQR)]
```

```
def graph(dt, col):
    plt.figure(figsize=[16,4])
    plt.suptitle('[' + col + ']')

    plt.subplot(1, 2, 1)
    dt[col].value_counts().plot(kind='bar')

    plt.subplot(1, 2, 2)
    sns.boxplot(x=col, data=dt)

def graph__plot(dt, col):
    dt[col].value_counts().plot(kind='bar')
```

Transactions

In [6]:

```
transactions.head()
```

Out[6]:

	t_dat	customer_id	article_id	price	sales_channel_id
0	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	663713001	0.050831	2
1	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	541518023	0.030492	2
2	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	505221004	0.015237	2
3	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687003	0.016932	2
4	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687004	0.016932	2

In [7]:

```
transactions.shape
```

Out[7]:

```
(31788324, 5)
```

In [8]:

```
transactions.dtypes
```

Out[8]:

```
t_dat                object
customer_id          object
article_id            int64
price               float64
sales_channel_id      int64
dtype: object
```

t_dat: data da transação `Date` (categórico nominal)

customer_id: id do cliente que fez a transação `String` (categórico nominal)

article_id: id do produto (artigo) comprado na transação `int64` (quantitativo discretos)

price: preço do produto comprado `float64` (quantitativo contínuo)

sales_channel_id: canal de vendas utilizado na transação (1 (loja) ou 2 (online)) `Int64` (quantitativo discreto e binário simétrico)

In [9]:

```
transactions['sales_channel_id'] = transactions['sales_channel_id'].astype(np.int8)
transactions.dtypes
```

Out[9]:

```
t_dat                 object
customer_id           object
article_id             int64
price                float64
sales_channel_id       int8
dtype: object
```

In [10]:

```
transactions.isnull().sum()
```

Out[10]:

```
t_dat                 0
customer_id           0
article_id            0
price                 0
sales_channel_id      0
dtype: int64
```

In [11]:

```
pd.get_dummies(transactions["sales_channel_id"]).head()
```

Out[11]:

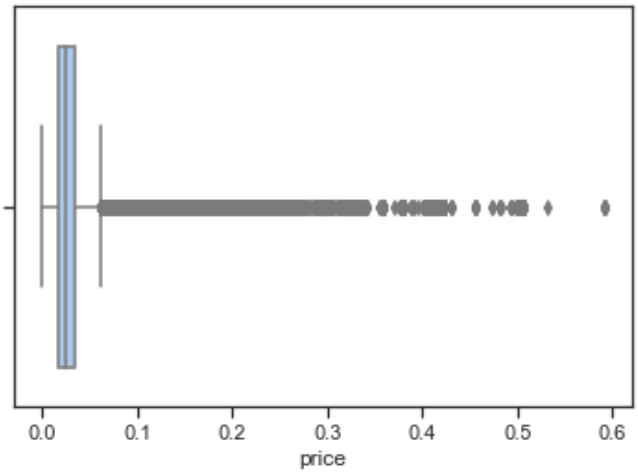
	1	2
0	0	1
1	0	1
2	0	1
3	0	1
4	0	1

In [15]:

```
sns.boxplot(x='price', data=transactions)
```

Out[15]:

```
<AxesSubplot:xlabel='price'>
```



In [18]:

```
max_price = transactions['price'].max()
print(f"Max price: {max_price}")
```

```
Max price: 0.5915254237288136
```

In [25]:

```
display(transactions['customer_id'].value_counts()[:20])
```

```
display(transactions['customer_id'].value_counts()[:20])
```

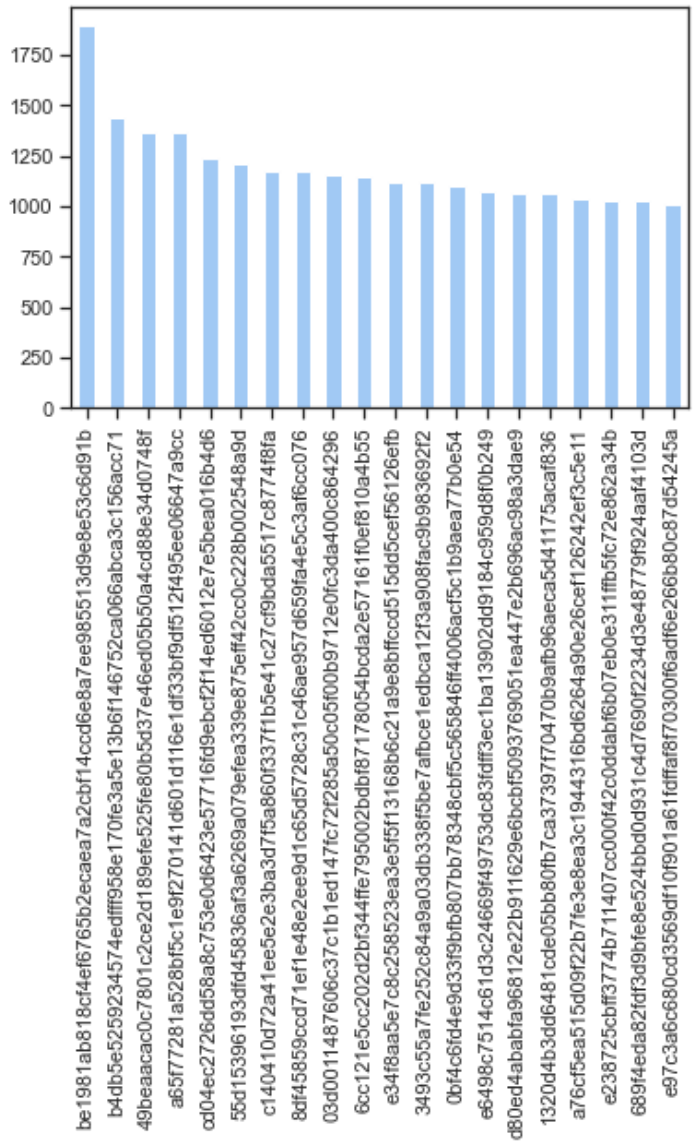
```
be1981ab818cf4ef6765b2ecaea7a2cbf14ccd6e8a7ee985513d9e8e53c6d91b    1895
b4db5e5259234574edfff958e170fe3a5e13b6f146752ca066abca3c156acc71    1441
49beaacac0c7801c2ce2d189efe525fe80b5d37e46ed05b50a4cd88e34d0748f    1364
a65f77281a528bf5c1e9f270141d601d116e1df33bf9df512f495ee06647a9cc    1361
cd04ec2726dd58a8c753e0d6423e57716fd9ebcf2f14ed6012e7e5bea016b4d6    1237
55d15396193dfd45836af3a6269a079efea339e875eff42cc0c228b002548a9d    1208
c140410d72a41ee5e2e3ba3d7f5a860f337f1b5e41c27cf9bda5517c8774f8fa    1170
8df45859ccd71ef1e48e2ee9d1c65d5728c31c46ae957d659fa4e5c3af6cc076    1169
03d0011487606c37c1b1ed147fc72f285a50c05f00b9712e0fc3da400c864296    1157
6cc121e5cc202d2bf344ffe795002bdbf87178054bcda2e57161f0ef810a4b55    1143
e34f8aa5e7c8c258523ea3e5f5f13168b6c21a9e8bffccd515dd5cef56126efb    1117
3493c55a7fe252c84a9a03db338f5be7afbce1edbca12f3a908fac9b983692f2    1115
0bf4c6fd4e9d33f9bfb807bb78348cbf5c565846ff4006acf5c1b9aea77b0e54    1099
e6498c7514c61d3c24669f49753dc83fdff3ec1ba13902dd9184c959d8f0b249    1068
d80ed4ababfa96812e22b911629e6bcbf5093769051ea447e2b696ac98a3dae9    1066
1320d4b3dd6481cde05bb80fb7ca37397f70470b9afb96aeca5d41175acaf836    1059
a76cf5ea515d09f22b7fe3e8ea3c1944316bd6264a90e26cef126242ef3c5e11    1038
e238725cbff3774b711407cc000f42c0ddabf6b07eb0e311ffb5fc72e862a34b    1022
689f4eda82fdf3d9bfe8e524bbd0d931c4d7690f2234d3e48779f924aaf4103d    1022
e97c3a6c680cd3569df10f901a61fdffaf8f70300f6adf6e266b80c87d54245a    1009
Name: customer_id, dtype: int64
```

In [19]:

```
transactions['customer_id'].value_counts()[:20].plot(kind='bar')
```

Out[19]:

```
<AxesSubplot:>
```



In [20]:

```
transactions_counts = transactions['customer_id'].value_counts().rename_axis('customer_i
```

```
transactions_counts = transactions['customer_id'].value_counts().rename_axis('customer_id').reset_index(name='counts')
transactions_counts
```

Out[20]:

	customer_id	counts
0	be1981ab818cf4ef6765b2ecaea7a2cbf14ccd6e8a7ee9...	1895
1	b4db5e5259234574edfff958e170fe3a5e13b6f146752c...	1441
2	49beaacac0c7801c2ce2d189efe525fe80b5d37e46ed05...	1364
3	a65f77281a528bf5c1e9f270141d601d116e1df33bf9df...	1361
4	cd04ec2726dd58a8c753e0d6423e57716fd9ebcf2f14ed...	1237
...	...	...
1362276	63b70b71291668f0a63ade8e321fb3eccb80eba164f208...	1
1362277	950b172c36d169bf427545991fe66371f21a085799b447...	1
1362278	7c284f13f4af9d6a53f97279381638ed0cb7afaa4fd4f3...	1
1362279	62d49d0ae11a4f65fa31e354cb87f6b557ebec648e0e5e...	1
1362280	268eaa31a07d6f2f4f060bfcf32a660f3ea3dbb21ef14c...	1

1362281 rows × 2 columns

In [25]:

```
pd.set_option('float_format', '{:f}'.format)
transactions_counts.describe()
```

Out[25]:

	counts
count	1362281.000000
mean	23.334631
std	39.242253
min	1.000000
25%	3.000000
50%	9.000000
75%	27.000000
max	1895.000000

In [24]:

