Importing necessary libraries and data

In [22]:

```
from pandas import read_csv
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import matplotlib.ticker as mtick
from matplotlib.patches import ConnectionPatch
from sklearn.impute import SimpleImputer
from wordcloud import WordCloud
#data = read_csv('B1X3-Orientation_MLAI_vinchinois_4-27-2023_8_56.csv')
#print(dt)
```

In [3]:

```
data = pd.read_excel('BX3-Orientation_MLAI_vinchinois_4-27-2023_8_57.xlsx
```

Checking the data

In [83]:

```
# shape of our data (5110 rows and 12 column)
data.shape
```

Out[83]:

```
(75, 41)
```

In [84]:

```
# counting the values of each level from the gender column.
data["1_Civilisation"].value_counts(normalize=False)
```

Out[84]:

```
Femme     37
Homme     36
Name: 1_Civilisation, dtype: int64
```

In [85]:

```
PieData = pd.DataFrame(data["1_Civilisation"].value_counts(normalize=Fals
```

In [86]:

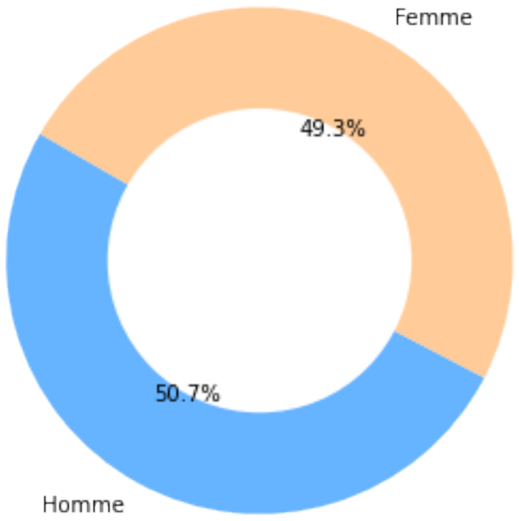
```
PieData
```

Out[86]:

	1_Civilisation
Femme	37
Homme	36

In [87]:

```
#Checking the percentages of stroke and no-stroke
PieData = pd.DataFrame(data["1_Civilisation"].value_counts(normalize=Fals

labels=['Homme','Femme']
colors = ['#66b3ff','#ffcc99']

fig1, ax1 = plt.subplots()
ax1.pie(PieData['1_Civilisation'], colors = colors, labels=labels, autopc

centre_circle = plt.Circle((0,0),0.60,fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)

ax1.axis('equal')
plt.tight_layout()
plt.show()
```



In [88]:

```
région = pd.DataFrame(data["5_Region"].value_counts(normalize=False))
région
```

Out[88]:

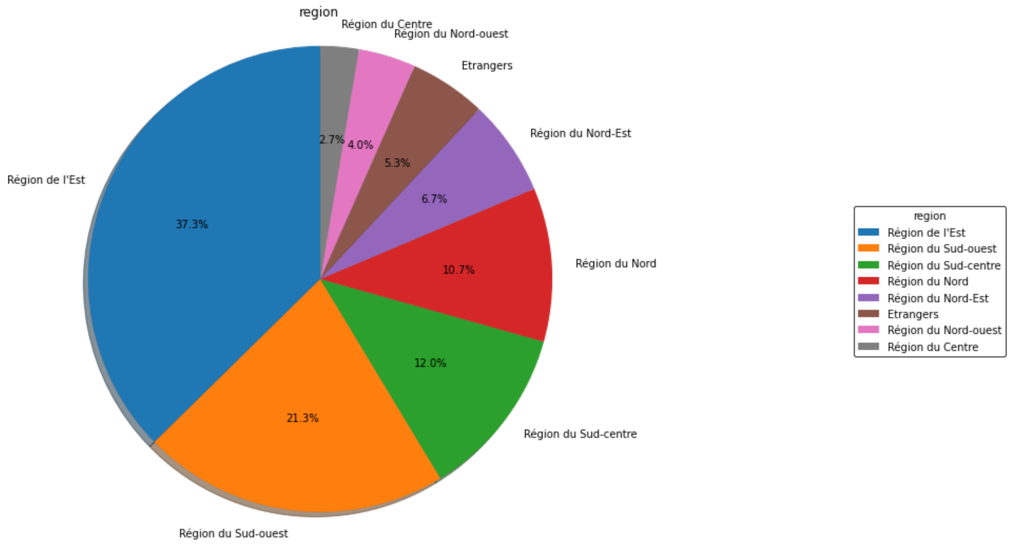
	5_Region
Région de l'Est (Huadong)	28
Région du Sud-ouest (Xi'nan)	16
Région du Sud-centre (Zhongnan)	9
Région du Nord (Huabei)	8
Région du Nord-Est (Dongbei)	5
Etrangers	4
Région du Nord-ouest (Xibei)	3
Région du Centre (Huazhong)	2

In [89]:

```
fig, ax = plt.subplots(figsize=(18, 9), subplot_kw=dict(aspect="equal"))
labels = "Région de l'Est", "Région du Sud-ouest", "Région du Sud-centre"

sizes = [28,16,9,8,5,4,3,2]
#explode = (0, 0)
ax.set_title("region")
ax.pie(sizes ,labels=labels, autopct='%1.1f%%',
        shadow=True, startangle=90)
ax.axis('equal')
#plt.title("\nStroke Patient's Gender",fontsize=25)
ax.legend(labels, title="region",loc="center left",bbox_to_anchor=(1, 0,0
```

Out[89]:

```
<matplotlib.legend.Legend at 0x7fbbd879a820>
```



In [90]:

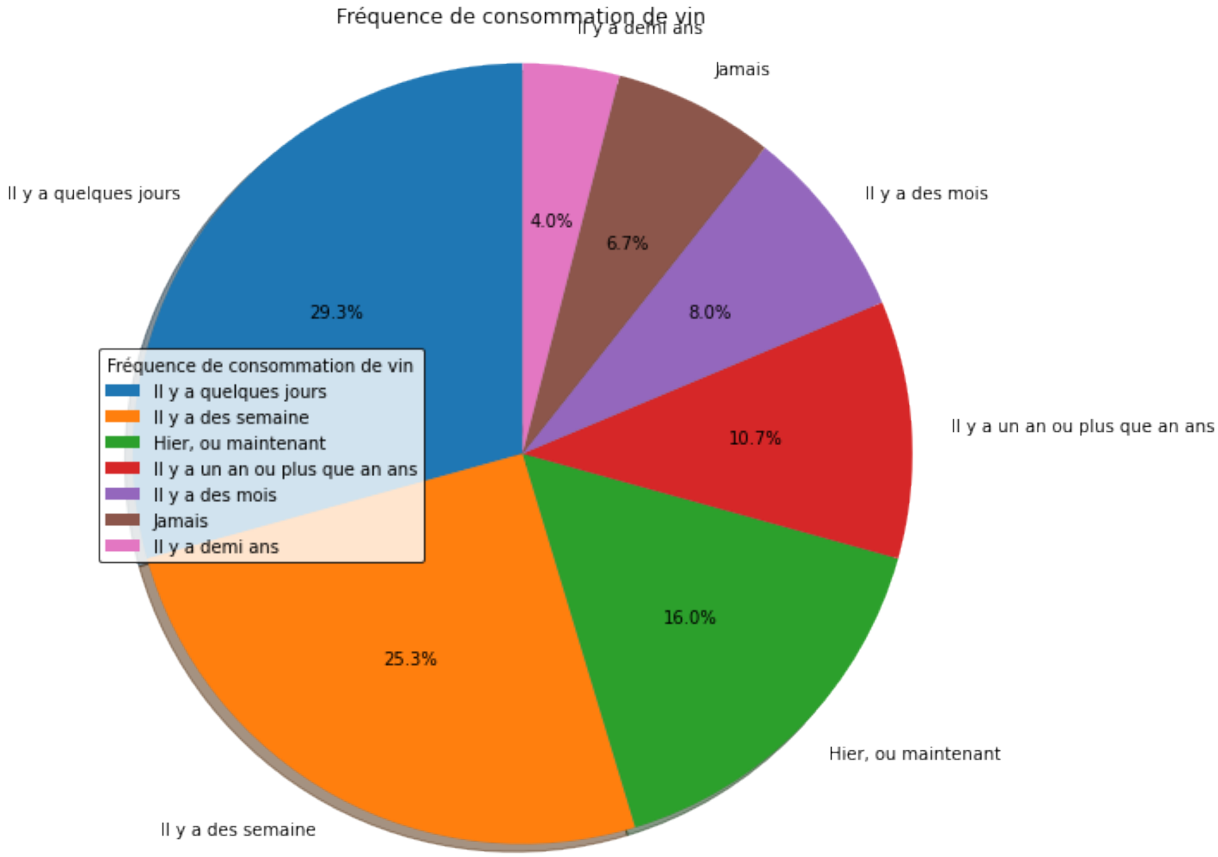
```
fréquance = pd.DataFrame(data["24_frequence"].value_counts(normalize=Fals
fréquance
```

Out[90]:

	24_frequence
Il y a quelques jours	22
Il y a des semaine	19
Hier, ou maintenant !	12
Il y a un an ou plus que an ans.	8
Il y a des mois	6
Jamais	5
Il y a demi ans.	3

In [91]:

