In [1]:
```
import os
import numpy as np
import pandas as pd
import missingno as msn
from scipy import stats
from scipy.stats import norm
```

In [2]:
```
import seaborn as sns
from matplotlib import style
import matplotlib.pyplot as plt
import plotly.graph_objects as go
import matplotlib.ticker as mticker
from matplotlib.gridspec import GridSpec
from plotly.subplots import make_subplots
from plotly.offline import init_notebook_mode

init_notebook_mode(connected=True)
sns.set()
style.use('fivethirtyeight')
```

In [3]:
```
from sklearn import metrics
import statsmodels.api as sm
from sklearn import preprocessing
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, classification_report
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier, AdaBoostClassifier
```

In [4]:
```
from tensorflow import keras
from tensorflow.keras.utils import plot_model
from sklearn.preprocessing import StandardScaler
```

In [5]:
```
data = pd.read_csv('Placement_Data_Full_Class.csv')
```

In [6]:
```
data.head()
```

Out[6]:

	sl_no	gender	ssc_p	ssc_b	hsc_p	hsc_b	hsc_s	degree_p	degree_t	workex	etest_p	specialisation	mba_p	status	salar
0	1	M	67.00	Others	91.00	Others	Commerce	58.00	Sci&Tech	No	55.0	Mkt&HR	58.80	Placed	270000.
1	2	M	79.33	Central	78.33	Others	Science	77.48	Sci&Tech	Yes	86.5	Mkt&Fin	66.28	Placed	200000.
2	3	M	65.00	Central	68.00	Central	Arts	64.00	Comm&Mgmt	No	75.0	Mkt&Fin	57.80	Placed	250000.
3	4	M	56.00	Central	52.00	Central	Science	52.00	Sci&Tech	No	66.0	Mkt&HR	59.43	Not Placed	Na
4	5	M	85.80	Central	73.60	Central	Commerce	73.30	Comm&Mgmt	No	96.8	Mkt&Fin	55.50	Placed	425000.

In [7]:
```
data.tail()
```

Out[7]:

	sl_no	gender	ssc_p	ssc_b	hsc_p	hsc_b	hsc_s	degree_p	degree_t	workex	etest_p	specialisation	mba_p	status	sal
210	211	M	80.6	Others	82.0	Others	Commerce	77.6	Comm&Mgmt	No	91.0	Mkt&Fin	74.49	Placed	40000
211	212	M	58.0	Others	60.0	Others	Science	72.0	Sci&Tech	No	74.0	Mkt&Fin	53.62	Placed	27500
212	213	M	67.0	Others	67.0	Others	Commerce	73.0	Comm&Mgmt	Yes	59.0	Mkt&Fin	69.72	Placed	29500
213	214	F	74.0	Others	66.0	Others	Commerce	58.0	Comm&Mgmt	No	70.0	Mkt&HR	60.23	Placed	20400
214	215	M	62.0	Central	58.0	Others	Science	53.0	Comm&Mgmt	No	89.0	Mkt&HR	60.22	Not Placed	N

In [8]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 215 entries, 0 to 214
Data columns (total 15 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   sl_no           215 non-null    int64  
 1   gender          215 non-null    object 
 2   ssc_p           215 non-null    float64
 3   ssc_b           215 non-null    object 
 4   hsc_p           215 non-null    float64
 5   hsc_b           215 non-null    object 
 6   hsc_s           215 non-null    object 
 7   degree_p        215 non-null    float64
 8   degree_t        215 non-null    object 
 9   workex          215 non-null    object 
 10  etest_p         215 non-null    float64
 11  specialisation  215 non-null    object 
 12  mba_p           215 non-null    float64
 13  status          215 non-null    object 
 14  salary          148 non-null    float64
dtypes: float64(6), int64(1), object(8)
memory usage: 25.3+ KB
```

In [9]:
```python
data.shape
```

Out[9]:
```
(215, 15)
```

In [10]:
```python
data.columns
```

Out[10]:
```
Index(['sl_no', 'gender', 'ssc_p', 'ssc_b', 'hsc_p', 'hsc_b', 'hsc_s',
       'degree_p', 'degree_t', 'workex', 'etest_p', 'specialisation', 'mba_p',
       'status', 'salary'],
      dtype='object')
```

In [11]:
```python
data.describe()
```

Out[11]:

	sl_no	ssc_p	hsc_p	degree_p	etest_p	mba_p	salary
count	215.000000	215.000000	215.000000	215.000000	215.000000	215.000000	148.000000
mean	108.000000	67.303395	66.333163	66.370186	72.100558	62.278186	288655.405405
std	62.209324	10.827205	10.897509	7.358743	13.275956	5.833385	93457.452420
min	1.000000	40.890000	37.000000	50.000000	50.000000	51.210000	200000.000000
25%	54.500000	60.600000	60.900000	61.000000	60.000000	57.945000	240000.000000
50%	108.000000	67.000000	65.000000	66.000000	71.000000	62.000000	265000.000000
75%	161.500000	75.700000	73.000000	72.000000	83.500000	66.255000	300000.000000
max	215.000000	89.400000	97.700000	91.000000	98.000000	77.890000	940000.000000

In [12]:
```python
data.isnull().sum()
```

Out[12]:
```
sl_no              0
gender             0
ssc_p              0
ssc_b              0
hsc_p              0
hsc_b              0
hsc_s              0
degree_p           0
degree_t           0
workex             0
etest_p            0
specialisation     0
mba_p              0
status             0
salary            67
dtype: int64
```

In [13]:
```python
data.duplicated().sum()
```

Out[13]:
```
0
```

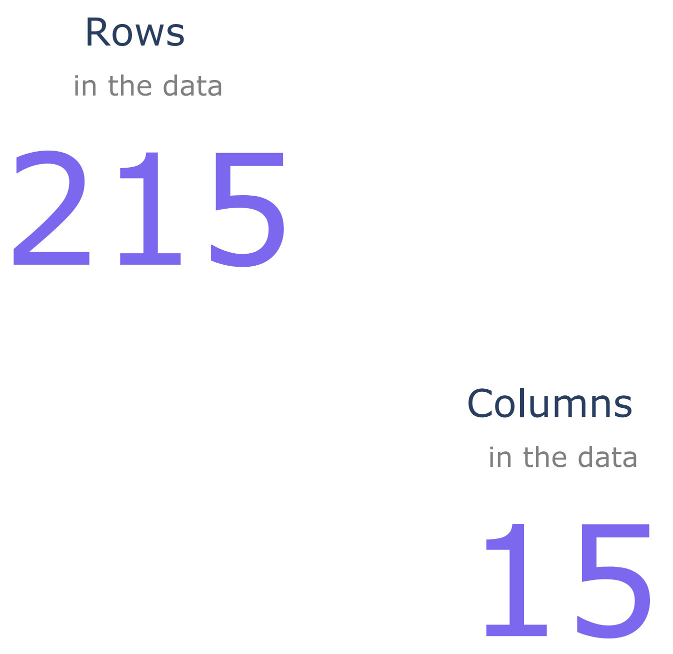
In [14]:
```python
data.nunique()
```

Out[14]:

```
sl_no            215
gender             2
ssc_p            103
ssc_b              2
hsc_p             97
hsc_b              2
hsc_s              3
degree_p          89
degree_t           3
workex             2
etest_p          100
specialisation     2
mba_p            205
status             2
salary            45
dtype: int64
```

In [15]:

```
fig = make_subplots(rows=1, cols=2)

fig.add_trace(go.Indicator(
                mode = "number",
                value = data.shape[0],
                number={'font':{'color': '#7b68ee', 'size':100}},
                delta = {"reference": 600},
                title = {"text": "Rows  <br><span style="
                                 "'font-size:0.7em;color:gray'>in the data</span>"},
                domain = {'y': [0.7, 1], 'x': [0, 0.5]}))

fig.add_trace(go.Indicator(
                mode = "number",
                value = data.shape[1],
                number={'font':{'color': '#7b68ee', 'size':100}},
                delta = {"reference": 600, "valueformat": ".0f"},
                title = {"text": "Columns  <br><span style="
                                 "'font-size:0.7em;color:gray'>in the data</span>"},
                domain = {'y': [0, 0.3], 'x': [0.5, 1]}))
fig.show()
```



In [16]:

```
data.status.unique()
```

Out[16]:

```
array(['Placed', 'Not Placed'], dtype=object)
```

In [17]:

```
data.status.value_counts()
```

Out[17]:

```
Placed        148
Not Placed     67
Name: status, dtype: int64
```

In [18]:

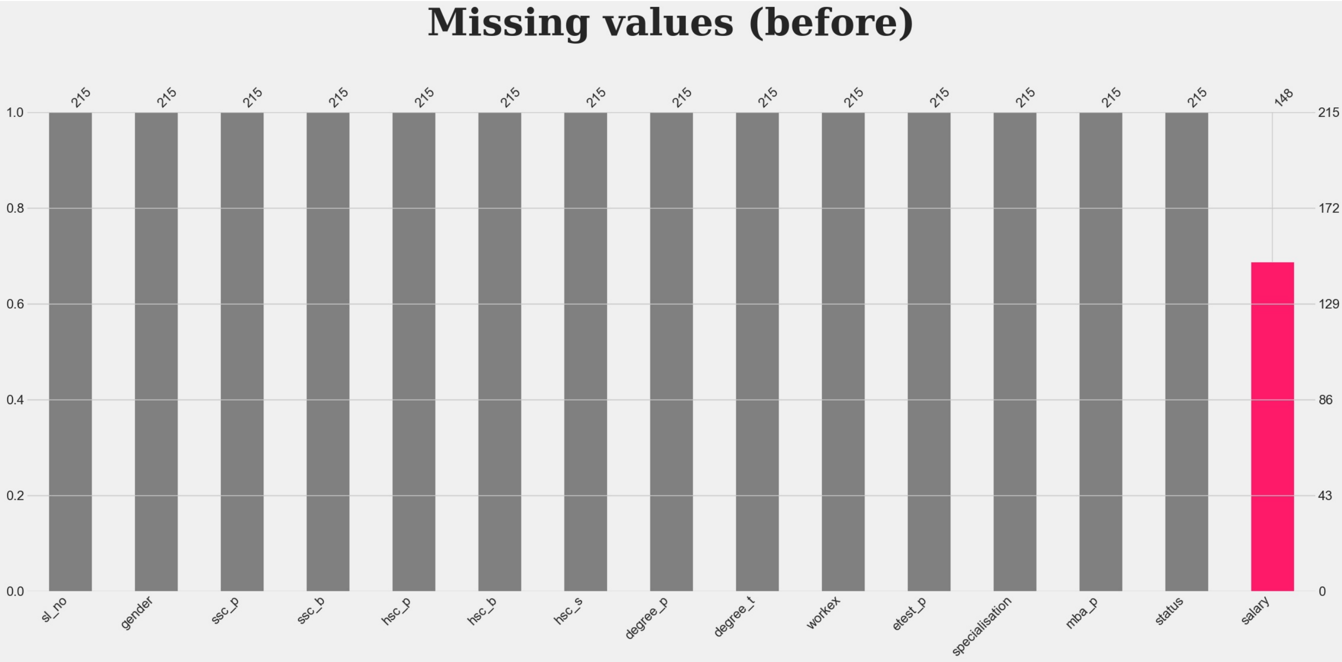
```
hfont = {'fontname':'serif', 'weight': 'bold'}
two_colors = ['#dd38ff', '#5727ed']
five_colors = ['#3E1CA8', '#5727ed', '#C82EE8', '#dd38ff', '#EC96FE']
```

In [19]:

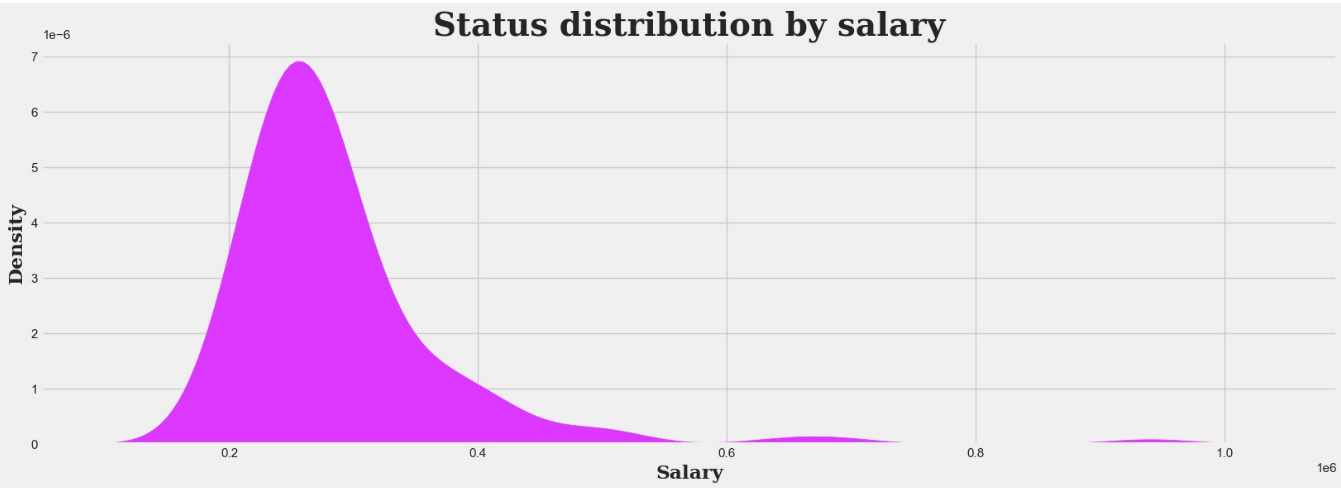
```
mis_val_colors = []
```

```python
for col in data.columns:
    if data[col].isna().sum() != 0:
        mis_val_colors.append('#fe1969')
    else:
        mis_val_colors.append('gray')
```

In [20]:
```python
msn.bar(data, color=mis_val_colors)
plt.title('Missing values (before)', size=45, y=1.15, **hfont)
plt.show()
```



In [21]:
```python
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title('Status distribution by salary', size=28, **hfont)

# Data without NaN values in salary column
temp_data = data.copy()
temp_data = temp_data.dropna()

# Main plots
sns.kdeplot(data=temp_data,x='salary', shade=True, ax=ax, color=two_colors[0], alpha=1)
plt.xlabel('Salary', **hfont)
plt.ylabel('Density', **hfont)
plt.show()
```



In [22]:
```python
temp_data.salary.mode().iloc[0]
```

Out[22]:
```
300000.0
```

In [23]:
```python
data[['status', 'salary']][np.isnan(data.salary)]
```

Out[23]:

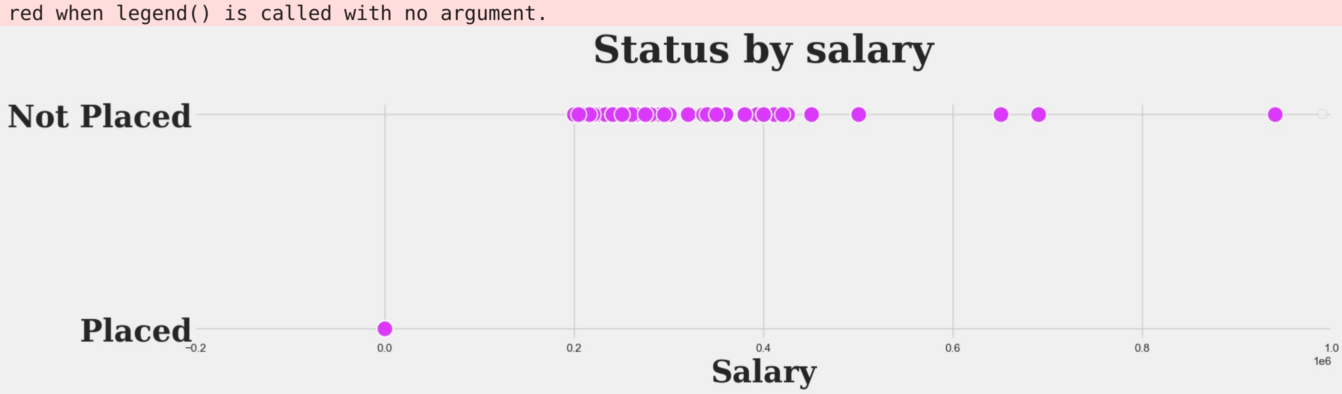
	status	salary
3	Not Placed	NaN
5	Not Placed	NaN
6	Not Placed	NaN
9	Not Placed	NaN
12	Not Placed	NaN
...	...	...
198	Not Placed	NaN
201	Not Placed	NaN
206	Not Placed	NaN
208	Not Placed	NaN
214	Not Placed	NaN

67 rows × 2 columns

In [24]:

```
data.salary.fillna(0, inplace=True)

fig, ax = plt.subplots(figsize = (18, 4))

status_salary_plot = sns.scatterplot(x = 'salary', y = 'status', data = data,
                                     s=250, color=two_colors[0])

ax.xaxis.set_ticks(ax.get_xticks())
ax.yaxis.set_ticks(ax.get_yticks())

status_salary_plot.set_yticklabels(['Not Placed', 'Placed'], size=30, **hfont)
status_salary_plot.set(ylabel=None)

plt.title('Status by salary', size=38, y=1.15, **hfont)
plt.xlabel('Salary', size=30, **hfont)
plt.legend()
plt.show()
```

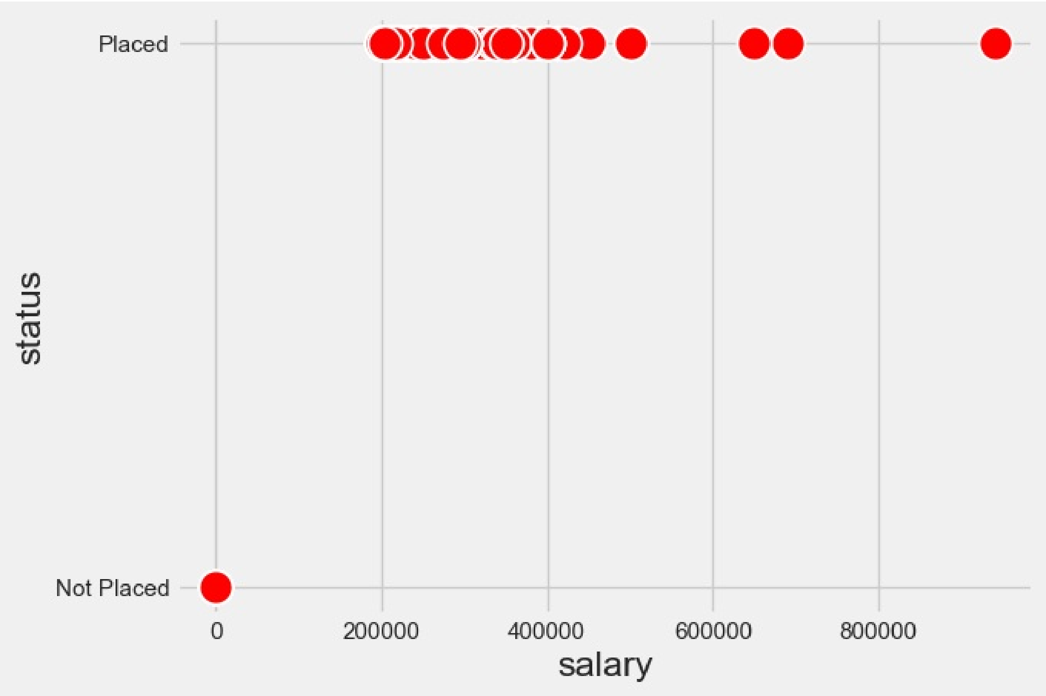
```
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are igno
red when legend() is called with no argument.
```



In [25]:

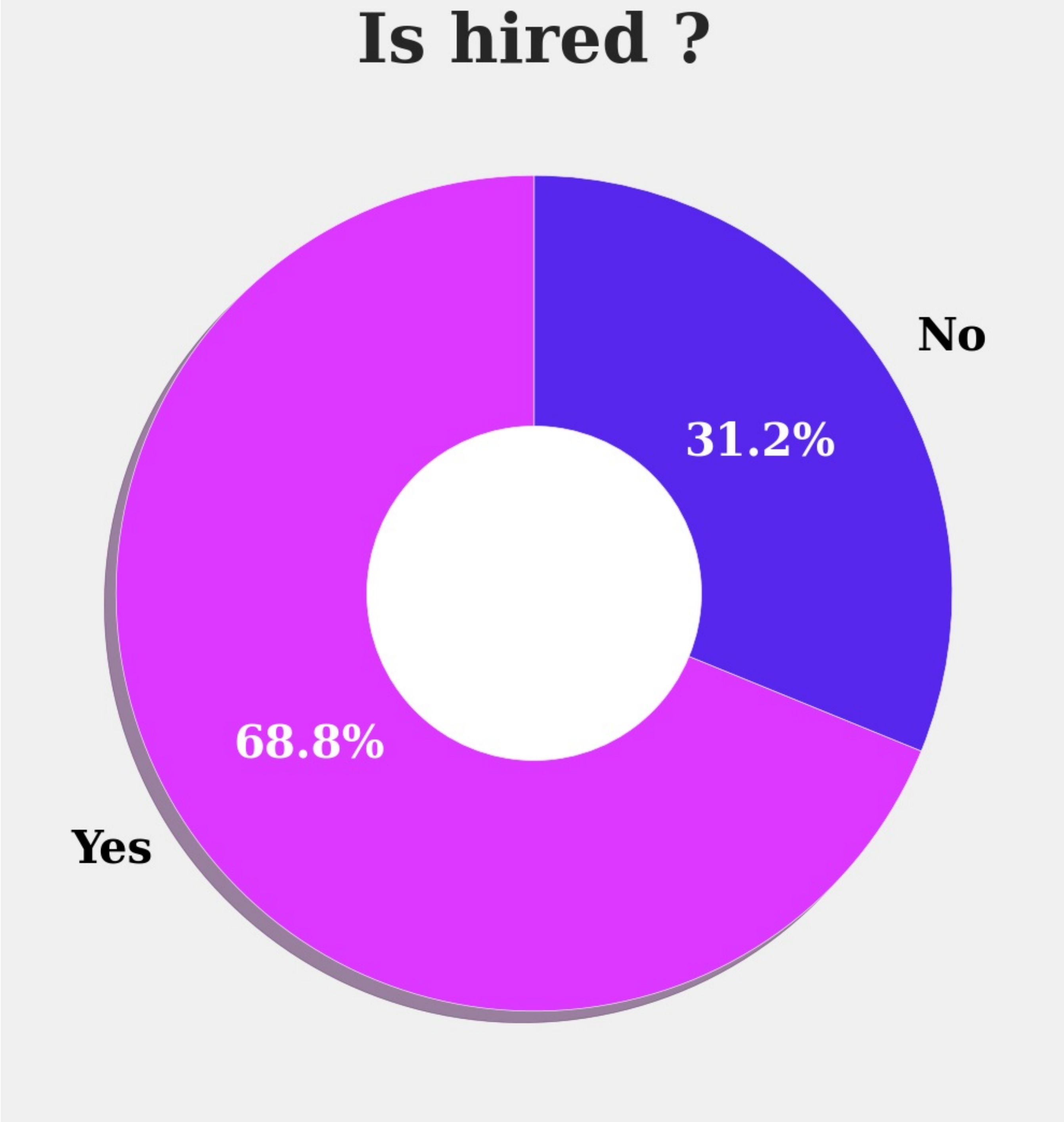
```
sns.scatterplot(x= 'salary',y ='status',data =data, s=250, color = 'red')
```

Out[25]: <AxesSubplot:xlabel='salary', ylabel='status'>



In [26]:
```
data = data.drop(columns=['salary'])
```

In [27]:
```
pie_colors = two_colors.copy()

pred_classes = data.status.value_counts()

plt.figure(figsize=(17, 12))
patches, texts, pcts = plt.pie(pred_classes,
                               labels=['Yes', 'No'],
                               colors=pie_colors,
                               pctdistance=0.65,
                               shadow=True,
                               startangle=90,
                               autopct='%1.1f%%',
                               textprops={'fontsize': 30,
                                          'color': 'black',
                                          'weight': 'bold',
                                          'family': 'serif'})
plt.setp(pcts, color='white', size=30)

plt.title('Is hired ?', size=45, **hfont)