```
display(transactions['article_id'].value_counts()[:20])
```

```
706016001    50287
706016002    35043
372860001    31718
610776002    30199
759871002    26329
464297007    25025
372860002    24458
610776001    22451
399223001    22236
706016003    21241
720125001    21063
156231001    21013
562245046    20719
562245001    20464
351484002    20415
399256001    20242
673396002    19834
568601006    19379
```

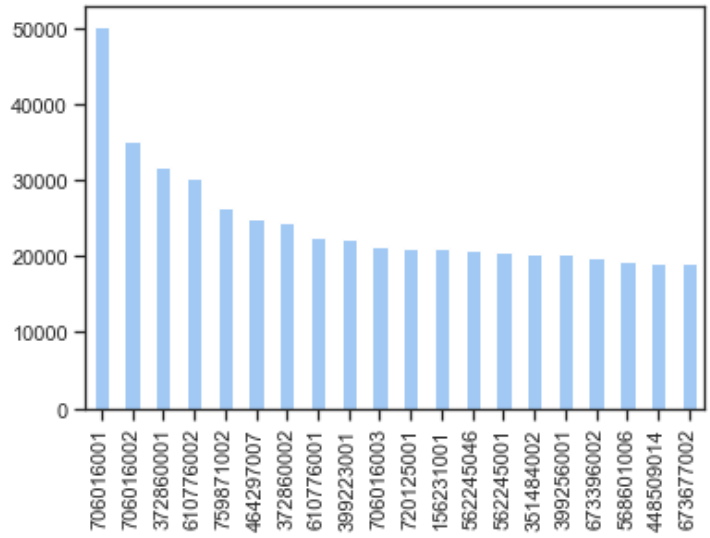
```
448509014    19216
673677002    19143
Name: article_id, dtype: int64
```

In [20]:

```
transactions['article_id'].value_counts()[:20].plot(kind='bar')
```

Out[20]:

```
<AxesSubplot:>
```



In [12]:

```
transactions.loc[transactions['article_id'] == 706016001]['price'].value_counts()
```

Out[12]:

```
0.033881    34760
0.027102     3510
0.030492     3136
0.028797      928
0.024390      500
            ...
0.028068        1
0.023373        1
0.028390        1
0.028119        1
0.024119        1
Name: price, Length: 563, dtype: int64
```

In [28]:

```
transactions['article_id'].value_counts().rename_axis('article_id').reset_index(name='counts')
```

Out[28]:

	article_id	counts
0	706016001	50287
1	706016002	35043
2	372860001	31718
3	610776002	30199
4	759871002	26329
...	...	...
104542	520736002	1
104543	619777003	1
104544	586904003	1

	article_id	counts
104545	512385003	1
104546	533261032	1

104547 rows × 2 columns

In [51]:

```
print('The number of customers: ', transactions['customer_id'].nunique())
print('The number of articles: ', transactions['article_id'].nunique())
```

```
The number of customers:  1362281
The number of articles:  104547
```

In [52]:

```
max_x = transactions['t_dat'].max()
min_x = transactions['t_dat'].min()
print(f"Início: {min_x}\nFim: {max_x}")
```

```
Início: 2018-09-20
Fim: 2020-09-22
```

Dados de transações em um intervalo de 2 anos e 2 dias

In [16]:

```
mask = transactions['t_dat'] > '2019-09-22'
transactions_last_year = transactions.loc[mask]
```

In [17]:

```
print('The number of customers: ', transactions_last_year['customer_id'].nunique())
print('The number of articles: ', transactions_last_year['article_id'].nunique())
```

```
The number of customers:  994320
The number of articles:  70906
```

In [38]:

```
transactions.describe()
```

Out[38]:

	article_id	price	sales_channel_id
count	3.178832e+07	3.178832e+07	3.178832e+07
mean	6.962272e+08	2.782927e-02	1.704028e+00
std	1.334480e+08	1.918113e-02	4.564786e-01
min	1.087750e+08	1.694915e-05	1.000000e+00
25%	6.328030e+08	1.581356e-02	1.000000e+00
50%	7.145820e+08	2.540678e-02	2.000000e+00
75%	7.865240e+08	3.388136e-02	2.000000e+00
max	9.562170e+08	5.915254e-01	2.000000e+00

Articles

In [53]:

```
articles.head()
```

Out[53]:

	article_id	product_code	prod_name	product_type_no	product_type_name	product_group_name	graphical_appearance_no

	article_id	product_code	prod_name	product_type_no	product_type_name	product_group_name	graphical_appearance_no
0	108775015	108775	Strap top	253	Vest top	Garment Upper body	1010016
1	108775044	108775	Strap top	253	Vest top	Garment Upper body	1010016
2	108775051	108775	Strap top (1)	253	Vest top	Garment Upper body	1010017
3	110065001	110065	OP T-shirt (Idro)	306	Bra	Underwear	1010016
4	110065002	110065	OP T-shirt (Idro)	306	Bra	Underwear	1010016

5 rows × 25 columns

In [31]:

```
articles.shape
```

Out[31]:

```
(105542, 25)
```

article_id : Identificador unico de cada artigo

product_code, prod_name : Identificador unico para cada produto e seu nome

product_type, product_type_name : Grupo no qual o produto pertece pelo código e seu nome

graphical_appearance_no, graphical_appearance_name : Grupo de "aparência gráfica" e seu nome

colour_group_code, colour_group_name : Grupo de cores e seu nome

perceived_colour_value_id, perceived_colour_value_name, perceived_colour_master_id, perceived_colour_master_name : Informações de cores adicionais

department_no, department_name: : Identificador unico de cada departamento e seu nome

index_code, index_name: : ??

index_group_no, index_group_name: : ??

section_no, section_name: : Identificador unico de cada seção e seu nome

garment_group_no, garment_group_name: : Identificador unico de cada peça de roupa e seu nome

detail_desc: : Detalhes

In [55]:

```
articles.isnull().sum()
```

Out[55]:

```
article_id                    0
product_code                  0
prod_name                     0
product_type_no               0
product_type_name             0
```

```
product_group_name                0
graphical_appearance_no           0
graphical_appearance_name         0
colour_group_code                 0
colour_group_name                 0
perceived_colour_value_id         0
perceived_colour_value_name       0
perceived_colour_master_id        0
perceived_colour_master_name      0
department_no                     0
department_name                   0
index_code                        0
index_name                        0
index_group_no                    0
index_group_name                  0
section_no                        0
section_name                      0
garment_group_no                  0
garment_group_name                0
detail_desc                     416
dtype: int64
```

In [56]:

```
#preenchendo valor null em detail_desc
articles['detail_desc'].fillna("empty description", inplace=True)
```

In [57]:

```
articles.isnull().sum()
```

Out[57]:

```
article_id                      0
product_code                    0
prod_name                       0
product_type_no                 0
product_type_name               0
product_group_name              0
graphical_appearance_no         0
graphical_appearance_name       0
colour_group_code               0
colour_group_name               0
perceived_colour_value_id       0
perceived_colour_value_name     0
perceived_colour_master_id      0
perceived_colour_master_name    0
department_no                   0
department_name                 0
index_code                      0
index_name                      0
index_group_no                  0
index_group_name                0
section_no                      0
section_name                    0
garment_group_no                0
garment_group_name              0
detail_desc                     0
dtype: int64
```

In [59]:

```
articles.drop(['product_type_name', 'graphical_appearance_name','colour_group_name','perc
eived_colour_value_name','perceived_colour_master_name','department_name','index_name','i
ndex_group_name','section_name','garment_group_name','prod_name', 'index_group_name'], ax
is=1, inplace=True)
```

In [61]:

```
articles.dtypes
```

Out[61]:

```
article_id                    int64
product_code                  int64
product_type_no               int64
product_group_name           object
graphical_appearance_no       int64
colour_group_code             int64
perceived_colour_value_id     int64
perceived_colour_master_id    int64
department_no                 int64
index_code                   object
index_group_no                int64
section_no                    int64
garment_group_no              int64
detail_desc                  object
dtype: object
```

In [78]:

```
articles
```

Out[78]:

	article_id	product_code	product_type_no	product_group_name	graphical_appearance_no	colour_group_code	perce
0	108775015	108775	253	Garment Upper body	1010016	9	
1	108775044	108775	253	Garment Upper body	1010016	10	
2	108775051	108775	253	Garment Upper body	1010017	11	
3	110065001	110065	306	Underwear	1010016	9	
4	110065002	110065	306	Underwear	1010016	10	
...	...	...	...	...	...	...	
105537	953450001	953450	302	Socks & Tights	1010014	9	
105538	953763001	953763	253	Garment Upper body	1010016	9	
105539	956217002	956217	265	Garment Full body	1010016	9	
105540	957375001	957375	72	Accessories	1010016	9	

	article_id	product_code	product_type_no	product_group_name	graphical_appearance_no	colour_group_code	perce
105541	959461001	959461	265	Garment Full body	1010016	11	

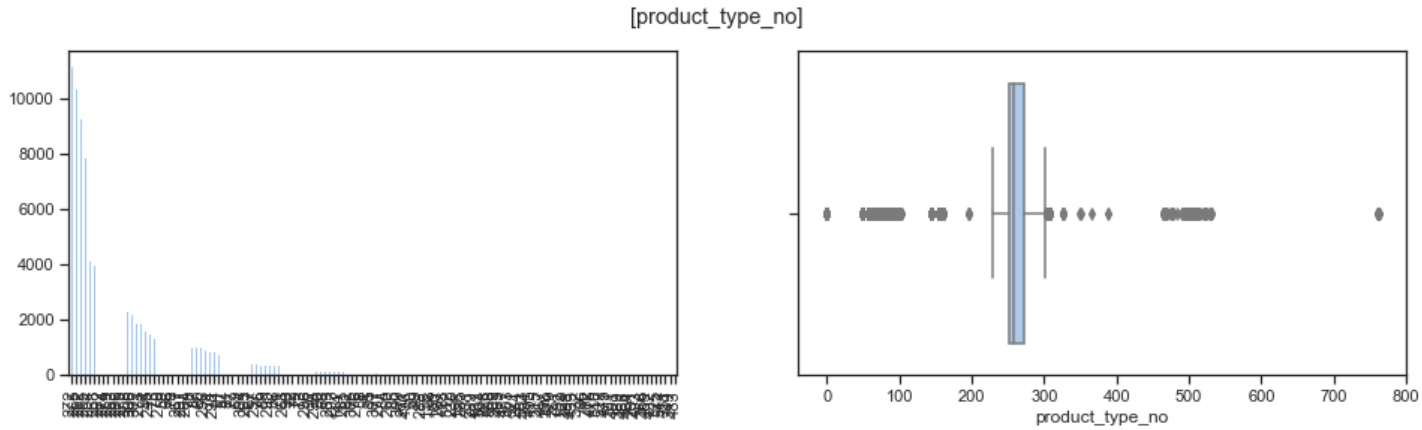
105542 rows × 14 columns

In [175]:

```
def iqr_fence(x):
    Q1 = x.quantile(0.25)
    Q3 = x.quantile(0.75)
    IQR = Q3 - Q1
    Lower_Fence = Q1 - (1.5 * IQR)
    Upper_Fence = Q3 + (1.5 * IQR)
    u = max(x[x<Upper_Fence])
    l = min(x[x>Lower_Fence])
    return [u,l]
```

In [75]:

```
graph(articles, 'product_type_no')
```



In [113]:

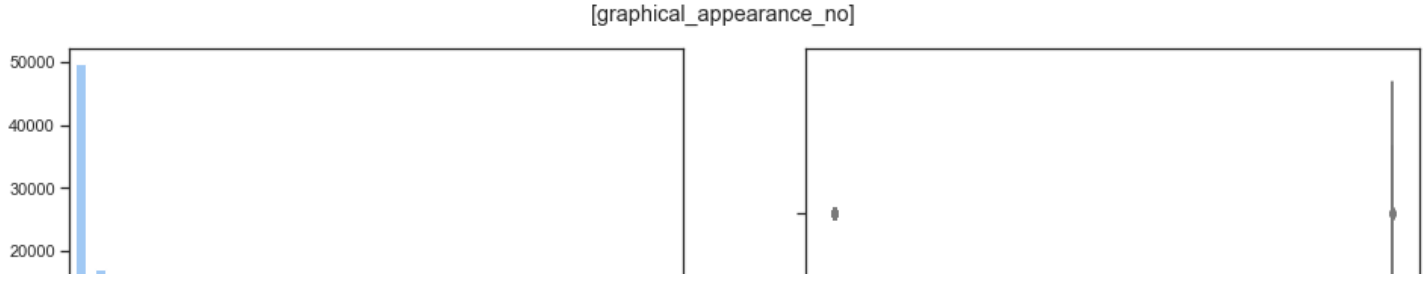
```
interval_interquartil(articles, 'product_type_no')['product_type_no'].value_counts()
```

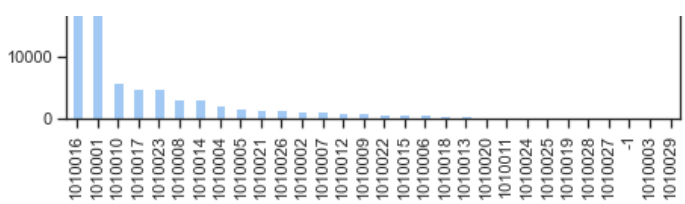
Out[113]:

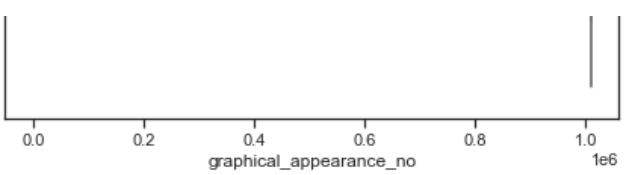
```
308    2356
306    2212
94     1621
75     1349
59     1307
       ...
525       1
514       1
351       1
349       1
483       1
Name: product_type_no, Length: 89, dtype: int64
```

In [77]:

```
graph(articles, 'graphical_appearance_no')
```







In [101]:

```
interval_interquartil(articles, 'graphical_appearance_no')['graphical_appearance_no'].val
ue_counts()
```

Out[101]:

```
-1          52
 1010029     8
Name: graphical_appearance_no, dtype: int64
```

In [102]:

```
max_x = articles['graphical_appearance_no'].max()
min_x = articles['graphical_appearance_no'].min()
print(f"Min: {min_x}  Max: {max_x}")
```

```
Min: -1  Max: 1010029
```

In [105]:

```
max_x = articles.loc[articles['graphical_appearance_no'] != 1010029]['graphical_appearanc
e_no'].max()
min_x = articles.loc[articles['graphical_appearance_no'] != -1]['graphical_appearance_no'
].min()
print(f"Min: {min_x}  Max: {max_x}")
```

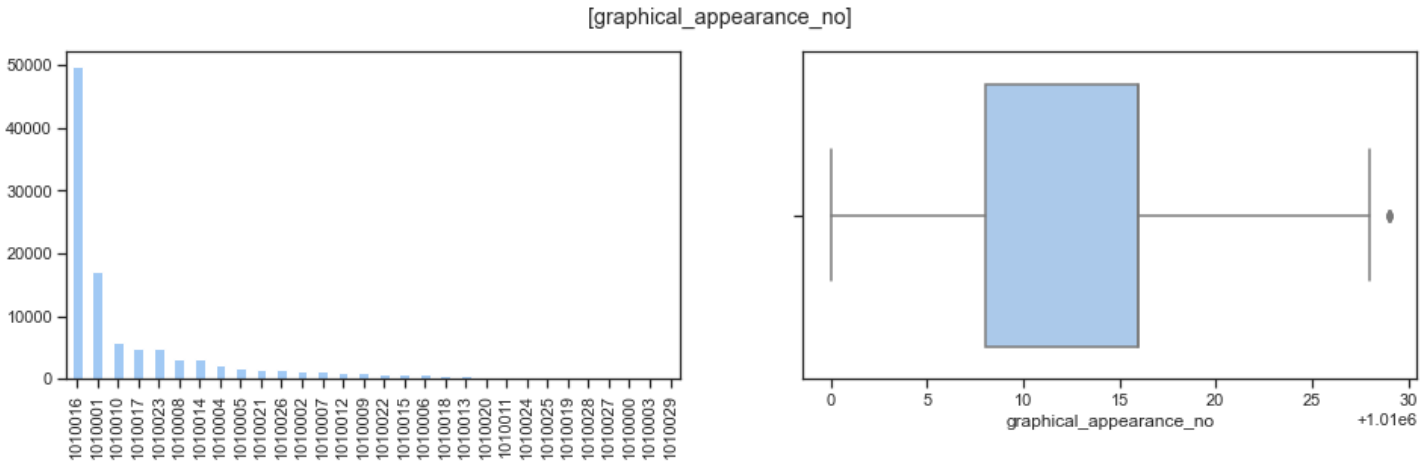
```
Min: 1010001  Max: 1010028
```

In [106]:

```
articles.loc[articles['graphical_appearance_no'] == -1, ['graphical_appearance_no']] = 1
010000
```

In [107]:

```
graph(articles, 'graphical_appearance_no')
```



In [108]:

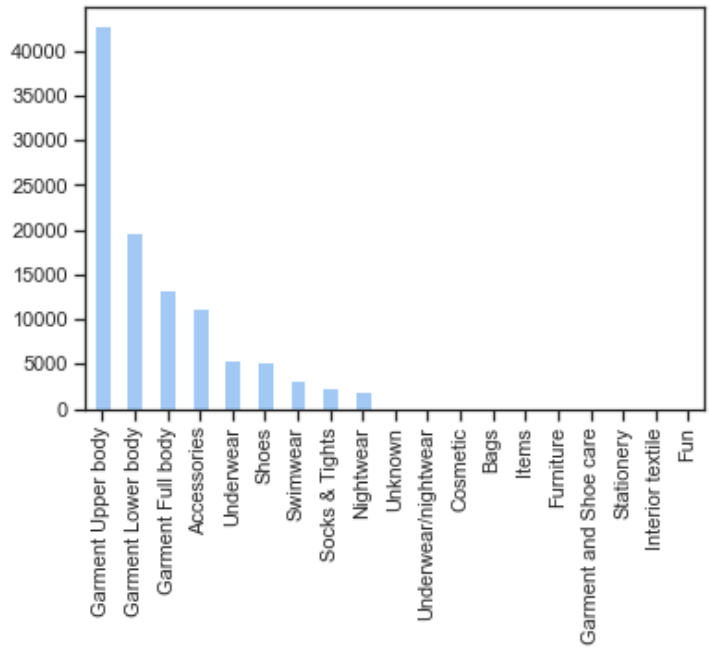
```
interval_interquartil(articles, 'graphical_appearance_no')['graphical_appearance_no'].val
ue_counts()
```

Out[108]:

```
1010029    8
Name: graphical_appearance_no, dtype: int64
```

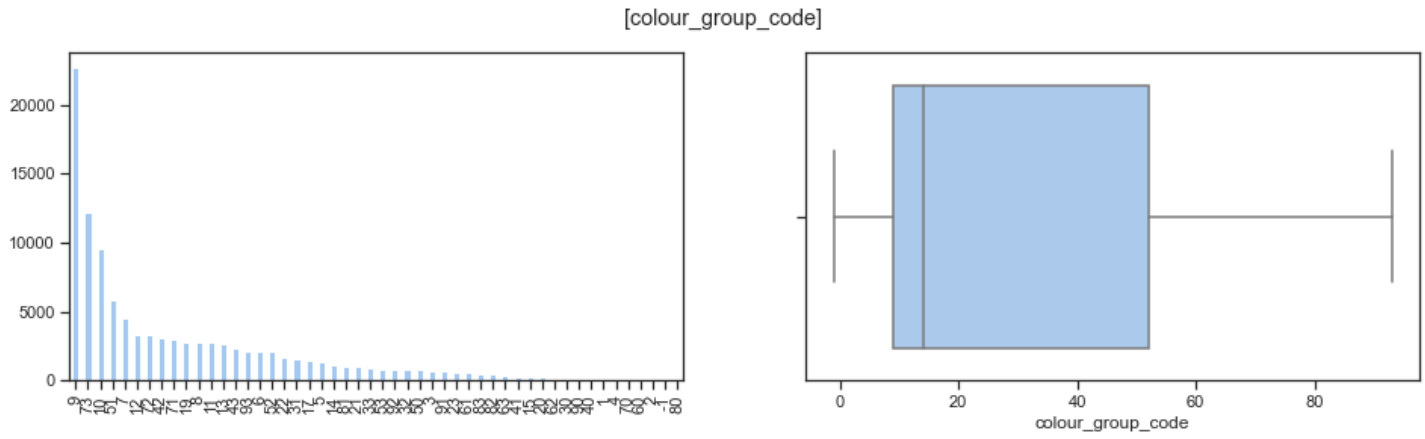
In [89]:

```
graph__plot(articles, 'product_group_name')
```



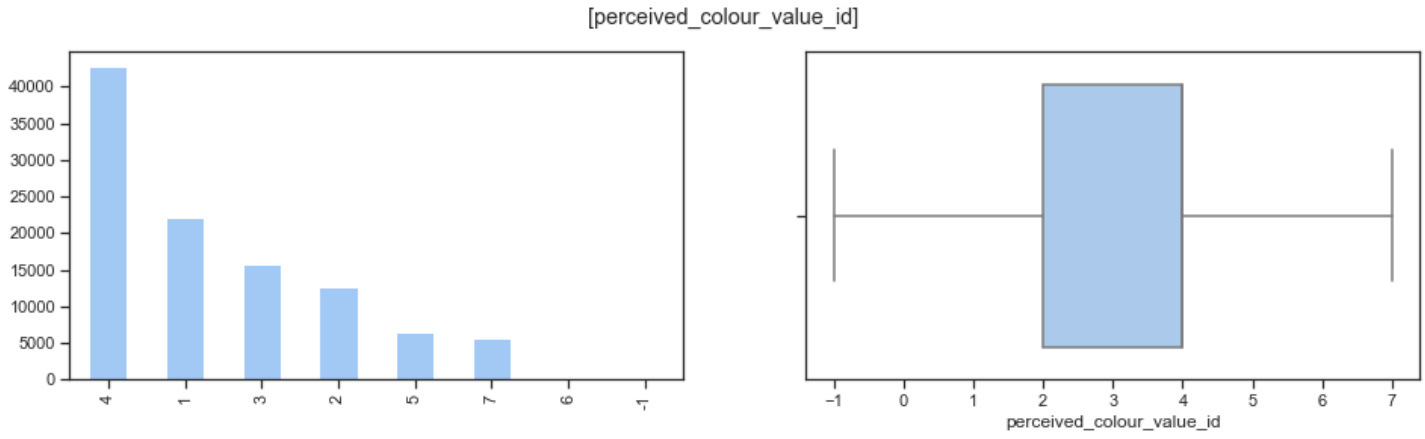
In [80]:

```
graph(articles, 'colour_group_code')
```



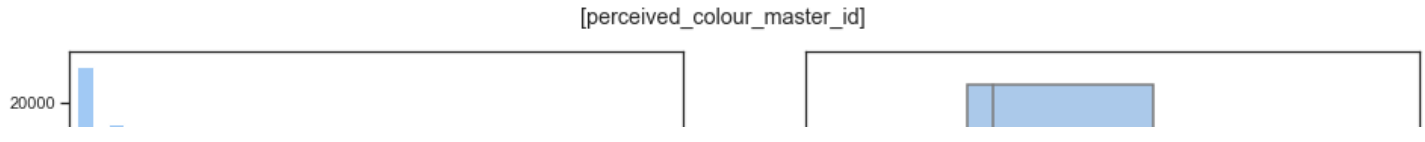
In [81]:

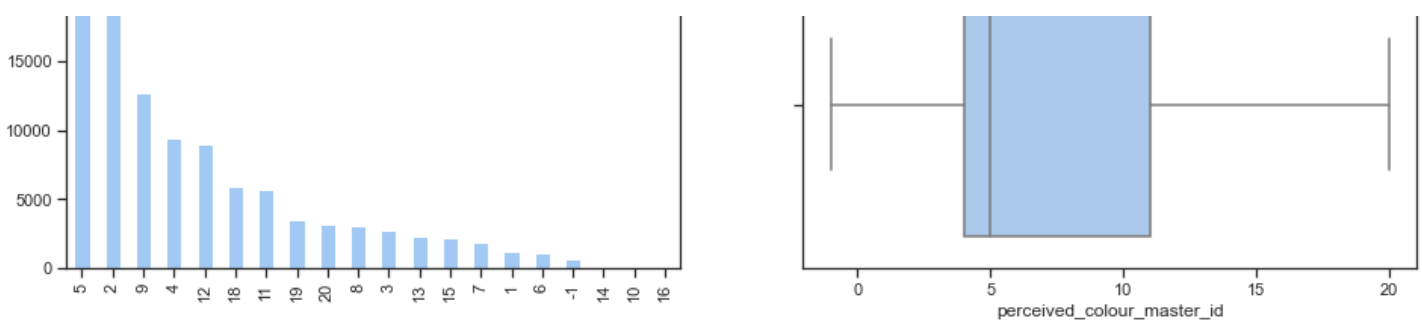
```
graph(articles, 'perceived_colour_value_id')
```



In [82]:

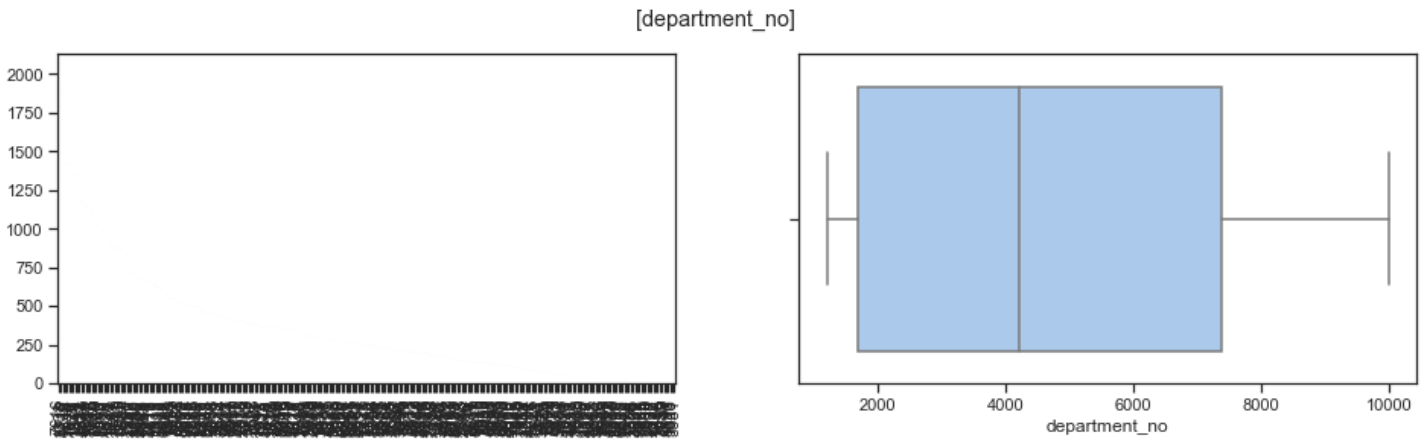
```
graph(articles, 'perceived_colour_master_id')
```





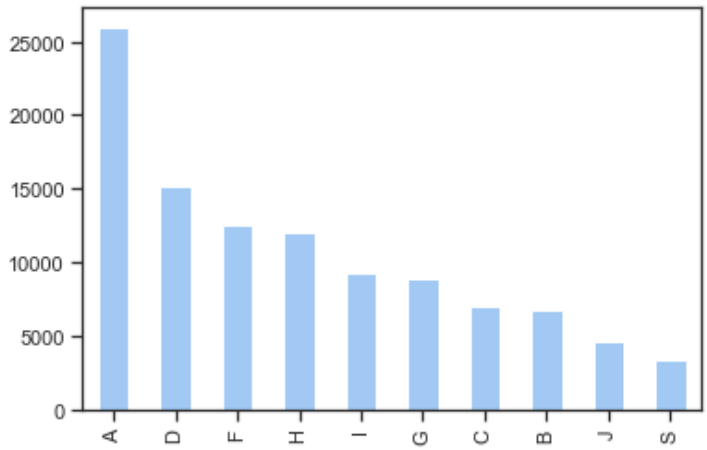
In [83]:

```
graph(articles, 'department_no')
```



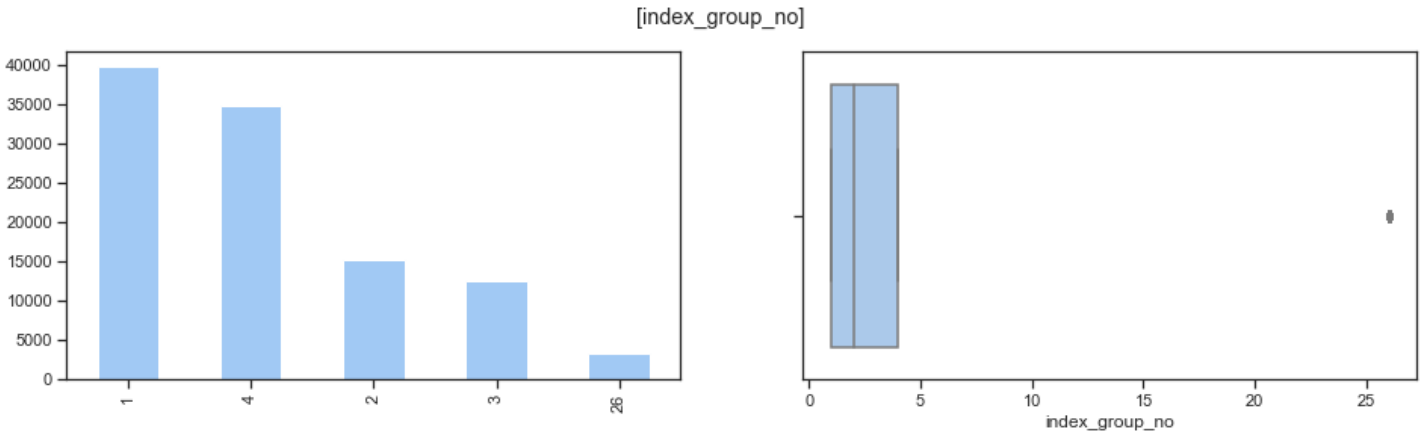
In [90]:

```
graph__plot(articles, 'index_code')
```



In [85]:

```
graph(articles, 'index_group_no')
```



In [94]:

```
print(articles['index_group_no'].value_counts())
```

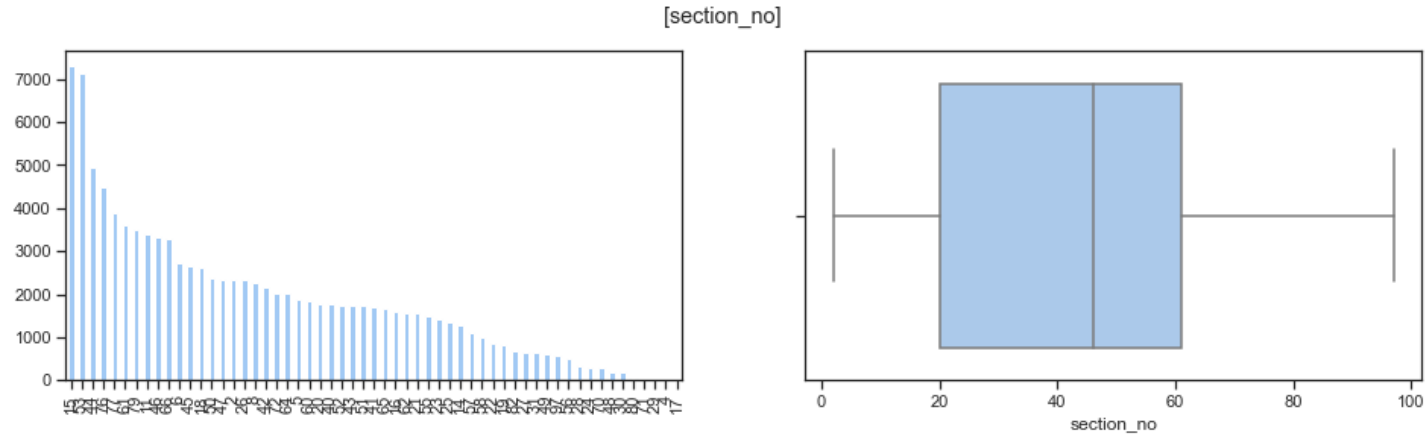
```
1     39737
4     34711
2     15149
3     12553
26     3392
Name: index_group_no, dtype: int64
```

In [95]:

```
articles.loc[articles['index_group_no'] == 26, ['index_group_no']] = 5
```

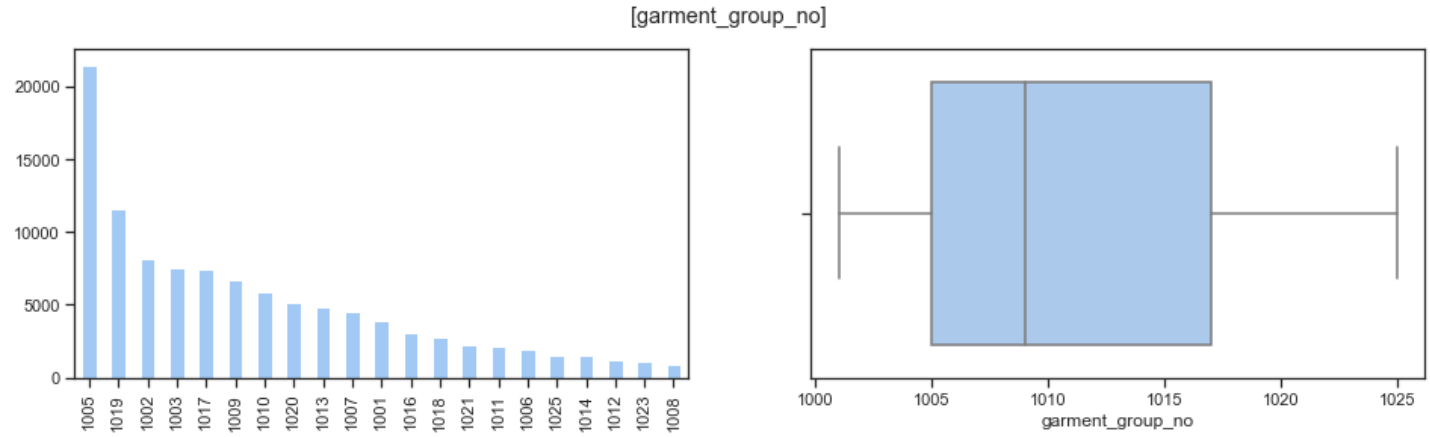
In [86]:

```
graph(articles, 'section_no')
```



In [87]:

```
graph(articles, 'garment_group_no')
```



In [93]:

```
print(articles['detail_desc'].value_counts())
```

```
empty description
416
T-shirt in printed cotton jersey.
159
Leggings in soft organic cotton jersey with an elasticated waist.
138
T-shirt in soft, printed cotton jersey.
137
Socks in a soft, jacquard-knit cotton blend with elasticated tops.
136

...
Ankle-length trousers in sturdy cotton jersey. High waist with pleats, a zip fly with a h
ook-and-eye fastening, and tapered legs with a slit at the front.
1
Fully lined bikini bottoms with a low waist with wide elastication. Wide sides and cutawa
y coverage at the back.
```

```
y coverage at the back.
1
Wide jumper in a sturdy rib knit with a turtle neck and wide raglan sleeves.
1
Calf-length skirt in a sturdy, slightly stretchy viscose weave with a concealed grosgrain
band inside the waistband and a concealed zip at the back with a hook-and-eye fastener. H
igh slits front and back. Unlined.      1
Calf-length dress in ribbed jersey made from a cotton blend. Low-cut V-neck at the back,
dropped shoulders and long, wide sleeves that taper to the cuffs. Unlined.
1
Name: detail_desc, Length: 43405, dtype: int64
```

In [96]:

```
print(articles['product_group_name'].value_counts())
```

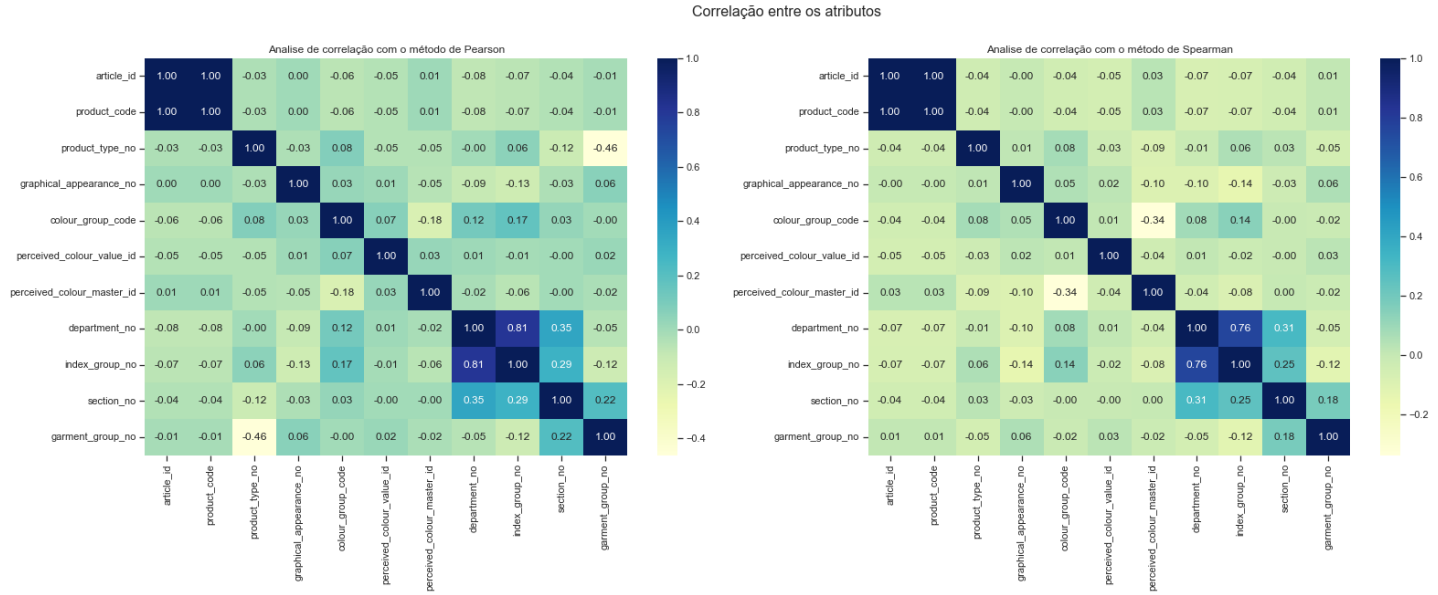
```
Garment Upper body       42741
Garment Lower body       19812
Garment Full body        13292
Accessories              11158
Underwear                 5490
Shoes                     5283
Swimwear                  3127
Socks & Tights            2442
Nightwear                 1899
Unknown                    121
Underwear/nightwear         54
Cosmetic                    49
Bags                        25
Items                       17
Furniture                   13
Garment and Shoe care        9
Stationery                   5
Interior textile             3
Fun                          2
Name: product_group_name, dtype: int64
```

In [140]:

```
plt.figure(figsize=(26, 8))
plt.suptitle('Correlação entre os atributos', fontsize=16)

plt.subplot(1, 2, 1)
plt.title('Analise de correlação com o método de Pearson')
sns.heatmap(articles.corr(), annot = True, cmap= 'YlGnBu', fmt= '.2f');

plt.subplot(1, 2, 2)
plt.title('Analise de correlação com o método de Spearman')
sns.heatmap(articles.corr(method="spearman"), annot = True, cmap= 'YlGnBu', fmt= '.2f');
```



Customers

In [141]:

```
customers.head()
```

Out[141]:

	customer_id	FN	Active	club_member_status	fashion_news_frequency	age	
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	NaN	NaN	ACTIVE	NONE	49.0	5
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	NaN	NaN	ACTIVE	NONE	25.0	2
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	NaN	NaN	ACTIVE	NONE	24.0	6
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	NaN	NaN	ACTIVE	NONE	54.0	5
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	ACTIVE	Regularly	52.0	25

In [142]:

```
customers.dtypes
```

Out[142]:

```
customer_id                object
FN                        float64
Active                    float64
club_member_status         object
fashion_news_frequency     object
age                       float64
postal_code                object
dtype: object
```

customer_id: id do cliente `String` (categórico nominal)

FN: Se o se um cliente receber o boletim informativo de notícias de moda `int` (quantitativo discreto e binário assimétrico)

Active: indicação se o cliente é ativo `int` (quantitativo discreto e binário assimétrico)

club_member_status: status do cliente no clube de membros [ACTIVE, LEFT CLUB,PRE-CREATE] `String` (categórico nominal)

fashion_news_frequency: frequencia de acompanhamento de nótivias da moda [Monthly e Regularly] `String` (categórico ordinal)

age: idade do cliente `float64` (quantitativo contínuo)

postal_code: codigo postal do cliente criptografado `String` (categórico nominal)

In [143]:

```
customers = customers.rename(columns={"FN":"fashion_news_newsletter", "Active": "active_communication"})
```

In [144]:

```
customers.shape
```

Out[144]:

```
(1371980, 7)
```

1371980 (quantidade de clientes em customers) - 1362281 (quantidade de clientes que fizeram uma compra em transactions) = 9699

Logo tem que 9699 não possuem dados de compra

- **Eliminando rows da tabela customers que possui clientes qua não possuem dados de compras em transactions**

In [145]:

```
transactions_customers = transactions['customer_id'].unique()
```

In [146]:

```
len(transactions_customers)
```

Out[146]:

```
1362281
```

In [147]:

```
customers = customers[customers['customer_id'].isin(transactions_customers)]
customers
```

Out[147]:

	customer_id	fashion_news_newsletter	active_communication	club_member
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	NaN	NaN	A
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	NaN	NaN	A
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	NaN	NaN	A
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	NaN	NaN	A
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	A
...	...	...	...	
1371975	ffffbbf78b6eaac697a8a5dfbfd2bfa8113ee5b403e474...	NaN	NaN	A
1371976	ffffcd5046a6143d29a04fb8c424ce494a76e5cdf4fab5...	NaN	NaN	A
1371977	ffffcf35913a0bee60e8741cb2b4e78b8a98ee5ff2e6a1...	1.0	1.0	A
1371978	ffffd7744cebcf3aca44ae7049d2a94b87074c3d4ffe38...	1.0	1.0	A
1371979	ffffd9ac14e89946416d80e791d064701994755c3ab686...	NaN	NaN	PRE-C

1362281 rows × 7 columns

In [148]:

```
customers.shape
```

Out[148]:

```
(1362281, 7)
```

In [149]:

```
customers.isnull().sum()
```

Out[149]:

```
customer_id                  0
fashion_news_newsletter    888922
active_communication       901382
club_member_status           6054
fashion_news_frequency      15999
age                         15761
postal_code                     0
dtype: int64
```

In [151]:

```
pd.get_dummies(customers["fashion_news_newsletter"]).head()
```

Out[151]:

	1.0
0	0
1	0
2	0
3	0
4	1

In [152]:

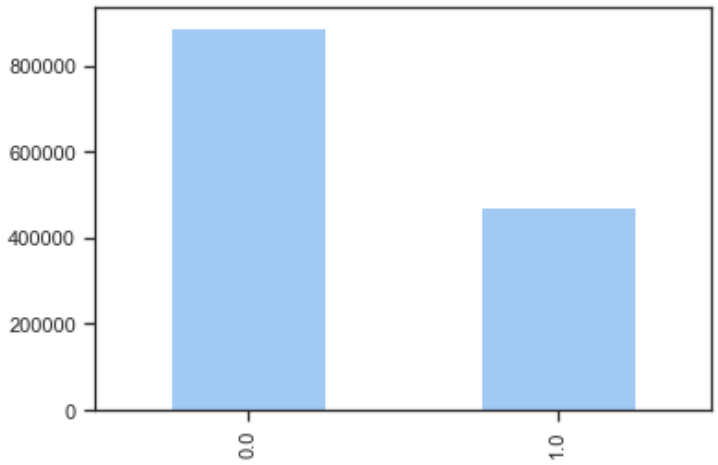
```
customers['fashion_news_newsletter'].fillna(0, inplace=True)
```

In [153]:

```
customers['fashion_news_newsletter'].value_counts().plot(kind='bar')
```

Out[153]:

<AxesSubplot:>



In [154]:

```
pd.get_dummies(customers["active_communication"]).head()
```

Out[154]:

	1.0
0	0
1	0
2	0
3	0
4	1

In [155]:

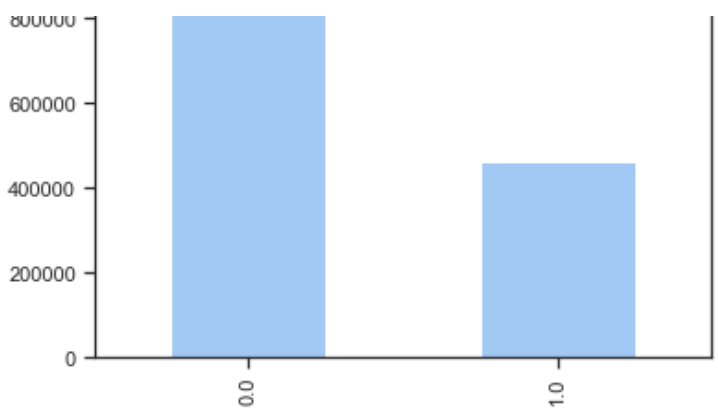
```
customers['active_communication'].fillna(0, inplace=True)
```

In [156]:

```
customers['active_communication'].value_counts().plot(kind='bar')
```

Out[156]:

<AxesSubplot:>



In [157]:

```
pd.get_dummies(customers["fashion_news_frequency"]).head()
```

Out[157]:

	Monthly	NONE	None	Regularly
0	0	1	0	0
1	0	1	0	0
2	0	1	0	0
3	0	1	0	0
4	0	0	0	1

In [158]:

```
customers.loc[customers['fashion_news_frequency'] == 'None']
```

Out[158]:

	customer_id	fashion_news_newsletter	active_communication	club_member_s
898114	a79d9cbfaceb0d25a91caccfad167d4d6391fd5bb4292b...	1.0	0.0	AC

In [159]:

```
customers.loc[customers['fashion_news_frequency'] == 'None', ['fashion_news_frequency']]
= "NONE"
```

In [165]:

```
customers["fashion_news_frequency"].fillna("NONE", inplace=True)
```

In [166]:

```
print(customers['fashion_news_frequency'].value_counts())
```

```
NONE          887598
Regularly     473843
Monthly          840
Name: fashion_news_frequency, dtype: int64
```

In [161]:

```
pd.get_dummies(customers["club_member_status"]).head()
```

Out[161]:

	ACTIVE	LEFT CLUB	PRE-CREATE
0	1	0	0
1	1	0	0

	ACTIVE	LEFT CLUB	PRE-CREATE
2	1	0	0
3	1	0	0
4	1	0	0

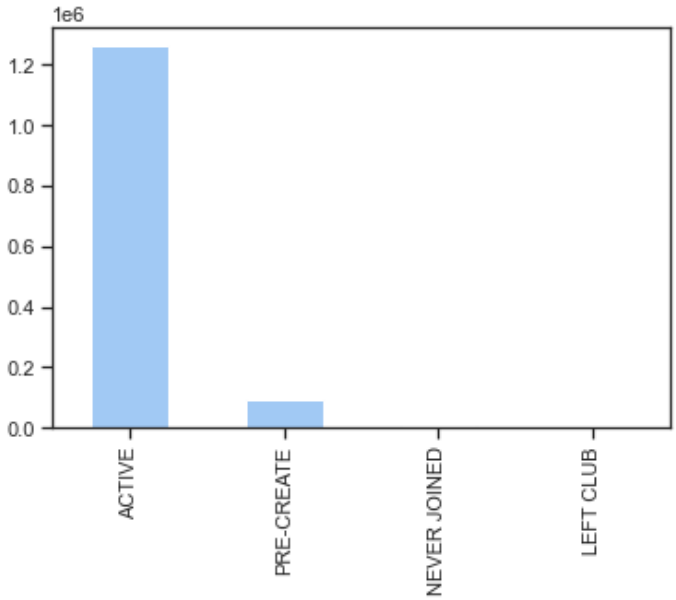
In [162]:

```
customers['club_member_status'].fillna("NEVER JOINED", inplace=True)
```

In [163]:

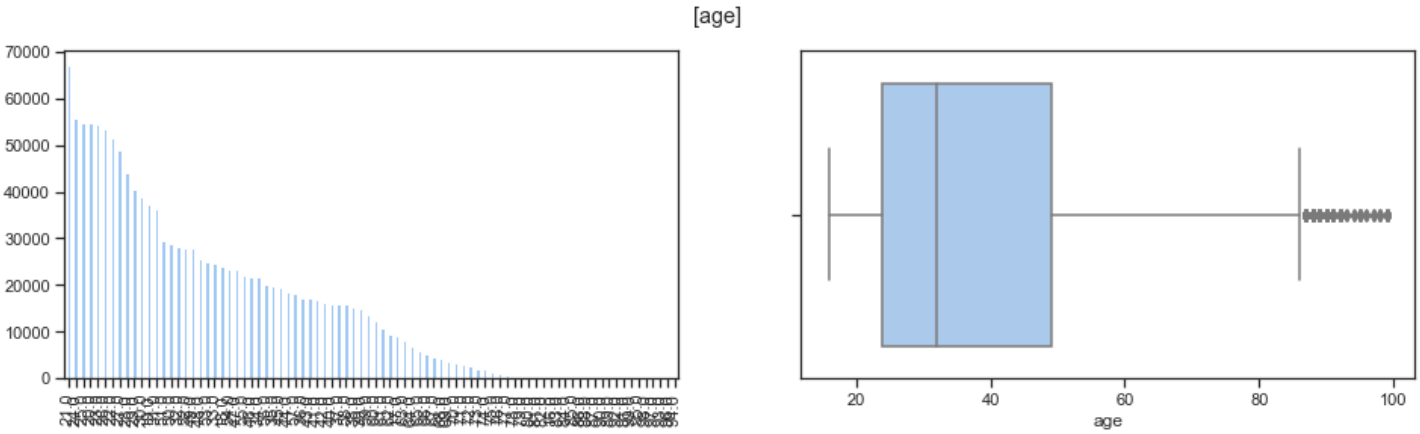
```
customers.club_member_status.value_counts().plot(kind='bar')
print(customers.club_member_status.value_counts())
```

```
ACTIVE          1263183
PRE-CREATE        92578
NEVER JOINED       6054
LEFT CLUB           466
Name: club_member_status, dtype: int64
```



In [168]:

```
graph(customers, 'age')
```



In [169]:

```
max_x = customers['age'].max()
min_x = customers['age'].min()
print(f"Min: {min_x}  Max: {max_x}")
```

```
Min: 16.0  Max: 99.0
```

In [177]:

```
max_age, min_age = iqr_fence(customers['age'])
```

```
print(f"Min: {min_age}  Max: {max_age}")
```

```
Min: 16.0  Max: 86.0
```

In [171]:

```
interval_interquartil(customers, 'age')['age'].value_counts()
```

Out[171]:

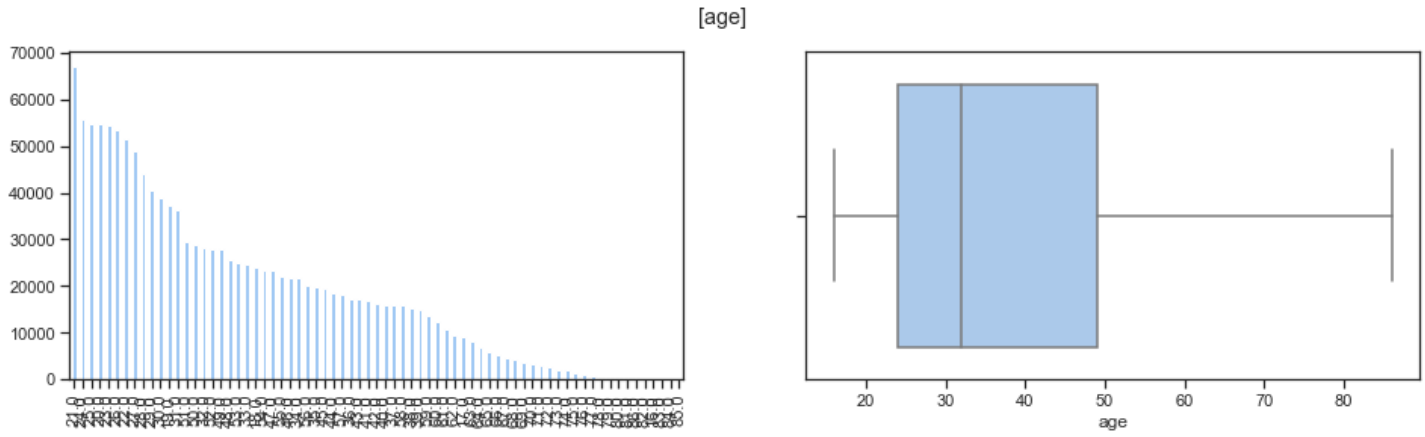
```
88.0    48
87.0    41
90.0    24
89.0    23
92.0    17
91.0    16
99.0    13
95.0    10
98.0     7
97.0     4
93.0     4
96.0     3
94.0     3
Name: age, dtype: int64
```

In [179]:

```
customers.loc[customers['age'] > max_age, ['age']] = max_age
```

In [180]:

```
graph(customers, 'age')
```



In [182]:

```
customers["age"].fillna(0, inplace=True)
```

In [183]:

```
customers.isnull().sum()
```

Out[183]:

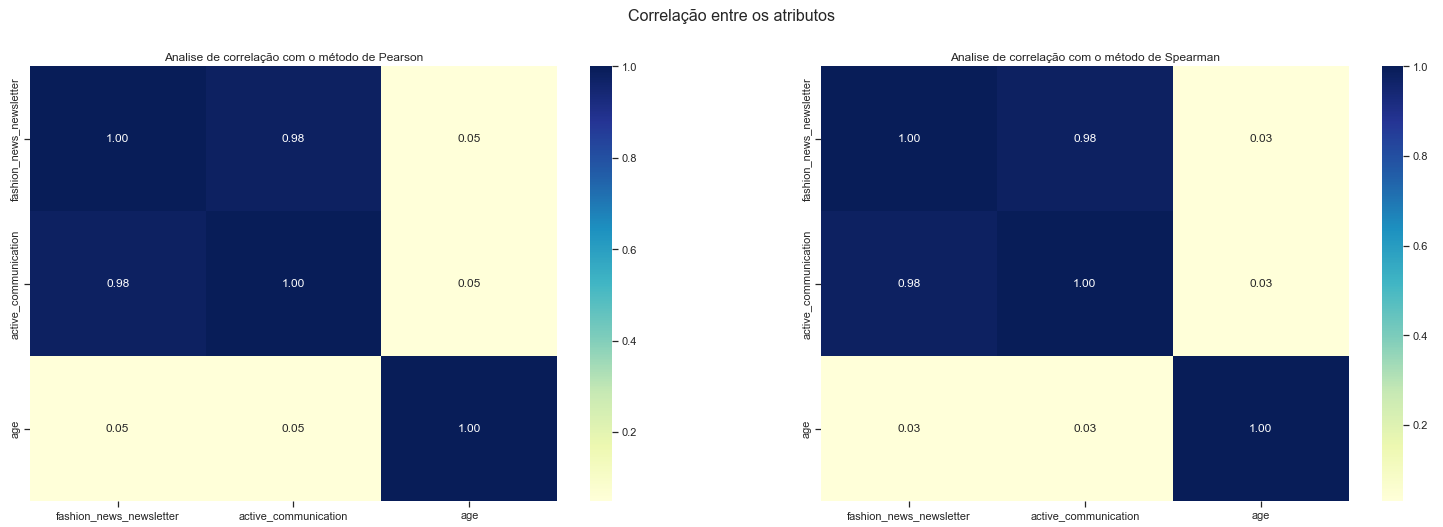
```
customer_id                0
fashion_news_newsletter    0
active_communication       0
club_member_status         0
fashion_news_frequency     0
age                        0
postal_code                0
dtype: int64
```

In [184]:

```
plt.figure(figsize=(26, 8))
plt.suptitle('Correlação entre os atributos', fontsize=16)
```

```
plt.subplot(1, 2, 1)
plt.title('Analise de correlação com o método de Pearson')
sns.heatmap(customers.corr(), annot = True, cmap= 'YlGnBu', fmt= '.2f');

plt.subplot(1, 2, 2)
plt.title('Analise de correlação com o método de Spearman')
sns.heatmap(customers.corr(method="spearman"), annot = True, cmap= 'YlGnBu', fmt= '.2f')
;
```



In [210]:

```
customers
```

Out[210]:

	customer_id	fashion_news_newsletter	active_communication	club_member_
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	A
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	A
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	A
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	A
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	A
...	...	...	...	
1362276	ffffbbf78b6eaac697a8a5dfbfd2bfa8113ee5b403e474...	0.0	0.0	A
1362277	ffffcd5046a6143d29a04fb8c424ce494a76e5cdf4fab5...	0.0	0.0	A
1362278	ffffcf35913a0bee60e8741cb2b4e78b8a98ee5ff2e6a1...	1.0	1.0	A
1362279	ffffd7744cebcf3aca44ae7049d2a94b87074c3d4ffe38...	1.0	1.0	A
1362280	ffffd9ac14e89946416d80e791d064701994755c3ab686...	0.0	0.0	PRE-C

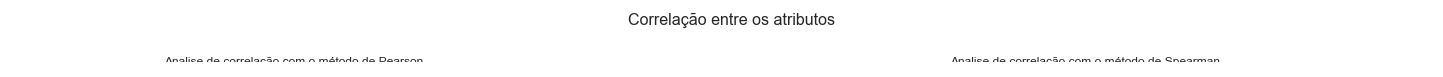
1362281 rows × 7 columns

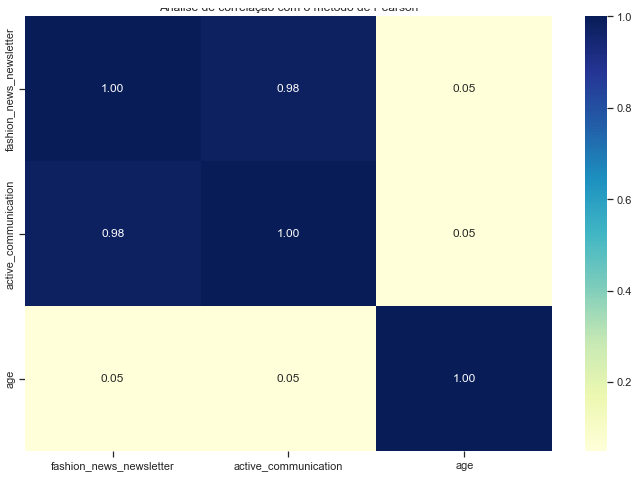
In [211]:

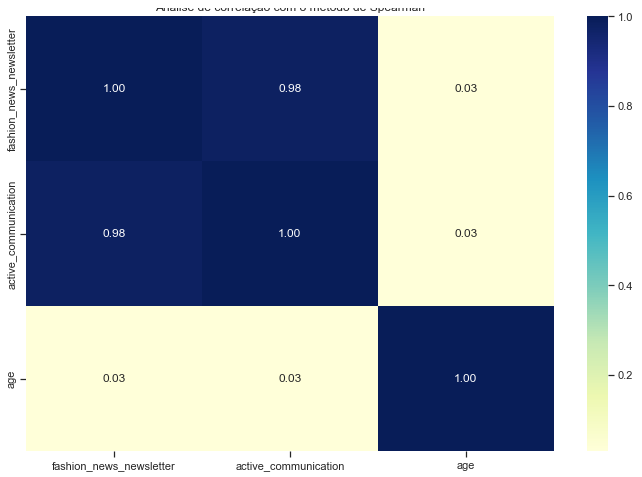
```
plt.figure(figsize=(26, 8))
plt.suptitle('Correlação entre os atributos', fontsize=16)

plt.subplot(1, 2, 1)
plt.title('Analise de correlação com o método de Pearson')
sns.heatmap(customers.corr(), annot = True, cmap= 'YlGnBu', fmt= '.2f');

plt.subplot(1, 2, 2)
plt.title('Analise de correlação com o método de Spearman')
sns.heatmap(customers.corr(method="spearman"), annot = True, cmap= 'YlGnBu', fmt= '.2f')
;
```







Transformações

In [247]:

```
def normalize(dt, attribute):
  dt[attribute] = (dt[attribute] - dt[attribute].min()) / (dt[attribute].max() - dt[attr
ibute].min())
```

In [213]:

```
from sklearn.preprocessing import OneHotEncoder
```

In [214]:

```
customers.head()
```

Out[214]:

	customer_id	fashion_news_newsletter	active_communication	club_member_status
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	ACTIVE
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	ACTIVE
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	ACTIVE
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	ACTIVE
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	ACTIVE

In [239]:

```
c_customers = customers.copy()
```

In [240]:

```
#creating instance of one-hot-encoder
encoder = OneHotEncoder(handle_unknown='ignore')

#perform one-hot encoding on 'team' column
encoder_df = pd.DataFrame(encoder.fit_transform(c_customers[['club_member_status']]).toar
ray())

c_customers = c_customers.join(encoder_df)
c_customers.head()
```

Out[240]:

	customer_id	fashion_news_newsletter	active_communication	club_member_status
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	ACTIVE
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	ACTIVE

	customer_id	fashion_news_newsletter	active_communication	club_member_status
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	ACTIVE
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	ACTIVE
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	ACTIVE

In [241]:

```
c_customers.loc[c_customers['club_member_status'] == 'LEFT CLUB']
```

Out[241]:

	customer_id	fashion_news_newsletter	active_communication	club_member_
5127	00fa6e1d4a247e2c81996af566b8aafd5cf766121d6906...	0.0	0.0	LEFT
5455	0108c5cb6d8a9103de36474ffc70c508fa9c361fc90b05...	0.0	0.0	LEFT
11281	021c897da6d36da705952b4ecc46e641b811e094d67f68...	0.0	0.0	LEFT
11359	02206adfebc3ceec651aee86a3cbb7db83bdbd44aff406...	0.0	0.0	LEFT
14762	02c3a111a4fce8b061a6baad19f1ca5322c3bea8386253...	0.0	0.0	LEFT
...	...	...	...	
1353638	fe5d81720a2ad64193c11617c7cfd069fc61d22f369837...	0.0	0.0	LEFT
1356905	fef8818faad84d92289fec9432ca848e56fb87e76073e9...	0.0	0.0	LEFT
1357441	ff128a0ed5bde04a8105c5d24fd2d141bca7cd1c3490c1...	0.0	0.0	LEFT
1361228	ffcc4dd5f7d2dc78a86729c8d6133debd17671cbbc52a8...	0.0	0.0	LEFT
1361466	ffd7d77fb2d081a05c849bc78a1a1550ff663d7a483bae...	1.0	0.0	LEFT

466 rows × 11 columns

In [242]:

```
c_customers.rename(columns = {0:'club_member_status_ACTIVE', 1:'club_member_status_LEFT_
CLUB', 2:'club_member_status_NEVER_JOINED', 3:'club_member_status_PRE_CREATE'}, inplace
= True)
c_customers.drop(['club_member_status'], axis=1, inplace=True)
c_customers.head()
```

Out[242]:

	customer_id	fashion_news_newsletter	active_communication	fashion_news_freque
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	NO
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	NO
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	NO
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	NO
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	Regul

In [244]:

```
#creating instance of one-hot-encoder
encoder = OneHotEncoder(handle_unknown='ignore')
#perform one-hot encoding on 'team' column
encoder_df = pd.DataFrame(encoder.fit_transform(c_customers[['fashion_news_frequency']]).
toarray())
c_customers = c_customers.join(encoder_df)
c_customers.head()
```

Out[244]:

	customer_id	fashion_news_newsletter	active_communication	fashion_news_freque

	customer_id	fashion_news_newsletter	active_communication	fashion_news_freque
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	NO
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	NO
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	NO
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	NO
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	Regul

In [245]:

```
c_customers.rename(columns = {0:'fashion_news_frequency_MONTHLY', 1:'fashion_news_freque
ncy_NONE', 2:'fashion_news_frequency_REGULARLY'}, inplace = True)
c_customers.drop(['fashion_news_frequency'], axis=1, inplace=True)
c_customers.head()
```

Out[245]:

	customer_id	fashion_news_newsletter	active_communication	age	
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	49.0	52043ee2162c
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	25.0	2973abc54da
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	24.0	64f17e6a330a
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	54.0	5d36574f5249
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	52.0	25fa5ddee9aac

In [248]:

```
normalize(c_customers, 'age')
```

In [249]:

```
c_customers.head()
```

Out[249]:

	customer_id	fashion_news_newsletter	active_communication	age	
0	00000dbacae5abe5e23885899a1fa44253a17956c6d1c3...	0.0	0.0	0.569767	52043ee2
1	0000423b00ade91418cceaf3b26c6af3dd342b51fd051e...	0.0	0.0	0.290698	2973abc
2	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	0.0	0.0	0.279070	64f17e6a
3	00005ca1c9ed5f5146b52ac8639a40ca9d57aeff4d1bd2...	0.0	0.0	0.627907	5d36574f
4	00006413d8573cd20ed7128e53b7b13819fe5cfc2d801f...	1.0	1.0	0.604651	25fa5ddee

In [253]:

```
articles.drop(['product_group_name'], axis=1, inplace=True)
```

In [254]:

```
c_articles = articles.copy()
```

In [255]:

```
c_articles.head()
```

Out[255]:

	article_id	product_code	product_type_no	graphical_appearance_no	colour_group_code	perceived_colour_value_id	percei
0	108775015	108775	253	1010016	9	4	

	article_id	product_code	product_type_no	graphical_appearance_no	colour_group_code	perceived_colour_value_id	percei
1	108775044	108775	253	1010016	10	3	
2	108775051	108775	253	1010017	11	1	
3	110065001	110065	306	1010016	9	4	
4	110065002	110065	306	1010016	10	3	

In [256]:

```
encoder = OneHotEncoder(handle_unknown='ignore')
encoder_df = pd.DataFrame(encoder.fit_transform(c_articles[['index_code']]).toarray())
c_articles = c_articles.join(encoder_df)
c_articles.head()
```

Out[256]:

	article_id	product_code	product_type_no	graphical_appearance_no	colour_group_code	perceived_colour_value_id	percei
0	108775015	108775	253	1010016	9	4	
1	108775044	108775	253	1010016	10	3	
2	108775051	108775	253	1010017	11	1	
3	110065001	110065	306	1010016	9	4	
4	110065002	110065	306	1010016	10	3	

5 rows × 23 columns

In [265]:

```
c_articles.loc[c_articles['index_code'] == 'S'].head()
```

Out[265]:

	article_id	product_code	product_type_no	graphical_appearance_no	colour_group_code	perceived_colour_value_id	perc
40	145872001	145872	252	1010016	9	4	
41	145872037	145872	252	1010010	8	4	
42	145872043	145872	252	1010016	10	3	
43	145872051	145872	254	1010010	9	4	
44	145872052	145872	252	1010010	73	4	

5 rows × 23 columns

In [266]:

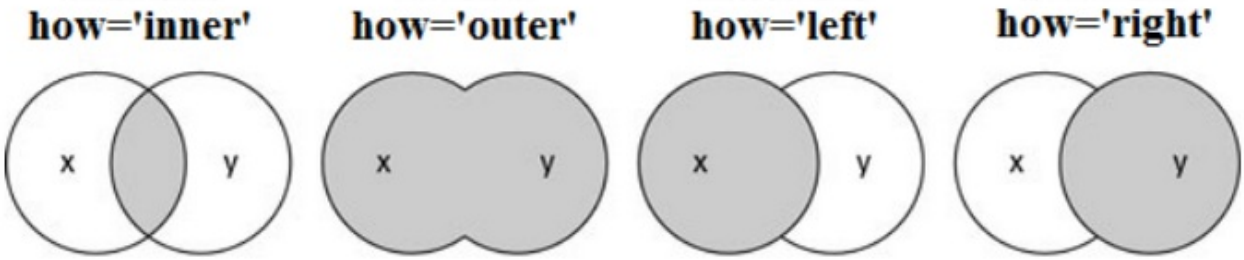
```
c_articles.rename(columns = {
    0:'index_code_A',
    1:'index_code_B',
```

```
    2:'index_code_C',
    3:'index_code_D',
    4:'index_code_F',
    5:'index_code_G',
    6:'index_code_H',
    7:'index_code_I',
    8:'index_code_J',
    9:'index_code_S',
    }, inplace = True)
c_articles.head()
```

Out[266]:

	article_id	product_code	product_type_no	graphical_appearance_no	colour_group_code	perceived_colour_value_id	percei
0	108775015	108775	253	1010016	9	4	
1	108775044	108775	253	1010016	10	3	
2	108775051	108775	253	1010017	11	1	
3	110065001	110065	306	1010016	9	4	
4	110065002	110065	306	1010016	10	3	

5 rows × 23 columns



In [212]:

```
count_transactions = transactions['customer_id'].value_counts().rename_axis('customer_id'
).reset_index(name='n_transactions')
```

In [268]:

```
c_transactions = transactions.copy()
```

In [269]:

```
transactions_join_customers = pd.merge(c_transactions, c_customers, on="customer_id", ho
w="left")
```

In [270]:

```
transactions_join_customers.head()
```

Out[270]:

	t_dat	customer_id	article_id	price	sales_channel_id	fashion_news_newslett
0	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	663713001	0.050831	2	0
1	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	541518023	0.030492	2	0
2	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	505221004	0.015237	2	1
3	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687003	0.016932	2	1
4	2018-					

	t_dat	customer_id	article_id	price	sales_channel_id	fashion_news_newslett
4	09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687004	0.016932	2	1

In [271]:

```
transactions_join_customers.shape
```

Out[271]:

```
(31788324, 16)
```

In [272]:

```
dt = pd.merge(transactions_join_customers, c_articles, on="article_id", how="left")
```

In [273]:

```
dt.shape
```

Out[273]:

```
(31788324, 38)
```

In [274]:

```
dt.isnull().sum()
```

Out[274]:

```
t_dat                                0
customer_id                          0
article_id                           0
price                                0
sales_channel_id                     0
fashion_news_newsletter              0
active_communication                 0
age                                  0
postal_code                          0
club_member_status_ACTIVE            0
club_member_status_LEFT_CLUB         0
club_member_status_NEVER_JOINED      0
club_member_status_PRE_CREATE        0
fashion_news_frequency_MONTHLY       0
fashion_news_frequency_NONE          0
fashion_news_frequency_REGULARLY     0
product_code                         0
product_type_no                      0
graphical_appearance_no              0
colour_group_code                    0
perceived_colour_value_id            0
perceived_colour_master_id           0
department_no                        0
index_code                           0
index_group_no                       0
section_no                           0
garment_group_no                     0
detail_desc                          0
index_code_A                         0
index_code_B                         0
index_code_C                         0
index_code_D                         0
index_code_F                         0
index_code_G                         0
index_code_H                         0
index_code_I                         0
index_code_J                         0
index_code_S                         0
dtype: int64
```

In [275]:

```
dt.head()
```

Out[275]:

	t_dat	customer_id	article_id	price	sales_channel_id	fashion_news_newslett
0	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	663713001	0.050831	2	0
1	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	541518023	0.030492	2	0
2	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	505221004	0.015237	2	1
3	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687003	0.016932	2	1
4	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687004	0.016932	2	1

5 rows × 38 columns

In [276]:

```
c_dt = dt.copy()
```

In [287]:

```
#from sklearn.preprocessing import LabelEncoder
#c_dt['customer_id_no'] = c_dt[['customer_id']].apply(LabelEncoder().fit_transform)
```

In [288]:

```
c_dt.head()
```

Out[288]:

	t_dat	customer_id	article_id	price	sales_channel_id	fashion_news_newslett
0	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	663713001	0.050831	2	0
1	2018-09-20	000058a12d5b43e67d225668fa1f8d618c13dc232df0ca...	541518023	0.030492	2	0
2	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	505221004	0.015237	2	1
3	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687003	0.016932	2	1
4	2018-09-20	00007d2de826758b65a93dd24ce629ed66842531df6699...	685687004	0.016932	2	1

5 rows × 39 columns