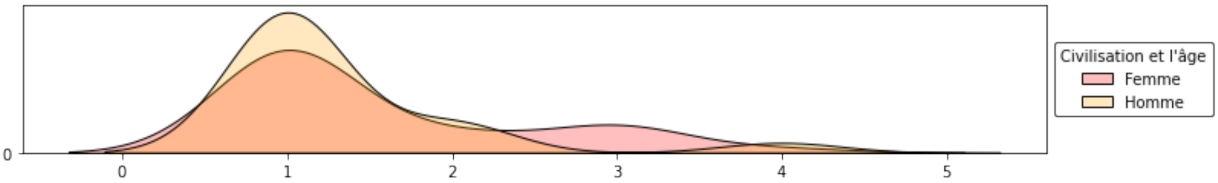
```
fig, ax = plt.subplots(figsize=(9, 9), subplot_kw=dict(aspect="equal"))
labels = "Il y a quelques jours", "Il y a des semaine", "Hier, ou mainten

sizes = [22,19,12,8,6,5,3]
#explode = (0, 0)
ax.set_title("Fréquence de consommation de vin")
ax.pie(sizes ,labels=labels, autopct='%1.1f%%',
        shadow=True, startangle=90)
ax.axis('equal')
#plt.title("\nStroke Patient's Gender",fontsize=25)
ax.legend(labels, title="Fréquence de consommation de vin",loc="center le
Out[91]: <matplotlib.legend.Legend at 0x7fbbeedc2700>
```



```
In [ ]:
```

```
In [102…
fig, ax2 = plt.subplots(figsize=(12, 12), subplot_kw=dict(aspect="equal")
labels2 = ['Femme','Homme']
ax2.grid(color='gray', linestyle=':', axis='y', zorder=0,  dashes=(1,5))
Femme = pd.DataFrame(data[(data["1_Civilisation"] == "Homme")])
Homme = pd.DataFrame(data[(data["1_Civilisation"] == "Femme")])
sns.kdeplot(Femme["3_Age"], ax=ax2,color="red", ec='black',shade=True, la
sns.kdeplot(Homme["3_Age"], ax=ax2, color="orange",ec='black', shade=True
#ax2.text(-0.06, 0.09, 'BMI',fontsize=14, fontweight='bold', fontfamily='
ax2.yaxis.set_major_locator(mtick.MultipleLocator(2))
ax2.set_ylabel('')
ax2.set_xlabel('')
ax2.legend(labels2, title="Civilisation et l'âge",loc="center left",bbox_
#l'âge
#1 = 18-29
#2 = 30-39
#3 = 40-49
#4 = 50 +
```

```
Out[102]: <matplotlib.legend.Legend at 0x7fbbeef740a0>
```



In [103…

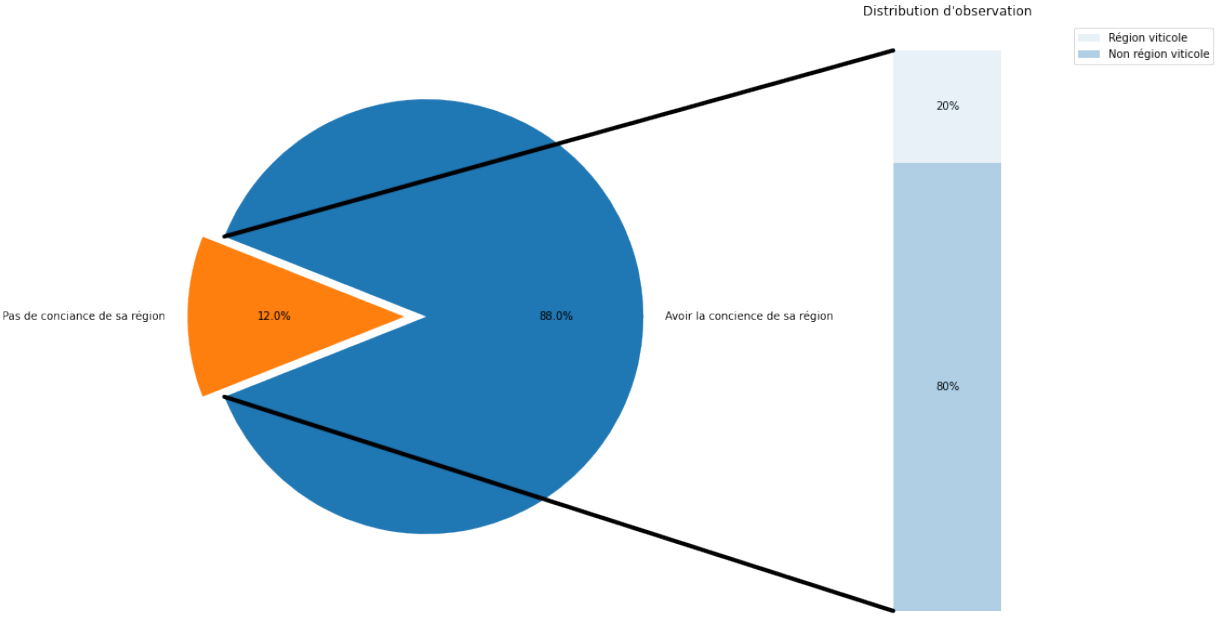
```
# Question 6
savoir = pd.DataFrame(data["6_OrigineDomaine"].value_counts(normalize=Fal
savoir
```

Out[103]:

	6_OrigineDomaine
Non	53
Oui	13
Je ne sais pas	9

In [113…

```
labels = "Non","Oui","Pas de Concience"

# make figure and assign axis objects
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(18, 10))
fig.subplots_adjust(wspace=0)

# pie chart parameters
overall_ratios = [.88, .12]
labels = ['Avoir la concience de sa région', 'Pas de conciance de sa régi
explode = [0.1, 0]
# rotate so that first wedge is split by the x-axis
angle = -180 * overall_ratios[0]
wedges, *_ = ax1.pie(overall_ratios, autopct='%1.1f%%', startangle=angle,
                     labels=labels, explode=explode)

# bar chart parameters
age_ratios = [.80, .20]
age_labels = ['Non région viticole', 'Région viticole']
bottom = 1
width = .2

# Adding from the top matches the legend.
for j, (height, label) in enumerate(reversed([*zip(age_ratios, age_labels
    bottom -= height
    bc = ax2.bar(0, height, width, bottom=bottom, color='C0', label=label
                 alpha=0.1 + 0.25 * j)
    ax2.bar_label(bc, labels=[f"{height:.0%}"], label_type='center')

ax2.set_title("Distribution d'observation")
ax2.legend()
ax2.axis('off')
ax2.set_xlim(- 2.5 * width, 2.5 * width)

# use ConnectionPatch to draw lines between the two plots
theta1, theta2 = wedges[0].theta1, wedges[0].theta2
center, r = wedges[0].center, wedges[0].r
bar_height = sum(age_ratios)

# draw top connecting line
x = r * np.cos(np.pi / 180 * theta2) + center[0]
y = r * np.sin(np.pi / 180 * theta2) + center[1]
con = ConnectionPatch(xyA=(-width / 2, bar_height), coordsA=ax2.transData
                      xyB=(x, y), coordsB=ax1.transData)
con.set_color([0, 0, 0])
con.set_linewidth(4)
ax2.add_artist(con)

# draw bottom connecting line
x = r * np.cos(np.pi / 180 * theta1) + center[0]
y = r * np.sin(np.pi / 180 * theta1) + center[1]
con = ConnectionPatch(xyA=(-width / 2, 0), coordsA=ax2.transData,
                      xyB=(x, y), coordsB=ax1.transData)
con.set_color([0, 0, 0])
ax2.add_artist(con)
con.set_linewidth(4)

plt.show()
```



In [132…

```
ciyun1 = pd.DataFrame(data["8_VinNation"].value_counts(normalize=False))
ciyun1
```

Out[132]:

	8_VinNation
NingXia	11
ShanDong	11
XinJiang	11
GanSu	4
HeBei	3
GuiZhou	1
YunNan	1

In [138…

```
ciyun1 = data['8_VinNation'].dropna().value_counts(normalize=False).to_di
wc = WordCloud(width=1200, height=800, background_color='white')

wc.generate_from_frequencies(ciyun1)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```

NingXia
YunNan
GuiZhou
GanSu
XinJiang
ShanDong
HeBei

In [144…

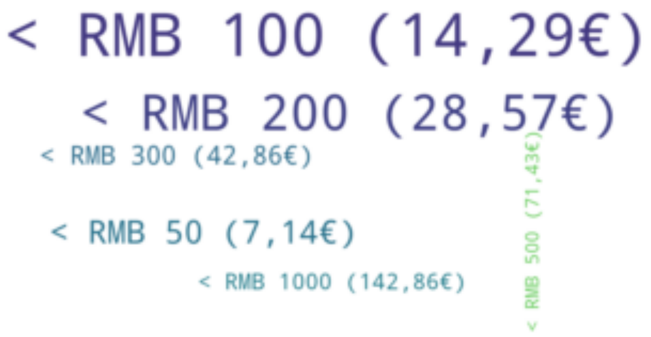
```
ciyun3 = pd.DataFrame(data["10_bas_gamme"].value_counts(normalize=False))
ciyun3
```

Out[144]:

	10_bas_gamme
< RMB 100 (14,29€)	34
< RMB 200 (28,57€)	23
< RMB 50 (7,14€)	7
< RMB 300 (42,86€)	4
< RMB 1000 (142,86€)	3
< RMB 500 (71,43€)	2

In [150…

```
ciyun3 = data['10_bas_gamme'].dropna().value_counts(normalize=False).to_d
wc = WordCloud(width=1600, height=800, background_color='white')

wc.generate_from_frequencies(ciyun3)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```



In [ ]:

```
conda install -c conda-forge wordcloud #第一次运行下载这个
```

In [142…

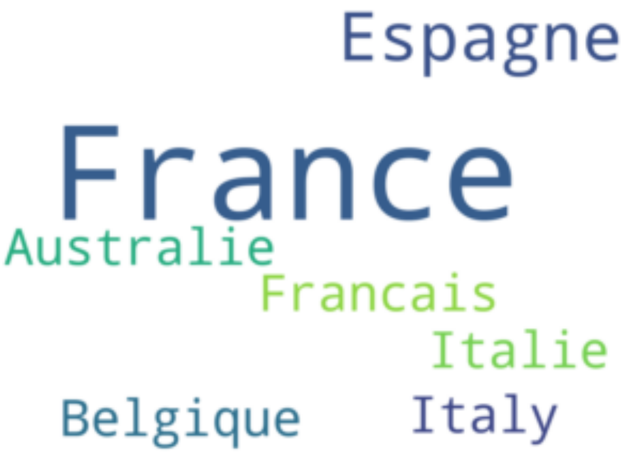
```
ciyun2 = pd.DataFrame(data["9_VinImport"].value_counts(normalize=False))
ciyun2
```

Out[142]:

	9_VinImport
France	65
Espagne	2
Australie	1
Belgique	1
Italy	1
Francais	1
Italie	1

In [143…

```
ciyun2 = data['9_VinImport'].dropna().value_counts(normalize=False).to_di
wc = WordCloud(width=1200, height=800, background_color='white')

wc.generate_from_frequencies(ciyun2)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```



In [151…

```
#Moyenne gamme
Moyennegmmme = pd.DataFrame(data["11_milieu_gamme"].value_counts(normaliz
Moyennegmmme
```

Out[151]:

	11_milieu_gamme
< RMB 300 (42,86€)	30
< RMB 200 (28,57€)	20
< RMB 500 (71,43€)	19
< RMB 1000 (142,86€)	4
< RMB 100 (14,29€)	2

In [173…