centre_circle = plt.Circle((0,0),0.40,fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)
plt.show()
```

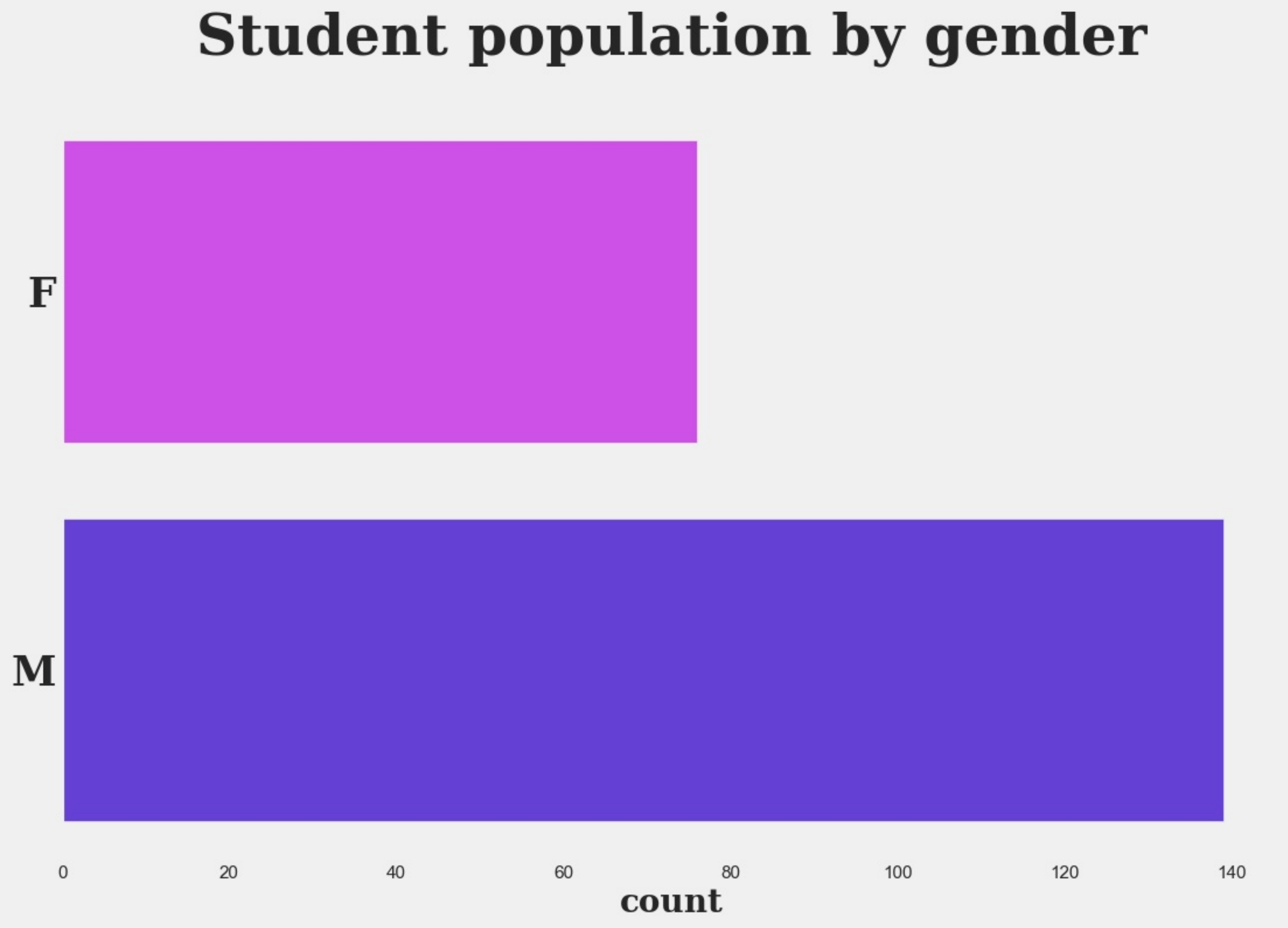


In [28]:
```
data.status = data.status.map({'Placed': 1, 'Not Placed': 0})
```

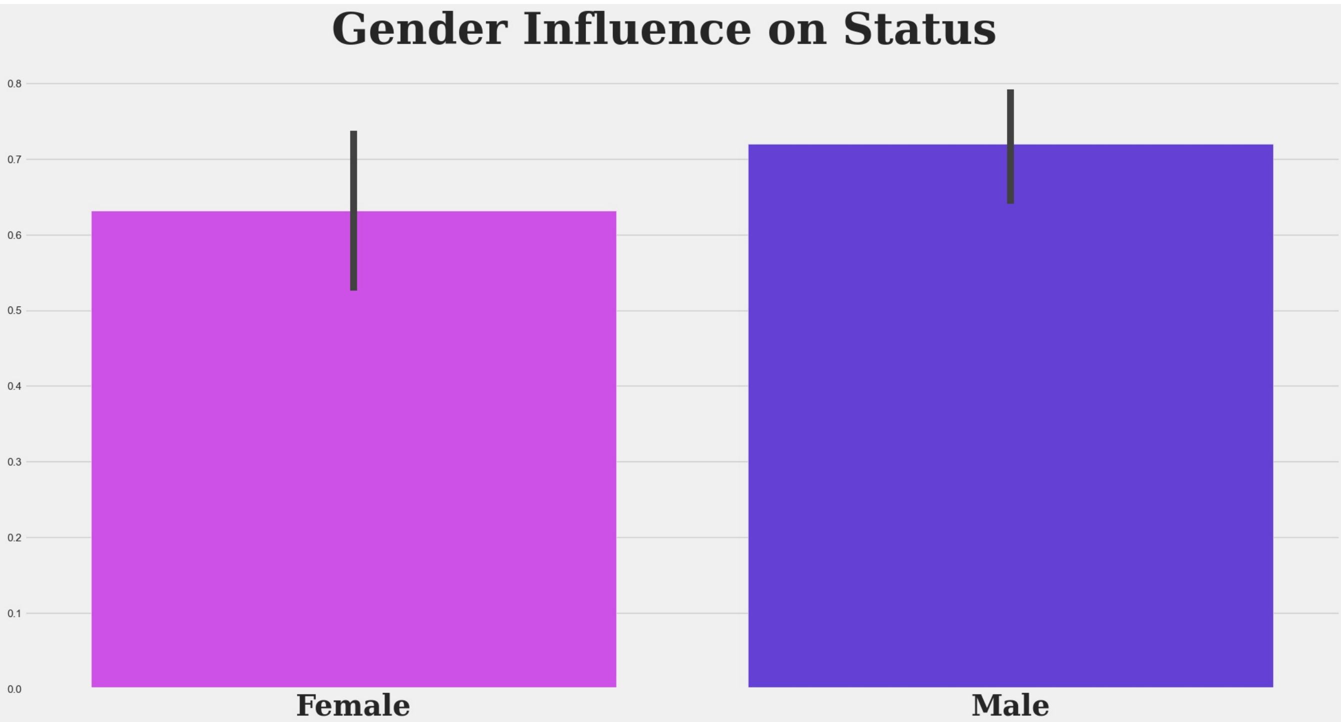
In [29]:
```
data.drop(columns=['sl_no'], inplace=True)
```

In [30]:
```
data.gender = data.gender.map({'M': 1, 'F': 0})
```

In [31]:
```
plt.figure(figsize=(12, 8))
gender_plot = sns.countplot(y=data.gender, palette=two_colors)
gender_plot.set_title('Student population by gender', fontsize=35, y=1.05, **hfont)
gender_plot.set(ylabel=None)
plt.grid(False)
gender_plot.set_yticklabels(['F', 'M'], size=25, **hfont)
gender_plot.set_xlabel('count', size=20, **hfont)
plt.show()
```

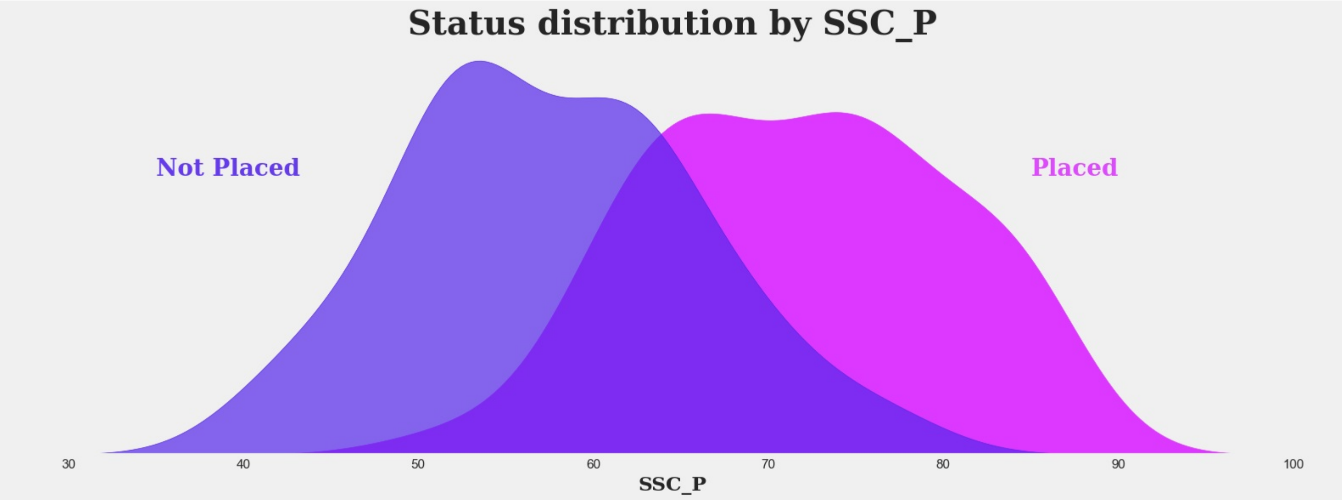


In [32]:
```
gender_plot = sns.catplot(y='status', x='gender', data=data,
                          height=10, aspect=2, kind='bar',
                          palette=two_colors)
gender_plot.set_xticklabels(['Female', 'Male'], size=30, **hfont)
gender_plot.fig.suptitle('Gender Influence on Status',
                         size=45, y=1.05, **hfont)
gender_plot.set(xlabel=None, ylabel=None)
plt.show()
```



In [33]:
```
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title('Status distribution by SSC_P', size=28, **hfont)
ax.grid(False)
ax.axes.get_yaxis().set_visible(False)
ax.text(85, 0.03, 'Placed', {'fontproperties': 'Serif',
                             'size': '20',
                             'weight': 'bold',
                             'color': two_colors[0]},
```

```
                             alpha=0.9)

ax.text(35, 0.03, 'Not Placed', {'fontproperties': 'Serif',
                                 'size': '20',
                                 'weight': 'bold',
                                 'color': two_colors[1]}, alpha=0.9)

sns.kdeplot(data=data[data.status == 1],
            x='ssc_p', shade=True, ax=ax, color=two_colors[0], alpha=1)
sns.kdeplot(data=data[data.status == 0],
            x='ssc_p', shade=True, ax=ax, color=two_colors[1], alpha=0.7)
plt.xlabel('SSC_P', **hfont)
plt.show()
```



In [34]:
```
placed_group = data[data.status == 1]['ssc_p']
not_placed_group = data[data.status == 0]['ssc_p']

t_test = stats.ttest_ind(placed_group, not_placed_group)
u_test = stats.mannwhitneyu(placed_group, not_placed_group)
```

In [35]:
```
print(f'Results of T-test                :   {t_test.pvalue}')
print(f'Results of U-test (Mann-whitneyu):   {u_test.pvalue}')
```

```
Results of T-test                :   4.115201043884403e-23
Results of U-test (Mann-whitneyu):   1.692865445594402e-18
```

In [36]:
```
data.ssc_b.unique()
```

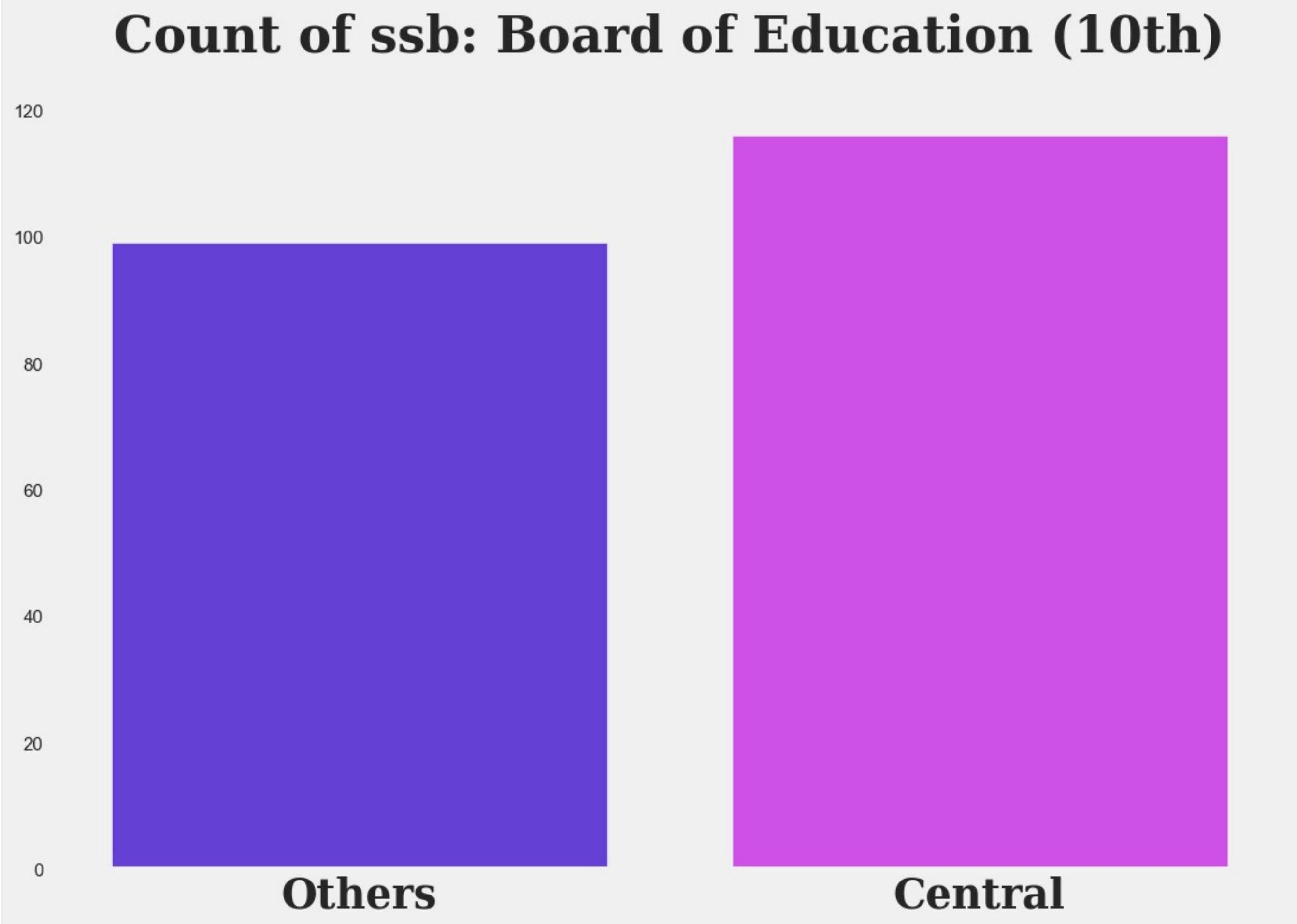
Out[36]:
```
array(['Others', 'Central'], dtype=object)
```

In [37]:
```
data.ssc_b.value_counts()
```

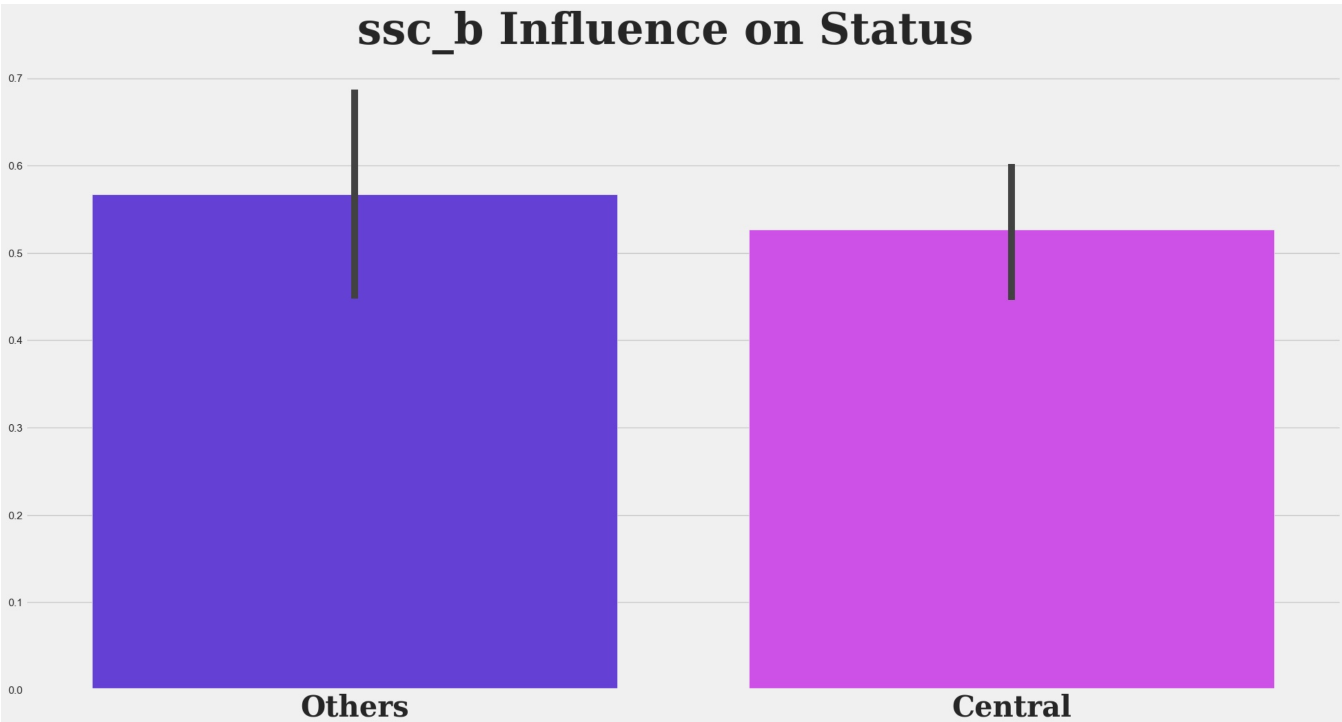
Out[37]:
```
Central    116
Others      99
Name: ssc_b, dtype: int64
```

In [38]:
```
data.ssc_b = data.ssc_b.map({'Central': 1, 'Others': 0})
```

In [39]:
```
plt.figure(figsize=(12, 8))
ssc_b_plot = sns.countplot(x=data.ssc_b,
                           palette=two_colors[::-1])
ssc_b_plot.set_title('Count of ssb: Board of Education (10th)',
                     fontsize=30, y=1.05, **hfont)
ssc_b_plot.set(xlabel=None, ylabel=None)
plt.grid(False)
ssc_b_plot.set_xticklabels(['Others', 'Central'], size=25, **hfont)
plt.show()
```



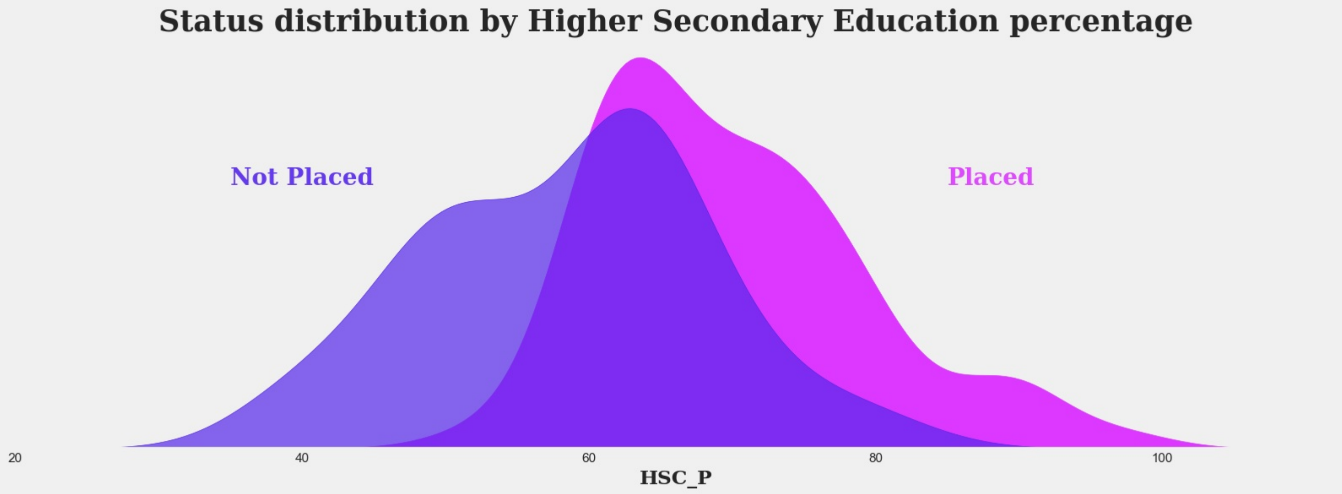
In [40]:
```
ssc_b_plot = sns.catplot(x='status', y='ssc_b', data=data,
                         height=10, aspect=2, kind='bar',
                         palette=two_colors[::-1])
ssc_b_plot.set_xticklabels(['Others', 'Central'], size=30, **hfont)
ssc_b_plot.fig.suptitle('ssc_b Influence on Status',
                        size=45, y=1.05, **hfont)
ssc_b_plot.set(xlabel=None, ylabel=None)
plt.show()
```



In [41]:
```
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title('Status distribution by Higher Secondary Education percentage', size=25, **hfont)
ax.grid(False)
ax.axes.get_yaxis().set_visible(False)
ax.text(85, 0.03, 'Placed', {'fontproperties': 'Serif',
                             'size': '20',
                             'weight': 'bold',
                             'color': two_colors[0]}, alpha=0.9)
```