```
Moyennegmmme = data['11_milieu_gamme'].dropna().value_counts(normalize=Fa
wc = WordCloud(width=1200, height=800, background_color='white')

wc.generate_from_frequencies(Moyennegmmme)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```

< RMB 1000 (142,86€)
< RMB 300 (42,86€)
< RMB 100 (14,29€)
< RMB 500 (71,43€)
< RMB 200 (28,57€)

In [174…

```
#haut gamme
haut_gamme = pd.DataFrame(data["12_haut_gamme"].value_counts(normalize=Fa
haut_gamme
```

Out[174]:

	12_haut_gamme
< RMB 1000 (142,86€)	38
< RMB 500 (71,43€)	17
< RMB 300 (42,86€)	15
< RMB 200 (28,57€)	2
< RMB 100 (14,29€)	1

In [182…

```
Moyennegmmme = data['12_haut_gamme'].dropna().value_counts(normalize=Fals
wc = WordCloud(width=1200, height=800, background_color='white')

wc.generate_from_frequencies(Moyennegmmme)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```

< RMB 300 (42,86€)
< RMB 1000 (142,86€)
< RMB 200 (28,57€)
< RMB 100 (14,29€)
< RMB 500 (71,43€)

In [183…

```
#13_grand_cru
grand = pd.DataFrame(data["13_grand_cru"].value_counts(normalize=False))
grand
```

Out[183]:

	13_grand_cru
milieu de gamme	45
haut de gamme	24
Bas de gamme	6

In [184…

```
Moyennegmmme = data['13_grand_cru'].dropna().value_counts(normalize=False
wc = WordCloud(width=1200, height=800, background_color='white')

wc.generate_from_frequencies(Moyennegmmme)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```

haut de gamme
Bas de gamme
milieu de gamme

In [5]:

```
#SatisPub
satisfait = pd.DataFrame(data["14_SatisPub"].value_counts(normalize=False
satisfait
```

Out[5]:

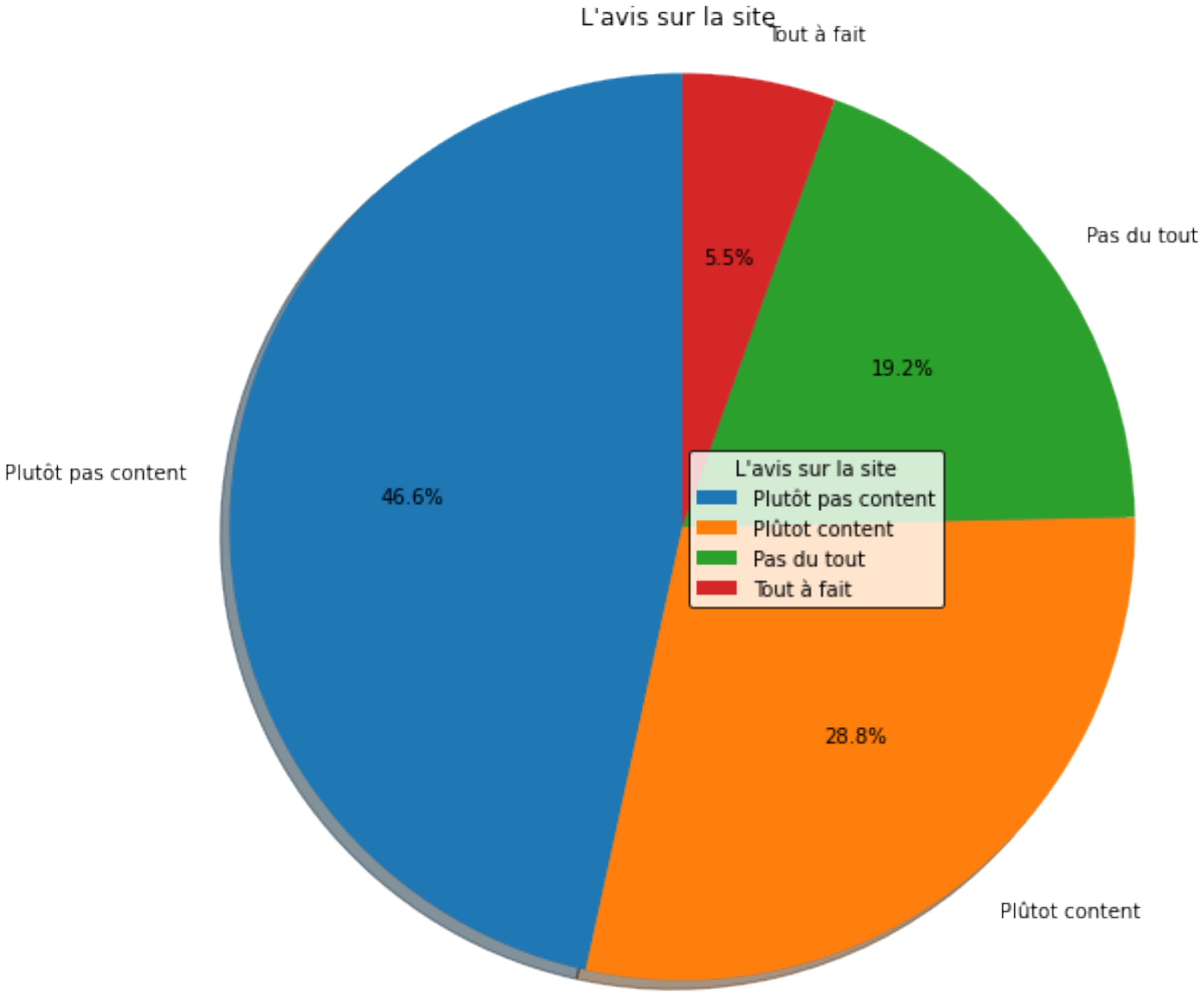
	14_SatisPub
Plutôt pas content	34
Plûtot content	21
Pas du tout	14
Tout à fait	4

In [13]:

```
fig, ax = plt.subplots(figsize=(9, 9), subplot_kw=dict(aspect="equal"))
labels = "Plutôt pas content", "Plûtot content", "Pas du tout","Tout à fa

sizes = [34,21,14,4]
#explode = (0, 0)
ax.set_title("L'avis sur la site")
ax.pie(sizes ,labels=labels, autopct='%1.1f%%',
        shadow=True, startangle=90)
ax.axis('equal')
#plt.title("\nStroke Patient's Gender",fontsize=25)
ax.legend(labels, title="L'avis sur la site",loc="center left",bbox_to_an
```

Out[13]:

```
<matplotlib.legend.Legend at 0x7fb1981ee190>
```

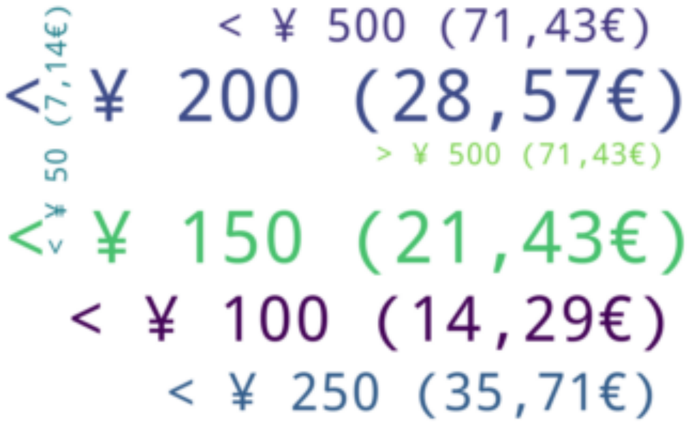


```
In [14]: #SatisPub
         q15 = pd.DataFrame(data["15_prixpub"].value_counts(normalize=False))
         q15
```

Out[14]:

	15_prixpub
< ¥ 200 (28,57€)	19
< ¥ 150 (21,43€)	19
< ¥ 100 (14,29€)	14
< ¥ 250 (35,71€)	9
< ¥ 500 (71,43€)	7
< ¥ 50 (7,14€)	2
> ¥ 500 (71,43€)	2

```
In [23]: Moyennegmmme = data['15_prixpub'].dropna().value_counts(normalize=False).
         wc = WordCloud(width=1200, height=800, background_color='white')

         wc.generate_from_frequencies(Moyennegmmme)

         plt.imshow(wc, interpolation='bilinear')
         plt.axis("off")
         plt.show()
```



In [65]:
```
#Q18
q18 = pd.DataFrame(data["18_FondPhoto"].value_counts(normalize=False))
q18
```

Out[65]:

	18_FondPhoto
Oui	55
Non	20

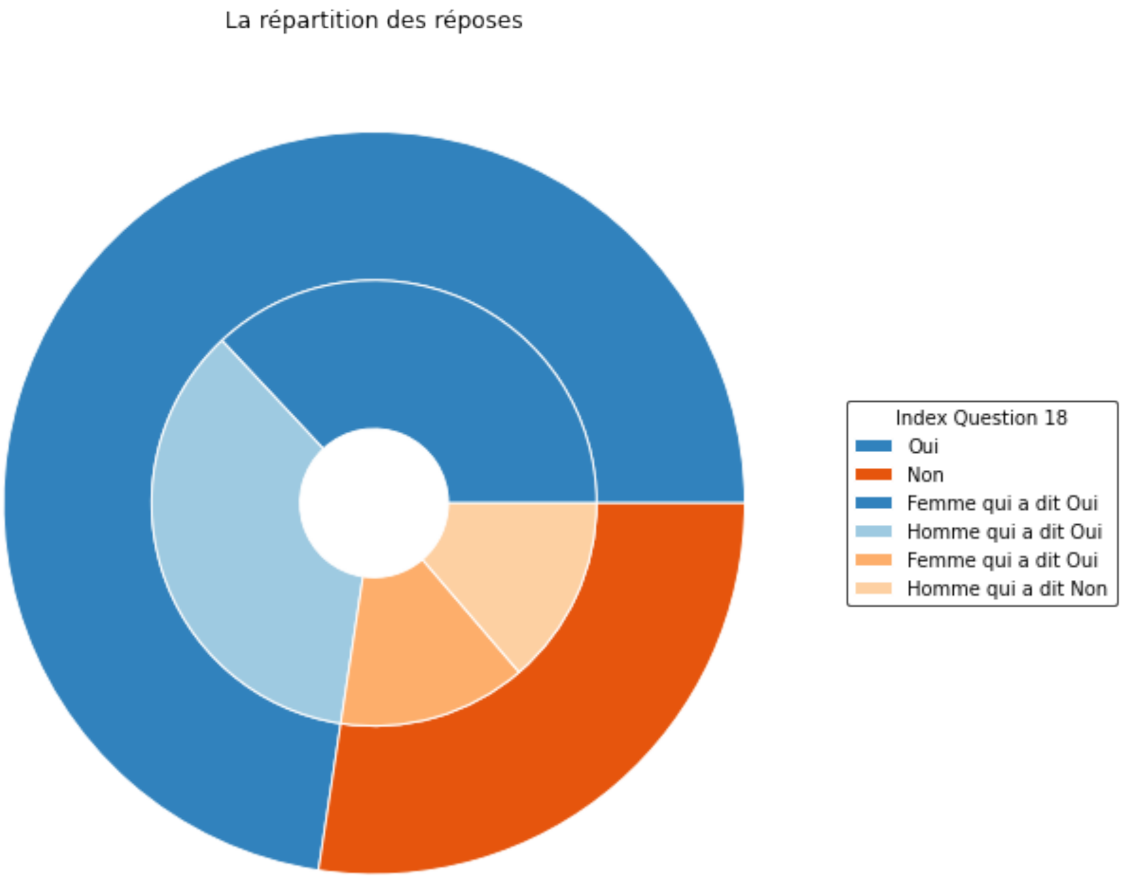
In [66]:
```
HommeOui = len(data[(data["1_Civilisation"] == "Femme") & (data["18_FondP
HommeNon = len(data[(data["1_Civilisation"] == "Femme") & (data["18_FondP
FemmeOui = len(data[(data["1_Civilisation"] == "Homme") & (data["18_FondP
FemmeNon = len(data[(data["1_Civilisation"] == "Homme") & (data["18_FondP
```

In [67]:
```
FemmeNon
```

Out[67]:
```
10
```

In [68]:
```
labels1 = ('Oui', 'Non', 'Femme qui a dit Oui', 'Homme qui a dit Oui' , '
#fig, ax1 = plt.subplots()
fig, ax1 = plt.subplots(figsize=(9, 9), subplot_kw=dict(aspect="equal"))
size = 0.4
vals = np.array([[HommeOui, FemmeOui], [HommeNon, FemmeNon]])

cmap = plt.colormaps["tab20c"]
outer_colors = cmap(np.arange(3)*4)
inner_colors = cmap([0, 2, 6, 7])

ax1.pie(vals.sum(axis=1), radius=1, colors=outer_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.pie(vals.flatten(), radius=1-size, colors=inner_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.set(aspect="equal", title="La répartition des réposes")
ax1.legend(labels1, title="Index Question 18",loc="center left",bbox_to_a
```

Out[68]:
```
<matplotlib.legend.Legend at 0x7fb1c9ec80d0>
```


La répartition des réposes

In [69]:

```
#Q19
q19 = pd.DataFrame(data["19_AppaGout"].value_counts(normalize=False))
HommeOui = len(data[(data["1_Civilisation"] == "Femme") & (data["19_AppaG
HommeNon = len(data[(data["1_Civilisation"] == "Femme") & (data["19_AppaG
FemmeOui = len(data[(data["1_Civilisation"] == "Homme") & (data["19_AppaG
FemmeNon = len(data[(data["1_Civilisation"] == "Homme") & (data["19_AppaG
```

In [70]:

```
q19
```

Out[70]:

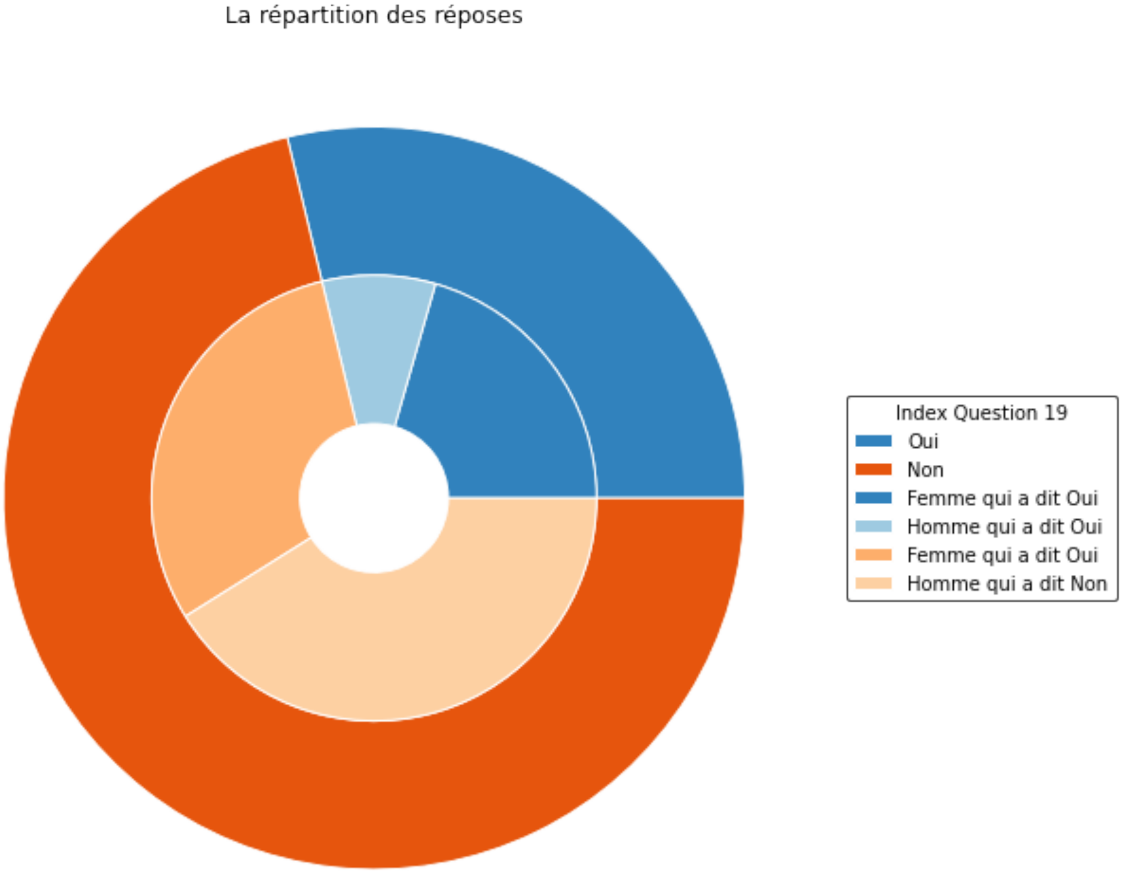
	19_AppaGout
Non	53
Oui	22

In [71]:

```
labels1 = ('Oui', 'Non', 'Femme qui a dit Oui', 'Homme qui a dit Oui' , '
#fig, ax1 = plt.subplots()
fig, ax1 = plt.subplots(figsize=(9, 9), subplot_kw=dict(aspect="equal"))
size = 0.4
vals = np.array([[HommeOui, FemmeOui], [HommeNon, FemmeNon]])

cmap = plt.colormaps["tab20c"]
outer_colors = cmap(np.arange(3)*4)
inner_colors = cmap([0, 2, 6, 7])

ax1.pie(vals.sum(axis=1), radius=1, colors=outer_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.pie(vals.flatten(), radius=1-size, colors=inner_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.set(aspect="equal", title="La répartition des réposes")
ax1.legend(labels1, title="Index Question 19",loc="center left",bbox_to_a
```

Out[71]:

```
<matplotlib.legend.Legend at 0x7fb1c9ec8d90>
```



In [72]:

```
#20_MondeouChinois
q20 = pd.DataFrame(data["20_MondeouChinois"].value_counts(normalize=False
HommeOui = len(data[(data["1_Civilisation"] == "Femme") & (data["20_Monde
HommeNon = len(data[(data["1_Civilisation"] == "Femme") & (data["20_Monde
FemmeOui = len(data[(data["1_Civilisation"] == "Homme") & (data["20_Monde
FemmeNon = len(data[(data["1_Civilisation"] == "Homme") & (data["20_Monde
```

In [73]:

```
HommeOui#29
HommeNon#7
FemmeOui#23
FemmeNon#13
q20
```

Out[73]:

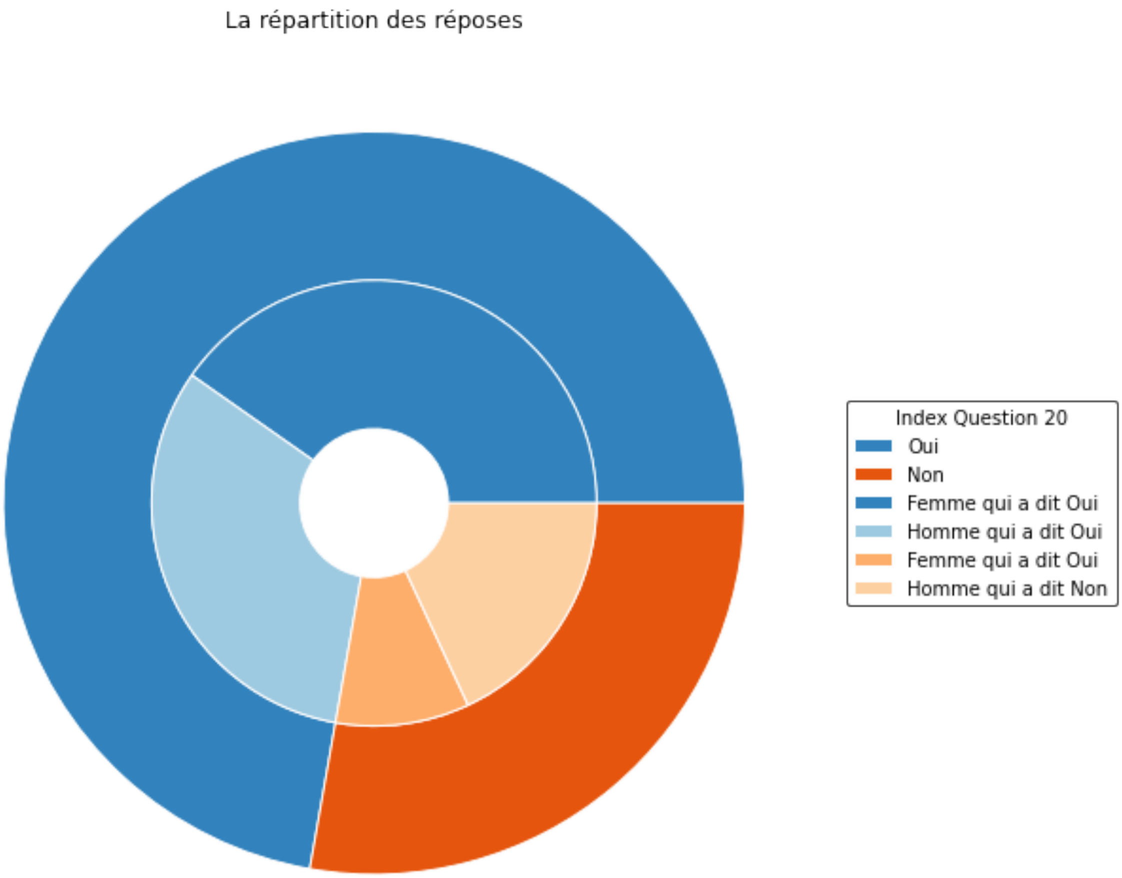
	20_MondeouChinois
Oui	53
Non	21

In [74]:

```
labels1 = ('Oui', 'Non', 'Femme qui a dit Oui', 'Homme qui a dit Oui' , '
#fig, ax1 = plt.subplots()
fig, ax1 = plt.subplots(figsize=(9, 9), subplot_kw=dict(aspect="equal"))
size = 0.4
vals = np.array([[HommeOui, FemmeOui], [HommeNon, FemmeNon]])

cmap = plt.colormaps["tab20c"]
outer_colors = cmap(np.arange(3)*4)
inner_colors = cmap([0, 2, 6, 7])

ax1.pie(vals.sum(axis=1), radius=1, colors=outer_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.pie(vals.flatten(), radius=1-size, colors=inner_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.set(aspect="equal", title="La répartition des réposes")
ax1.legend(labels1, title="Index Question 20",loc="center left",bbox_to_a
```

Out[74]:

```
<matplotlib.legend.Legend at 0x7fb198a05b80>
```



In [75]:

```
#Question 25
split_data = data['25_canaux_achat'].str.split(';')

# 将每个列表元素拆分成一个单独的行
exploded_data = split_data.explode()

# 统计每个单词的出现次数
word_counts = exploded_data.value_counts()
```

In [76]:

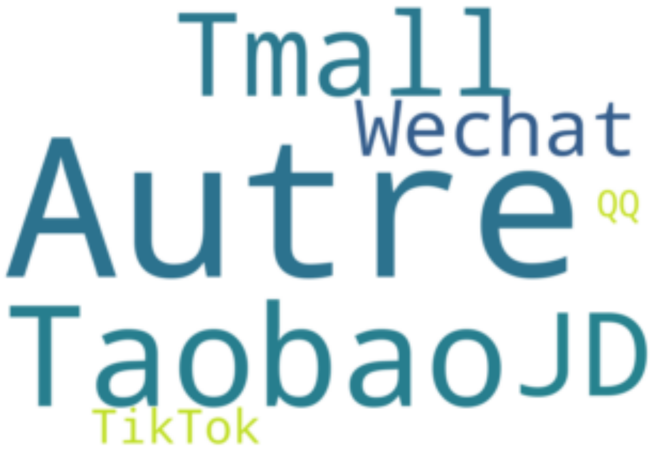
```
word_counts
```

Out[76]:

```
Autre      45
Taobao     20
Tmall      13
JD         13
Wechat     10
TikTok      2
QQ          1
Name: 25_canaux_achat, dtype: int64
```

In [78]:

```
Moyennegmmme = word_counts.to_dict()
wc = WordCloud(width=1200, height=800, background_color='white')

wc.generate_from_frequencies(Moyennegmmme)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```



In [79]:

```
# Question 27
split_data = data['27_modivation'].str.split(';')

# 将每个列表元素拆分成一个单独的行
exploded_data = split_data.explode()

# 统计每个单词的出现次数
word_counts = exploded_data.value_counts()
word_counts
```

Out[79]:

```
Achetez et buvez pour vous-même    61
Cadeaux                            28
Apprentissage et éducation         11
Collection ou investissement       10
Autre                               5
Name: 27_modivation, dtype: int64
```

In [94]:

```
Moyennegmmme = word_counts.to_dict()
wc = WordCloud(width=1200, height=600, background_color='white')

wc.generate_from_frequencies(Moyennegmmme)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```

Apprentissage et éducation
Achetez et buvez pour vous-même
Cadeaux
Autre
Collection ou investissement

In [95]:

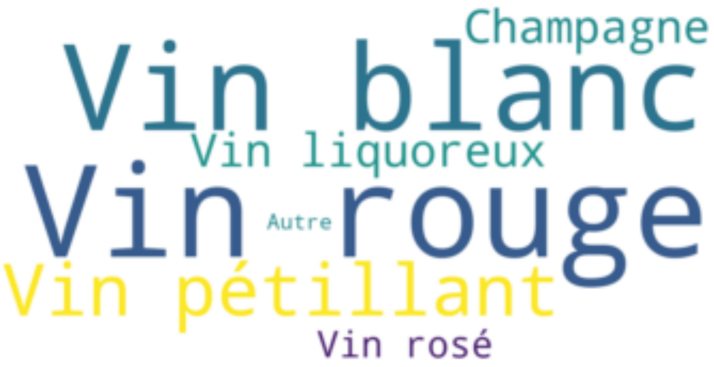
```
# Question 29
split_data = data['29_Quel_type_de_vin_buvez-vous_souvent'].str.split(';'

# 将每个列表元素拆分成一个单独的行
exploded_data = split_data.explode()

# 统计每个单词的出现次数
word_counts = exploded_data.value_counts()
word_counts
```

Out[95]:

```
Vin rouge        52
Vin blanc        45
Vin pétillant    31
Vin liquoreux    27
Champagne        27
Vin rosé         16
Autre             3
Name: 29_Quel_type_de_vin_buvez-vous_souvent, dtype: int64
```

In [96]:

```
Moyennegmmme = word_counts.to_dict()
wc = WordCloud(width=1200, height=600, background_color='white')

wc.generate_from_frequencies(Moyennegmmme)

plt.imshow(wc, interpolation='bilinear')
plt.axis("off")
plt.show()
```



In [18]:

```
#filling the  missing values in bmi column with the mean of bmi values

imp_mean = SimpleImputer(missing_values=np.nan, strategy='mean')

data['bmi'] = imp_mean.fit_transform(data['bmi'].values.reshape(-1,1))

data.isna().sum()
```

Out[18]:

```
id                   0
gender               0
age                  0
hypertension         0
heart_disease        0
ever_married         0
work_type            0
Residence_type       0
avg_glucose_level    0
bmi                  0
smoking_status       0
stroke               0
dtype: int64
```

We can see that the missing values no longer exist

3. Exploratory Data Analysis

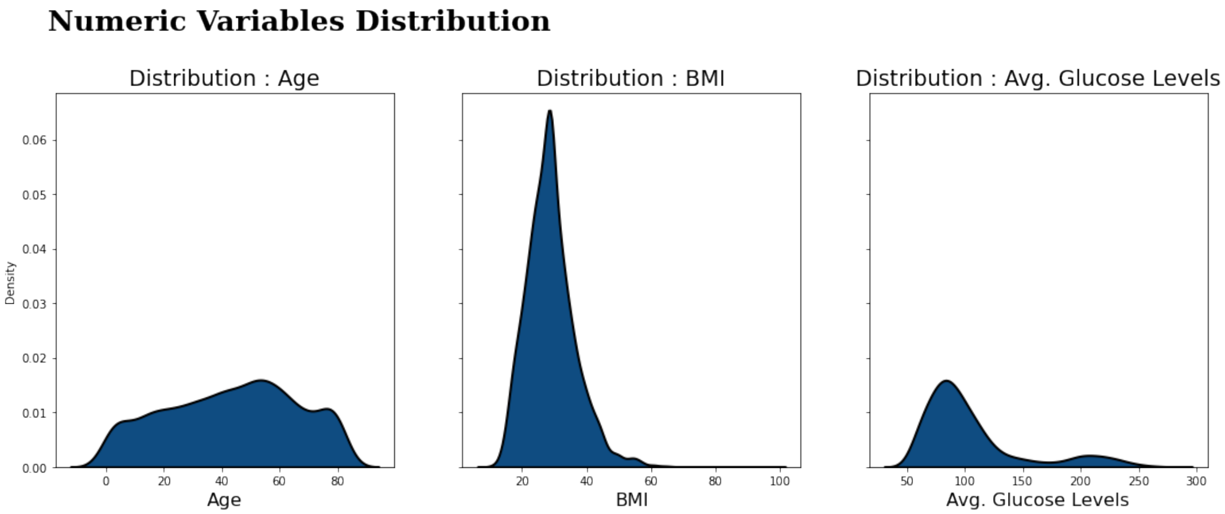
The data is hugely biased towards no stroke with a ratio of 19:1

4. Distribution of numerical variables

In [21]:

```
# Plotting the distribution of each of the numerical variables
plt.figure(figsize=(20,5))
fig, (ax1, ax2, ax3) = plt.subplots(ncols=3, sharey=True,figsize=(18, 6))

sns.kdeplot(data['age'], ax=ax1, color='#0f4c81',shade=True, linewidth=2,
ax1.set_xlabel('Age', fontsize=16)
ax1.set_title('Distribution : Age', fontsize= 19)

sns.kdeplot(data['bmi'], ax=ax2, color='#0f4c81',shade=True, linewidth=2,
ax2.set_xlabel('BMI', fontsize=16)
ax2.set_title('Distribution : BMI', fontsize= 19)

sns.kdeplot(data['avg_glucose_level'], ax=ax3, color='#0f4c81',shade=True
ax3.set_xlabel('Avg. Glucose Levels', fontsize=16)
ax3.set_title('Distribution : Avg. Glucose Levels', fontsize= 19)

ax1.text(-20, 0.08, 'Numeric Variables Distribution', fontsize=25, fontwe

plt.show()
```

```
<Figure size 1440x360 with 0 Axes>
```



We can remarke that :

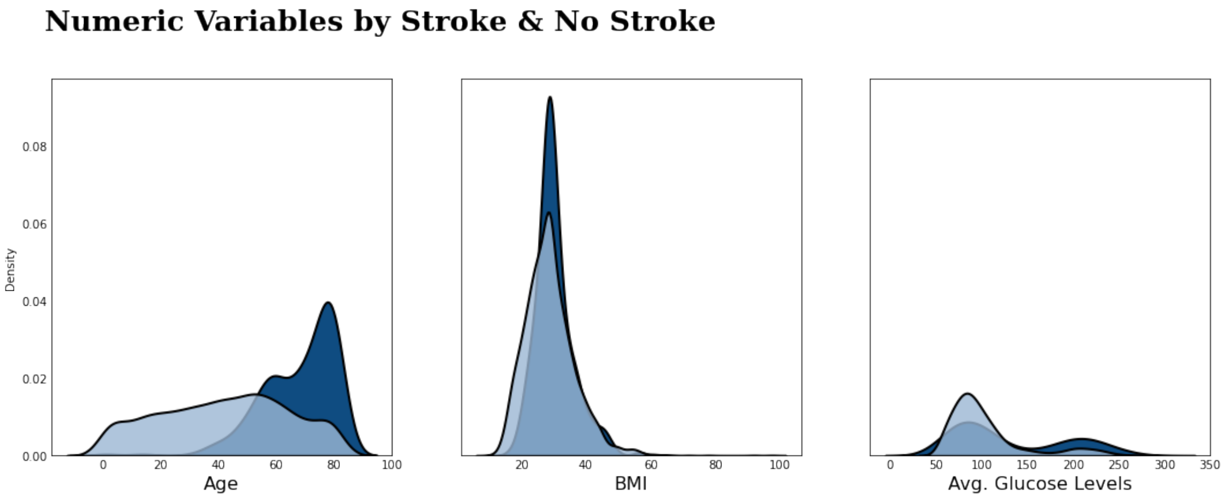
- There is a positive skew in BMI and Glucos levels
- The average glucose level has 2 peaks of uneven heights present at values around : 100 & 200
- Bmi is ditributed normally but it has some low values on the right side

We gained some understanding on the distributions of our numeric variables, but we can add more information to this plot by seeing how the distribution of our numeric variables is different for those that have strokes, and those that do not.

In [23]:

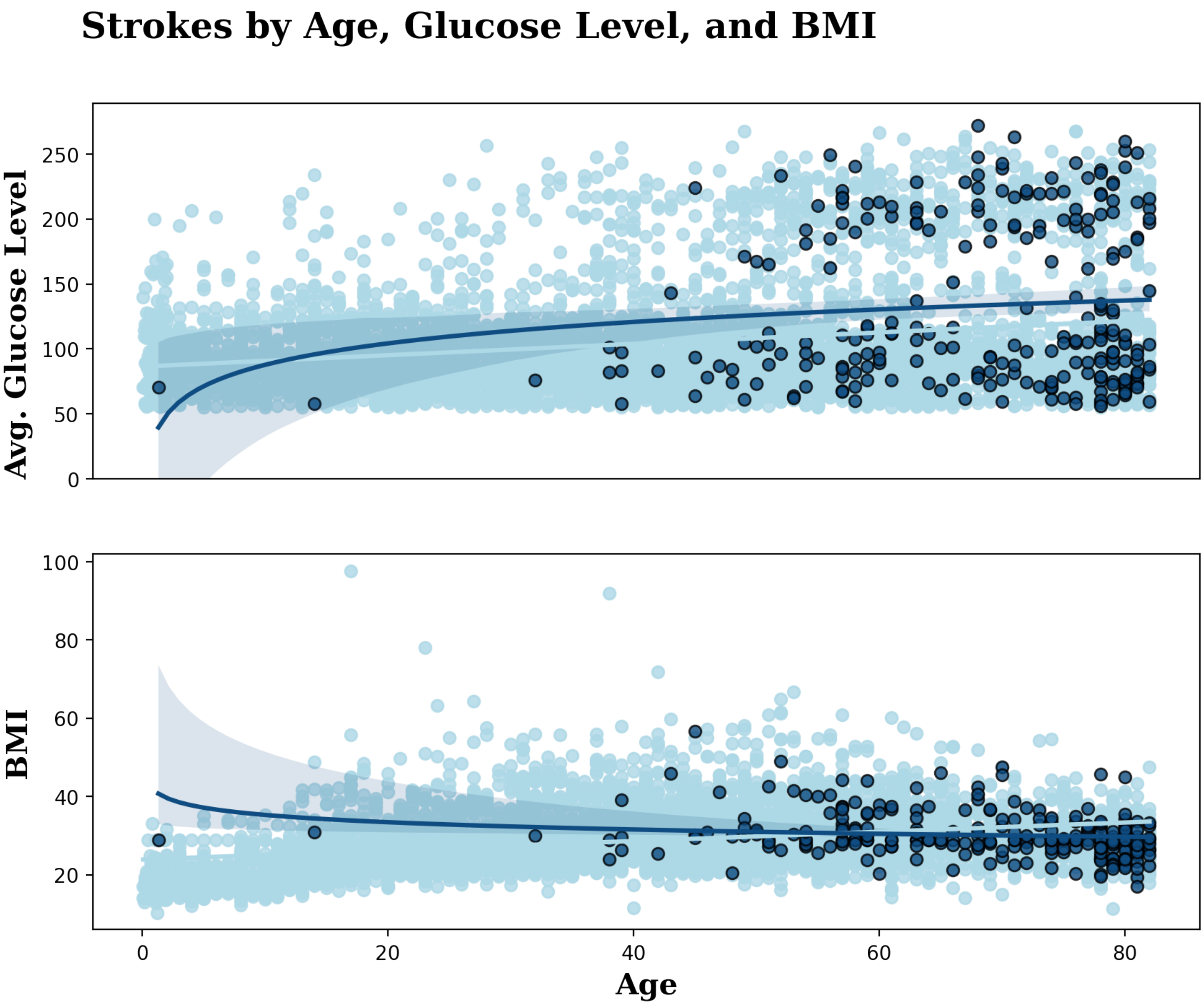
```
background_color = '#9bb7d4'
plt.figure(figsize=(20,5), facecolor=background_color)
fig, (ax1, ax2, ax3) = plt.subplots(ncols=3, sharey=True,figsize=(18, 6))
ax1.tick_params(axis=u'both', which=u'both',length=0)
ax2.tick_params(axis=u'both', which=u'both',length=0)
ax3.tick_params(axis=u'both', which=u'both',length=0)

s = data[data['stroke'] == 1]
ns = data[data['stroke'] == 0]

sns.kdeplot(s['age'], ax = ax1, color='#0f4c81',shade=True, linewidth=2,
sns.kdeplot(ns['age'], ax = ax1, color='#9bb7d4',shade=True, linewidth=2,
ax1.set_xlabel('Age', fontsize=16)


sns.kdeplot(s['bmi'], ax = ax2, color='#0f4c81',shade=True, linewidth=2,
sns.kdeplot(ns['bmi'], ax = ax2, color='#9bb7d4',shade=True, linewidth=2,
ax2.set_xlabel('BMI', fontsize=16)

sns.kdeplot(s['avg_glucose_level'], ax = ax3, color='#0f4c81',shade=True,
sns.kdeplot(ns['avg_glucose_level'], ax = ax3, color='#9bb7d4',shade=True
ax3.set_xlabel('Avg. Glucose Levels', fontsize=16)

ax1.text(-20, 0.11, 'Numeric Variables by Stroke & No Stroke', fontsize=2

plt.show()
```

```
<Figure size 1440x360 with 0 Axes>
```


Numeric Variables by Stroke & No Stroke

Looking at plots above, it seems that Age is a big factor in stroke patients, meaning the older you get the more at risk you are. We can also see differences in Avg. Glucose Levels and BMI, even though it's less obvious.

In [25]:
```
stroke_only = data[data['stroke'] == 1]
no_stroke_only = data[data['stroke'] == 0]


fig = plt.figure(figsize=(10,16),dpi=200)
gs = fig.add_gridspec(4, 2)
gs.update(wspace=0.5, hspace=0.2)
ax1 = fig.add_subplot(gs[0, 0:2])
ax2 = fig.add_subplot(gs[1, 0:2])


sns.regplot(x = no_stroke_only['age'], y = no_stroke_only['avg_glucose_le
sns.regplot(x = stroke_only['age'], y = stroke_only['avg_glucose_level'],
            color='#0f4c81', logx=True,
            scatter_kws={'edgecolors':['black'],
            'linewidth': 1},)


ax1.set(ylim=(0, None))
ax1.set_xlabel("Age",fontsize=12,fontfamily='serif')
ax1.set_ylabel("Avg. Glucose Level",fontsize=15,fontfamily='serif',loc='b

ax1.tick_params(axis='x', bottom=False)
ax1.get_xaxis().set_visible(False)

sns.regplot(x = no_stroke_only['age'], y = no_stroke_only['bmi'], ax = ax
sns.regplot(x = stroke_only['age'], y = stroke_only['bmi'], ax = ax2,
            color='#0f4c81', logx=True,
            scatter_kws={'edgecolors':['black'],
            'linewidth': 1},)

ax2.set_xlabel("Age",fontsize=15,fontfamily='serif',loc='center', fontwei
ax2.set_ylabel("BMI",fontsize=15,fontfamily='serif',loc='center', fontwei

ax1.text(-5,340,'Strokes by Age, Glucose Level, and BMI',fontsize=18,font

plt.show()
```



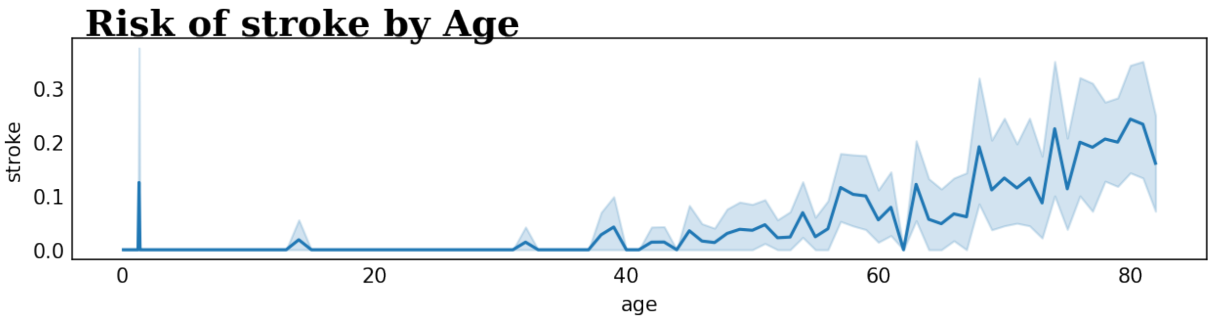
We can conclude that age is a big factor, and also has slight relationships with BMI & average Glucose levels. It is intuitive that with the increasing of the age of the patient, the risk of having a stroke increases too, which something we can visualise.