```
ax.text(35, 0.03, 'Not Placed', {'fontproperties': 'Serif',
                                 'size': '20',
                                 'weight': 'bold',
                                 'color': two_colors[1]}, alpha=0.9)

sns.kdeplot(data=data[data.status == 1],
            x='hsc_p', shade=True, ax=ax, color=two_colors[0], alpha=1)
sns.kdeplot(data=data[data.status == 0],
            x='hsc_p', shade=True, ax=ax, color=two_colors[1], alpha=0.7)
plt.xlabel('HSC_P', **hfont)

print(f'Placed mean:       {data[data.status == 1]["hsc_p"].mean()}')
print(f'Not Placed mean:   {data[data.status == 0]["hsc_p"].mean()}')
plt.show()
```

```
Placed mean:       69.92655405405407
Not Placed mean:   58.3955223880597
```



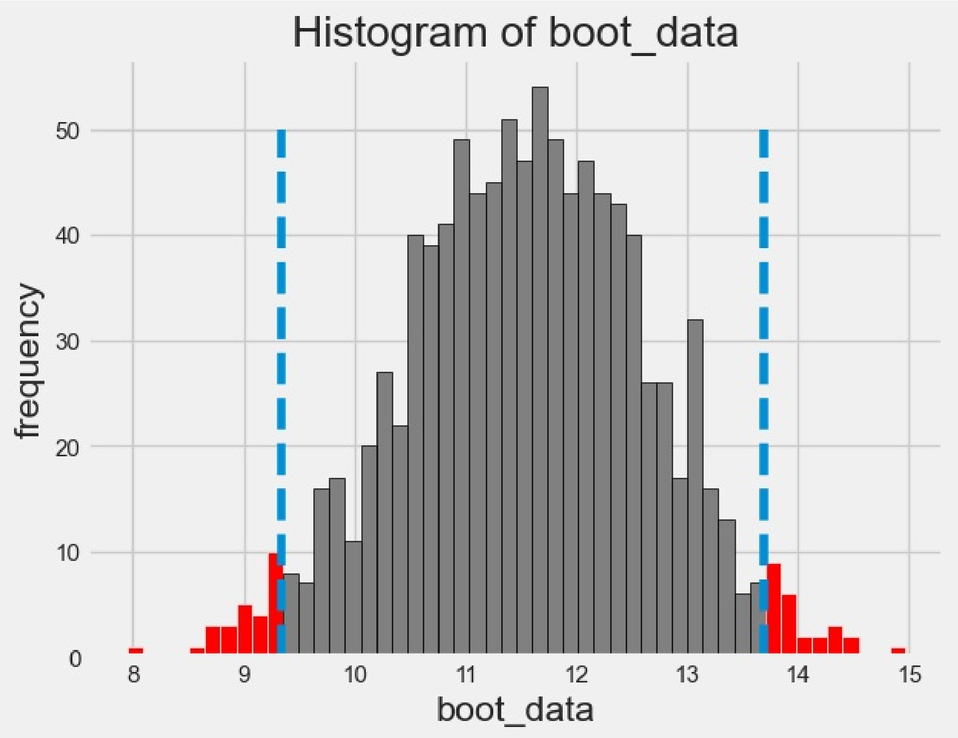
In [42]:

```
from tqdm.auto import tqdm

def get_bootstrap(
    data_column_1, # numeric values for group 1
    data_column_2, # numeric values for group 2
    boot_it = 1000, # bootstrap samples
    statistic = np.mean, # the statistic
    bootstrap_conf_level = 0.95 # significance threshold
):
    boot_len = max([len(data_column_1), len(data_column_2)])
    boot_data = []
    for i in tqdm(range(boot_it)): # get samples
        samples_1 = data_column_1.sample(
            boot_len,
            replace = True
        ).values

        samples_2 = data_column_2.sample(
            boot_len,
            replace = True
        ).values

        boot_data.append(statistic(samples_1-samples_2))
    pd_boot_data = pd.DataFrame(boot_data)

    left_quant = (1 - bootstrap_conf_level)/2
    right_quant = 1 - (1 - bootstrap_conf_level) / 2
    quants = pd_boot_data.quantile([left_quant, right_quant])

    p_1 = norm.cdf(
        x = 0,
        loc = np.mean(boot_data),
        scale = np.std(boot_data)
    )
    p_2 = norm.cdf(
        x = 0,
        loc = -np.mean(boot_data),
        scale = np.std(boot_data)
    )
    p_value = min(p_1, p_2) * 2

    # Visualization
    _, _, bars = plt.hist(pd_boot_data[0], bins = 50)
    for bar in bars:
        if abs(bar.get_x()) <= quants.iloc[0][0] or abs(bar.get_x()) >= quants.iloc[1][0]:
            bar.set_facecolor('red')
        else:
            bar.set_facecolor('grey')
            bar.set_edgecolor('black')
```

```
    plt.vlines(quants,ymin=0,ymax=50,linestyle='--')
    plt.xlabel('boot_data')
    plt.ylabel('frequency')
    plt.title("Histogram of boot_data")
    plt.show()

    return {"boot_data": boot_data,
            "quants": quants,
            "p_value": p_value}
```

In [43]:
```
hsc_p_test = get_bootstrap(data[data.status == 1]["hsc_p"], data[data.status == 0]["hsc_p"])
```