In [27]:

```
fig = plt.figure(figsize=(10, 5), dpi=150)
gs = fig.add_gridspec(2, 1)
gs.update(wspace=0.11, hspace=0.5)
ax1 = fig.add_subplot(gs[0, 0])
ax1.tick_params(axis=u'both', which=u'both',length=0)

sns.lineplot(x = data['age'],y  = data['stroke'], ax = ax1)

ax1.text(-3,0.4,'Risk of stroke by Age',fontsize=18,fontfamily='serif',fo
```

Out[27]:

```
Text(-3, 0.4, 'Risk of stroke by Age')
```



We can see clearly that as the age increases, the risk of having a stroke also increases

In [29]:

```
dt = data
```

Now, we have delect thoses datas "NA", let's see what's the repartition of these sample
I want to know what is the distribution of gender durling the people who got thee troke.

In [30]:

```
(dt1[dt1["stroke"] == 1]["gender"] == "Male").value_counts()[0:2]
```

Out[30]:

```
False     141
True      108
Name: gender, dtype: int64
```

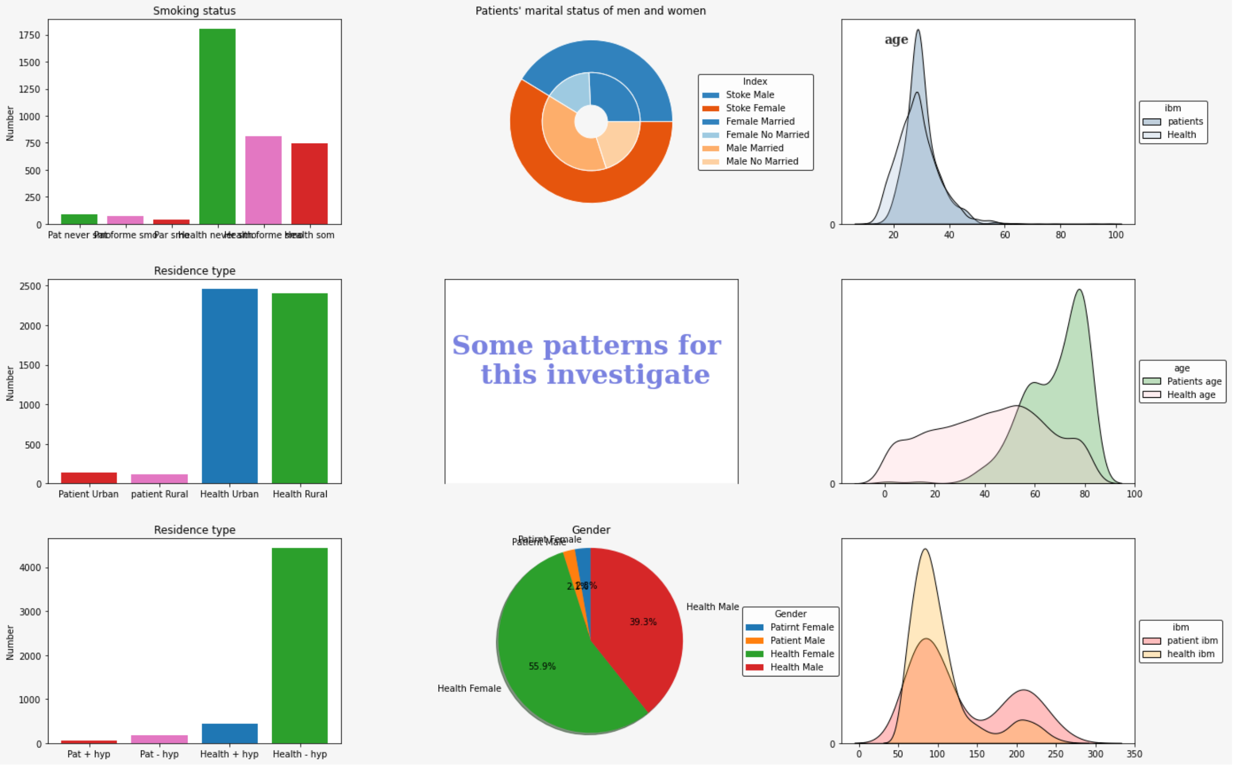
In [31]:

```
fig = plt.figure(figsize=(22,15))
gs = fig.add_gridspec(3, 3)
gs.update(wspace=0.35, hspace=0.27)
ax0 = fig.add_subplot(gs[0, 0])
ax1 = fig.add_subplot(gs[0, 1])
ax2 = fig.add_subplot(gs[0, 2])
ax3 = fig.add_subplot(gs[1, 0])
ax4 = fig.add_subplot(gs[1, 1])
ax5 = fig.add_subplot(gs[1, 2])
ax6 = fig.add_subplot(gs[2, 0])
ax7 = fig.add_subplot(gs[2, 1])
ax8 = fig.add_subplot(gs[2, 2])

background_color = "#f6f6f6"
fig.patch.set_facecolor(background_color) # figure background color

###########################
#SSN = Stroke Smoke Never
#SSF = Stroke Smoke fprmerly
#SSS = Stroke Smoke Souvent
#HSN = Health Smoke Never
#HSF = Health Smoke fprmerly
#HSS = Health Smoke Souvent

SSN = len(dt1[(dt1.stroke == 1) & (dt1.smoking_status == "never smoked")]
SSF = len(dt1[(dt1.stroke == 1) & (dt1.smoking_status == "formerly smoked
SSS = len(dt1[(dt1.stroke == 1) & (dt1.smoking_status == "smokes")])
HSN = len(dt1[(dt1.stroke == 0) & (dt1.smoking_status == "never smoked")]
HSF = len(dt1[(dt1.stroke == 0) & (dt1.smoking_status == "formerly smoked
HSS = len(dt1[(dt1.stroke == 0) & (dt1.smoking_status == "smokes")])

labels0 = ['Pat never smo', 'Pat forme smo', 'Par smo', 'Health never smo
place = [SSN,SSF,SSS,HSN,HSF,HSS]
bar_colors = ['tab:green', 'tab:pink', 'tab:red', 'tab:green', 'tab:pink'

ax0.bar(labels0, place, label=labels0, color=bar_colors)
ax0.set_ylabel('Number')
ax0.set_title('Smoking status')

###########################
#Mn = Male no married      SMn = Stroke Male no married
```

```
#MM = Male married          SMM = Stroke Male married
#Fn = Female no married     SFn = Stroke Female no married
#FM = Female married        SFM = Stroke Female married

Mn = dt1[(dt1.gender == "Male") & (dt1.stroke == 1) & (dt1.ever_married==
MM = dt1[(dt1.gender == "Male") & (dt1.stroke == 1) & (dt1.ever_married==
Fn = dt1[(dt1.gender == "Female") & (dt1.stroke == 1) & (dt1.ever_married
FM = dt1[(dt1.gender == "Female") & (dt1.stroke == 1) & (dt1.ever_married
Mn = dt1[(dt1.gender == "Male") & (dt1.stroke == 0) & (dt1.ever_married==
MM = dt1[(dt1.gender == "Male") & (dt1.stroke == 0) & (dt1.ever_married==
Fn = dt1[(dt1.gender == "Female") & (dt1.stroke == 0) & (dt1.ever_married
FM = dt1[(dt1.gender == "Female") & (dt1.stroke == 0) & (dt1.ever_married

labels1 = ('Stoke Male', 'Stoke Female', 'Female Married', 'Female No Mar
           'Health Male', 'Health Female', 'Female Married', 'Female No M
#fig, ax1 = plt.subplots()

size = 0.4
vals = np.array([[MM, Mn], [FM, Fn]])

cmap = plt.colormaps["tab20c"]
outer_colors = cmap(np.arange(3)*4)
inner_colors = cmap([0, 2, 6, 7])

ax1.pie(vals.sum(axis=1), radius=1, colors=outer_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.pie(vals.flatten(), radius=1-size, colors=inner_colors,
       wedgeprops=dict(width=size, edgecolor='w'))

ax1.set(aspect="equal", title="Patients' marital status of men and women"
ax1.legend(labels1, title="Index",loc="center left",bbox_to_anchor=(1, 0,


####################################
labels2 = ['patients','Health']
ax2.grid(color='gray', linestyle=':', axis='y', zorder=0,  dashes=(1,5))
positive = pd.DataFrame(dt1[(dt1.stroke == 1)])
negative = pd.DataFrame(dt1[(dt1.stroke == 0)])
sns.kdeplot(positive["bmi"], ax=ax2,color="#0f4c81", ec='black',shade=Tru
sns.kdeplot(negative["bmi"], ax=ax2, color="#9bb7d4",ec='black', shade=Tr
#ax2.text(-0.06, 0.09, 'BMI',fontsize=14, fontweight='bold', fontfamily='
ax2.yaxis.set_major_locator(mtick.MultipleLocator(2))
ax2.set_ylabel('')
ax2.set_xlabel('')
ax2.legend(labels2, title="ibm",loc="center left",bbox_to_anchor=(1, 0,0.

###################################
#SResiU = Stroke residence in Urban #SResiR = Stroke residence in Rural
#HResiU = Health residence in Urban #HResiR = Health residence in Rural

SResiU = len(dt1[(dt1.stroke == 1) & (dt1.Residence_type == 'Urban')])
SResiR = len(dt1[(dt1.stroke == 1) & (dt1.Residence_type == 'Rural')])
HResiU = len(dt1[(dt1.stroke == 0) & (dt1.Residence_type == 'Urban')])
HResiR = len(dt1[(dt1.stroke == 0) & (dt1.Residence_type == 'Rural')])

labels2 = ['Patient Urban', 'patient Rural', 'Health Urban', 'Health Rura
place = [SResiU, SResiR, HResiU, HResiR]
bar_colors = ['tab:red', 'tab:pink', 'tab:blue', 'tab:green']

ax3.bar(labels2, place, label=labels2, color=bar_colors)
```

```
ax3.set_ylabel('Number')
ax3.set_title('Residence type')

####################################
ax4.spines["bottom"].set_visible(False)
ax4.tick_params(left=False, bottom=False)
ax4.set_xticklabels([])
ax4.set_yticklabels([])
ax4.text(0.5, 0.6, 'Some patterns for \n this investigate', horizontalali
         fontsize=30, fontweight='bold', fontfamily='serif', color="#7A82


####################################
labels5 = ['Patients age', 'Health age']
ax5.grid( linestyle=':', axis='y', zorder=0,  dashes=(1,5))
positive = pd.DataFrame(dt1[(dt1.stroke == 1)])
negative = pd.DataFrame(dt1[(dt1.stroke == 0)])
sns.kdeplot(positive["age"], ax=ax5,color="green", ec='black',shade=True,
sns.kdeplot(negative["age"], ax=ax5, color="pink",ec='black', shade=True,
ax5.text(-0.06, 0.09, 'age',fontsize=14, fontweight='bold', fontfamily='s
ax5.yaxis.set_major_locator(mtick.MultipleLocator(2))
ax5.set_ylabel('')
ax5.set_xlabel('')
ax5.legend(labels5, title="age",loc="center left",bbox_to_anchor=(1, 0,0.

####################################

Shypertension = len(dt1[(dt1.stroke == 1) & (dt1.hypertension == 1)])
SNhy = len(dt1[(dt1.stroke == 1) & (dt1.hypertension == 0)])
Phypertension = len(dt1[(dt1.stroke == 0) & (dt1.hypertension == 1)])
PNhy = len(dt1[(dt1.stroke == 0) & (dt1.hypertension == 0)])

labels3 = ['Pat + hyp', 'Pat - hyp', 'Health + hyp', 'Health - hyp']
place = [Shypertension, SNhy, Phypertension, PNhy]
bar_colors = ['tab:red', 'tab:pink', 'tab:blue', 'tab:green']

ax6.bar(labels3, place, label=labels2, color=bar_colors)
ax6.set_ylabel('Number')
ax6.set_title('Residence type')

#######################################

labels = 'Patirnt Female', 'Patient Male', 'Health Female','Health Male'

sizes = [(dt1[dt1["stroke"] == 1]["gender"] == "Male").value_counts()[0],
         (dt1[dt1["stroke"] == 1]["gender"] == "Male").value_counts()[1],
         (dt1[dt1["stroke"] == 0]["gender"] == "Male").value_counts()[0],
         (dt1[dt1["stroke"] == 0]["gender"] == "Male").value_counts()[1]]
#explode = (0, 0)
ax7.set_title("Gender")
ax7.pie(sizes ,labels=labels, autopct='%1.1f%%',
        shadow=True, startangle=90)
ax7.axis('equal')
#plt.title("\nStroke Patient's Gender",fontsize=25)
ax7.legend(labels, title="Gender",loc="center left",bbox_to_anchor=(1, 0,

######################################
labels8 = 'patient ibm', 'health ibm'
ax8.grid(color='gray', linestyle=':', axis='y', zorder=0,  dashes=(1,5))
positive = pd.DataFrame(dt1[(dt1.stroke == 1)])
negative = pd.DataFrame(dt1[(dt1.stroke == 0)])
```

```
sns.kdeplot(positive["avg_glucose_level"], ax=ax8,color="red", ec='black'
sns.kdeplot(negative["avg_glucose_level"], ax=ax8, color="orange",ec='bla
#ax8.text(-0.06, 0.09, 'avg_glucose_level',fontsize=14, fontweight='bold'
ax8.yaxis.set_major_locator(mtick.MultipleLocator(2))
ax8.set_ylabel('')
ax8.set_xlabel('')
ax8.legend(labels8, title="ibm",loc="center left",bbox_to_anchor=(1, 0,0.

plt.show()
```



Reminder the expression of the correlation:

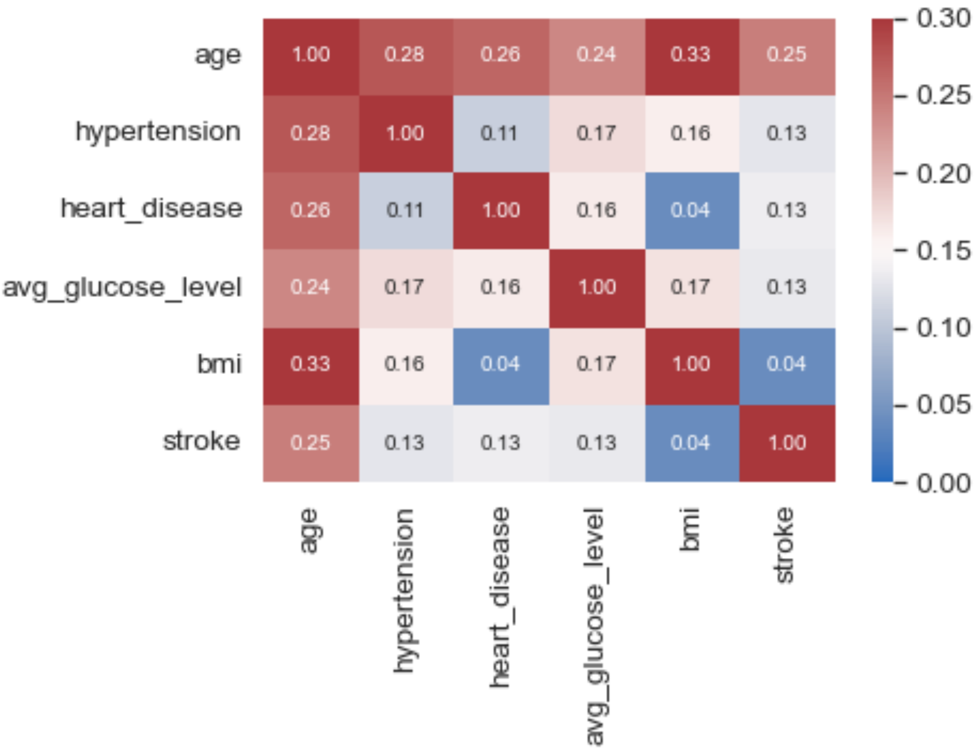
$$cor(x_i, y_i) = \frac{\frac{1}{n}\sum_{i=1}^{n}(x - \bar{x}_i)(y_i - \bar{Y})}{\sqrt{s_x^2 S_y^2}}$$

```
In [32]: dt1.loc[:, ~dt1.columns.isin(['id'])].corr()["stroke"]
         dtcr = dt1.loc[:, ~dt1.columns.isin(['id'])].corr()
         print(dtcr)
```

```
                        age  hypertension  heart_disease  avg_glucose_lev
el  \
age                1.000000      0.276398       0.263796           0.2381
71
hypertension       0.276398      1.000000       0.108306           0.1744
74
heart_disease      0.263796      0.108306       1.000000           0.1618
57
avg_glucose_level  0.238171      0.174474       0.161857           1.0000
00
bmi                0.325942      0.160189       0.038899           0.1687
51
stroke             0.245257      0.127904       0.134914           0.1319
45

                        bmi    stroke
age                0.325942  0.245257
hypertension       0.160189  0.127904
heart_disease      0.038899  0.134914
avg_glucose_level  0.168751  0.131945
bmi                1.000000  0.038947
stroke             0.038947  1.000000
```

In [33]:

```python
k = 6 #number of variables for heatmap
#cm = np.corrcoef(dtcr[cols].values.T)
sns.set(font_scale=1.25)
hm = sns.heatmap(dtcr, vmax=0.3, vmin=0, annot=True,  cmap='vlag',
                 fmt='.2f', annot_kws={'size': 10})
plt.show()
```



In [34]:

```
SResiU = len(dt1[(dt1.stroke == 1) & (dt1.Residence_type == 'Urban')])
SResiR = len(dt1[(dt1.stroke == 1) & (dt1.Residence_type == 'Rural')])
PResiU = len(dt1[(dt1.stroke == 0) & (dt1.Residence_type == 'Urban')])
PResiR = len(dt1[(dt1.stroke == 0) & (dt1.Residence_type == 'Rural')])

ttype = ['Patient Urban', 'patient Rural', 'People Urban', 'People Rural'
place = [SResiU, SResiR, PResiU, PResiR]
bar_labels = ['red', 'blue', '_red', 'orange']
bar_colors = ['tab:red', 'tab:blue', 'tab:red', 'tab:orange']

ax3.bar(ttype, place, label=bar_labels, color=bar_colors)
ax3.set_ylabel('fruit supply')
ax3.set_title('Fruit supply by kind and color')
ax3.legend(title='Fruit color')

plt.show()
```

In [29]:

```
###########################
#the patients sign & health & a little fat & fat
#Sbmi1= len(dt1[(dt1.stroke == 1) & (dt1.bmi < 18.4)])
#Sbmi2= len(dt1[(dt1.stroke == 1) & (dt1.bmi >= 18.4) & (dt1.bmi < 23.9)]
#Sbmi3= len(dt1[(dt1.stroke == 1) & (dt1.bmi >= 23.9) & (dt1.bmi < 27.9)]
#Sbmi4= len(dt1[(dt1.stroke == 1) & (dt1.bmi >= 27.9)])

#the normal person's sign & health & a little fat & fat
#bmi1= len(dt1[(dt1.stroke == 0) & (dt1.bmi < 18.4)])
#bmi2= len(dt1[(dt1.stroke == 0) & (dt1.bmi >= 18.4) & (dt1.bmi < 23.9)])
#bmi3= len(dt1[(dt1.stroke == 0) & (dt1.bmi >= 23.9) & (dt1.bmi < 27.9)])
#bmi4= len(dt1[(dt1.stroke == 0) & (dt1.bmi >= 27.9)])

#Strokebmi = np.array([Sbmi1, Sbmi2, Sbmi3, Sbmi4])
#Nostrokebmi = np.array([bmi1, bmi2, bmi3, bmi4])
#labels2 = ['Lean', 'Normal', 'Fat', 'Too Fat']
```

Out[29]:

```
109
```

We have see that there hasn't the correlation about "gender", "ever married", "work type", and "smoking status", which means that this corrélation don't make any sens when it is a "objectif"