```
  0%|          | 0/1000 [00:00<?, ?it/s]
```

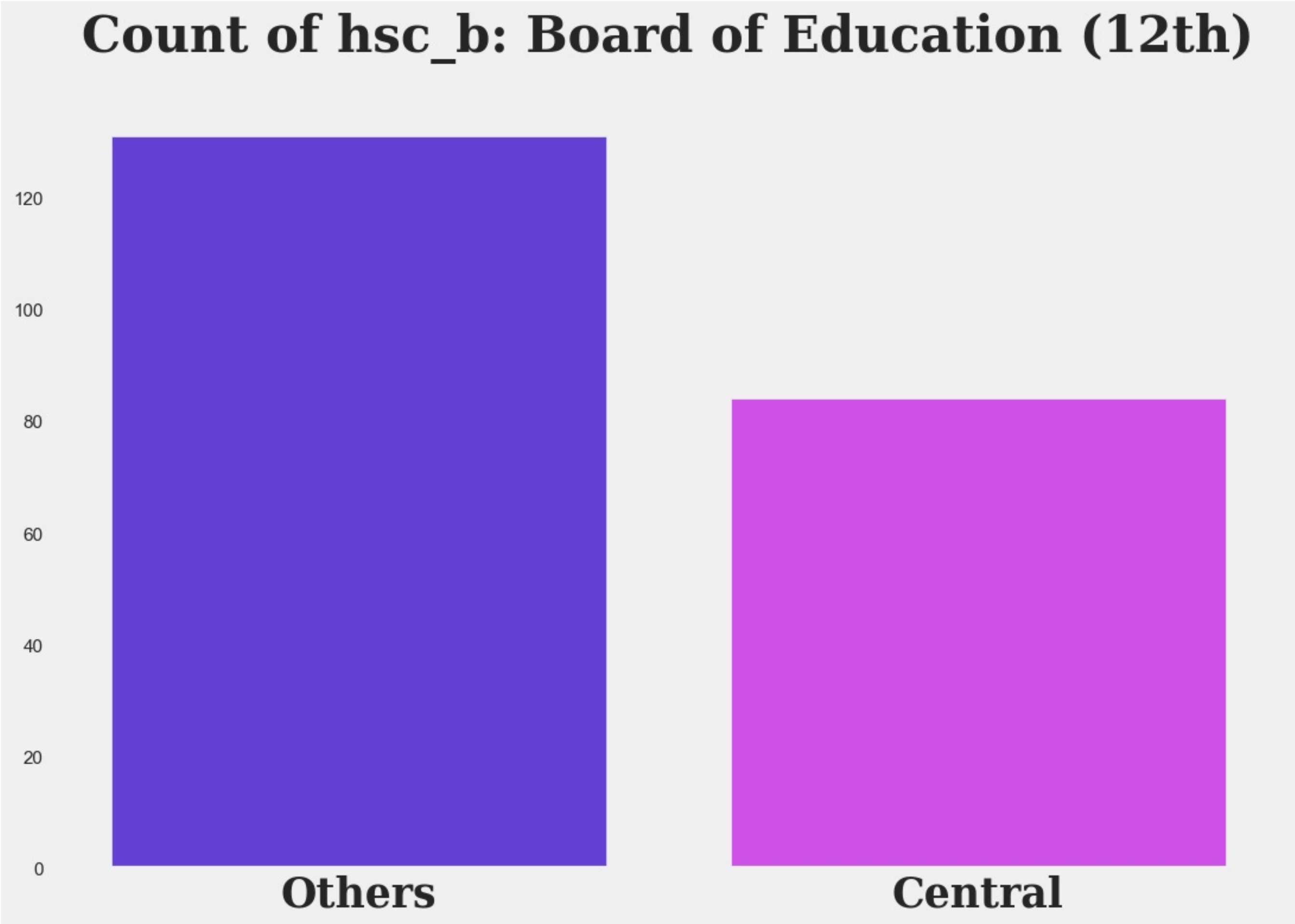


In [44]:
```
print(f'P value for this test: {hsc_p_test["p_value"]}')
```

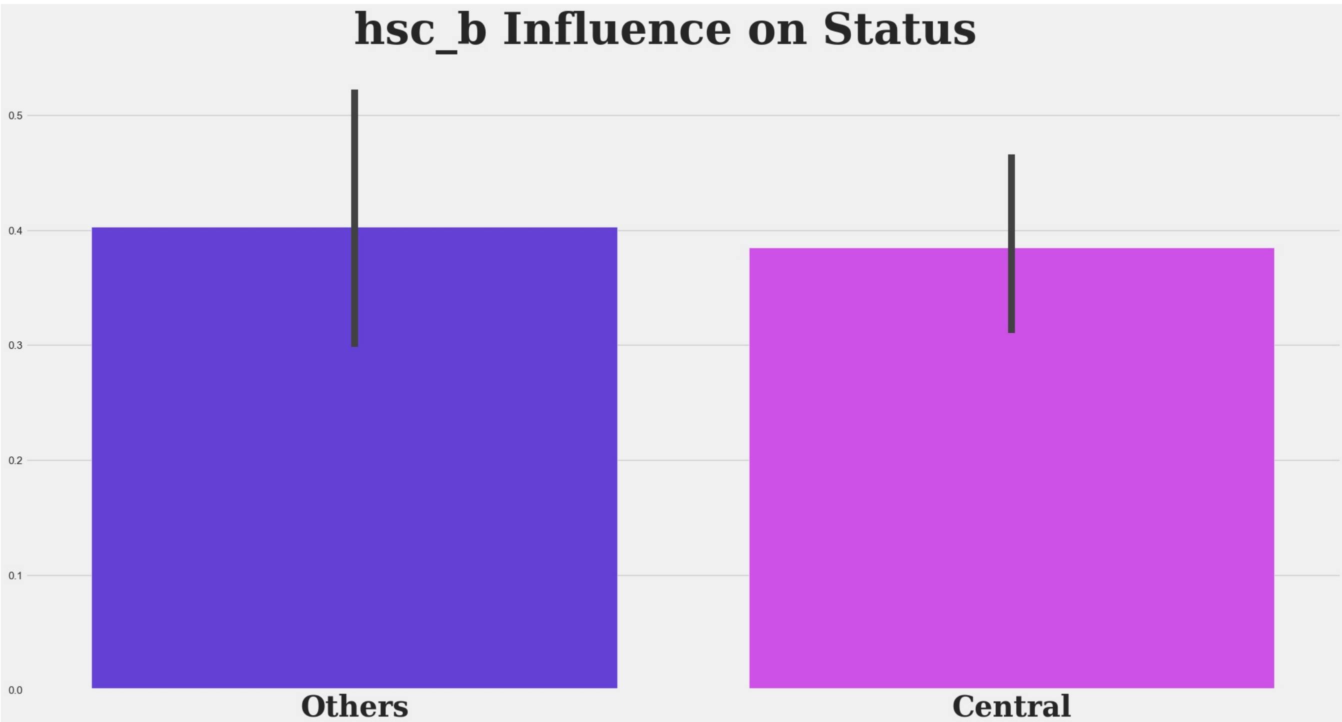
```
P value for this test: 3.2948563012526555e-26
```

In [45]:
```
data.hsc_b = data.hsc_b.map({'Central': 1, 'Others': 0})
```

In [46]:
```
plt.figure(figsize=(12, 8))
ssc_b_plot = sns.countplot(x=data.hsc_b,
                            palette=two_colors[::-1])
ssc_b_plot.set_title('Count of hsc_b: Board of Education (12th)',
                      fontsize=30, y=1.05, **hfont)
ssc_b_plot.set(xlabel=None, ylabel=None)
plt.grid(False)
ssc_b_plot.set_xticklabels(['Others', 'Central'], size=25, **hfont)
plt.show()
```



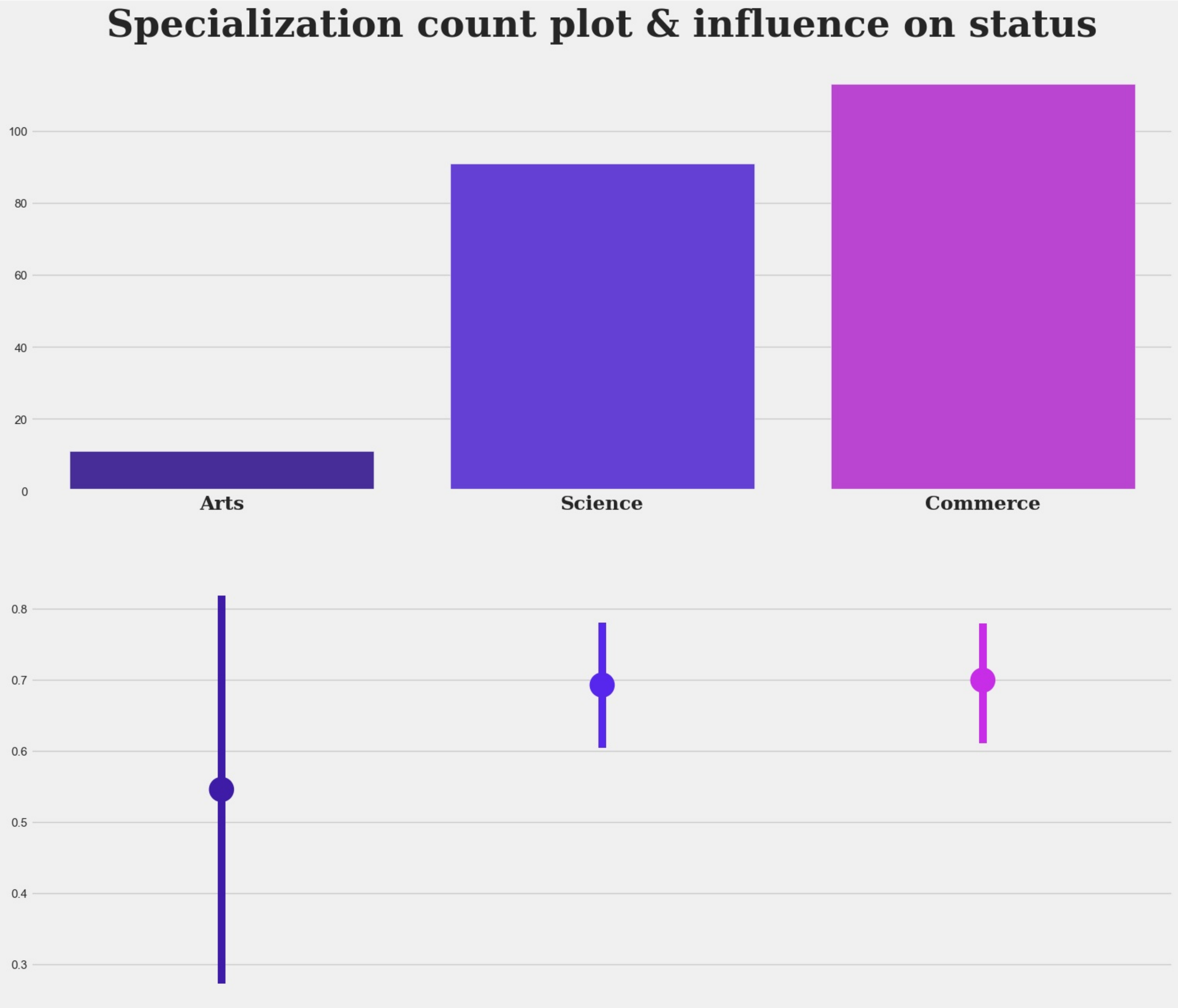
In [47]:
```
hsc_b_plot = sns.catplot(x='status', y='hsc_b', data=data,
                         height=10, aspect=2, kind='bar',
                         palette=two_colors[::-1])
hsc_b_plot.set_xticklabels(['Others', 'Central'], size=30, **hfont)
hsc_b_plot.fig.suptitle('hsc_b Influence on Status',
                        size=45, y=1.05, **hfont)
hsc_b_plot.set(xlabel=None, ylabel=None)
plt.show()
```



In [48]:
```
data.hsc_s = data.hsc_s.map({'Commerce': 2, 'Science': 1, 'Arts': 0})
```

In [49]:
```
fig = plt.figure(figsize=(17, 15))
grid = GridSpec(ncols=1, nrows=2, figure=fig)

ax1 = fig.add_subplot(grid[0, :])
hsc_s_plot = sns.countplot(x=data.hsc_s, ax=ax1, palette=five_colors)
hsc_s_plot.set_title('Specialization count plot &'
                     ' influence on status',
```

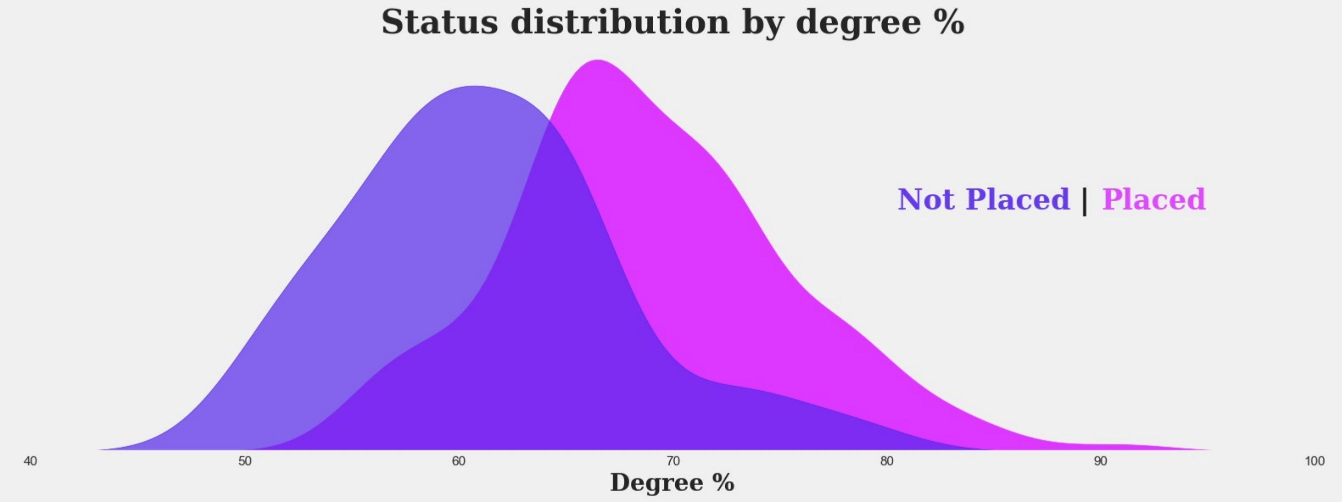
```
                         fontsize=35, y=1.05, **hfont)
hsc_s_plot.set(xlabel=None,
                   ylabel=None)
hsc_s_plot.set_xticklabels(['Arts', 'Science', 'Commerce'],
                                size=18, **hfont)


ax2 = fig.add_subplot(grid[1, :])
hsc_s_cat = sns.pointplot(x=data.hsc_s, y='status', data=data,
             ax=ax2, palette=five_colors)
hsc_s_cat.set(xlabel=None,
                   ylabel=None)
hsc_s_cat.set_xticklabels([])
plt.show()
```



In [50]:
```
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title(f'Status distribution by degree %', size=28, **hfont)
ax.grid(False)
ax.axes.get_yaxis().set_visible(False)

height = 0.04

ax.text(90, height, 'Placed', {'fontproperties': 'Serif',
                              'size': '24',
                              'weight': 'bold',
                              'color': two_colors[0]}, alpha=0.9)

ax.text(89, height, '|', {'fontproperties': 'Serif',
                         'size': '24',
                         'weight': 'bold',
                         'color': 'black'}, alpha=0.9)

ax.text(80.5, height, 'Not Placed', {'fontproperties': 'Serif',
                               'size': '24',
                               'weight': 'bold',
                               'color': two_colors[1]}, alpha=0.9)


sns.kdeplot(data.degree_p[data.status == 1], shade=True, ax=ax, color=two_colors[0],
            alpha=1)
```

```
sns.kdeplot(data.degree_p[data.status == 0], shade=True, ax=ax, color=two_colors[1],
            alpha=0.7)

plt.xlabel('Degree %', size=20, **hfont)

print(f'Placed mean:       {data[data.status == 1]["degree_p"].mean()}')
print(f'Not Placed mean:   {data[data.status == 0]["degree_p"].mean()}')
```

```
Placed mean:       68.74054054054054
Not Placed mean:   61.13417910447761
```

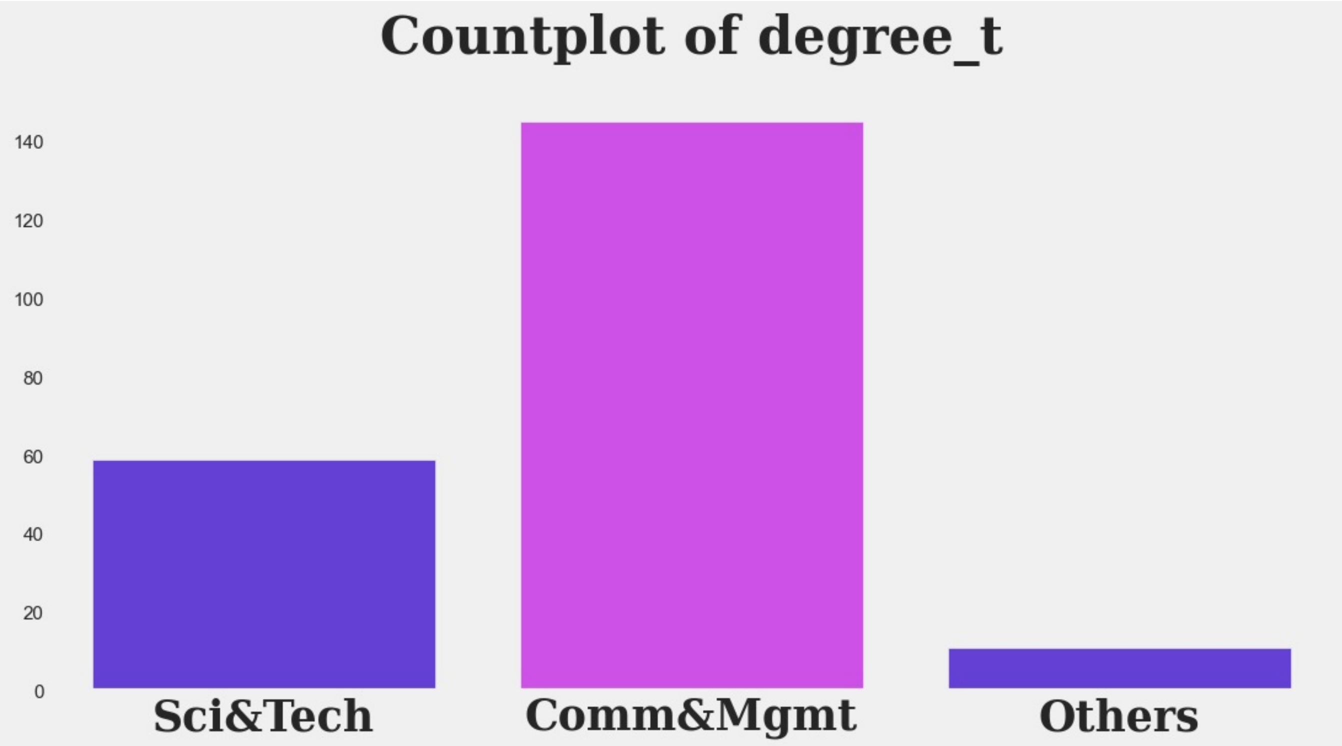


In [51]:
```
placed_group = data[data.status == 1]['degree_p']
not_placed_group = data[data.status == 0]['degree_p']

t_test = stats.ttest_ind(placed_group, not_placed_group)
u_test = stats.mannwhitneyu(placed_group, not_placed_group)
```

In [52]:
```
print(f'Results of T-test                 :    {t_test.pvalue}')
print(f'Results of U-test (Mann-whitneyu):    {u_test.pvalue}')
```

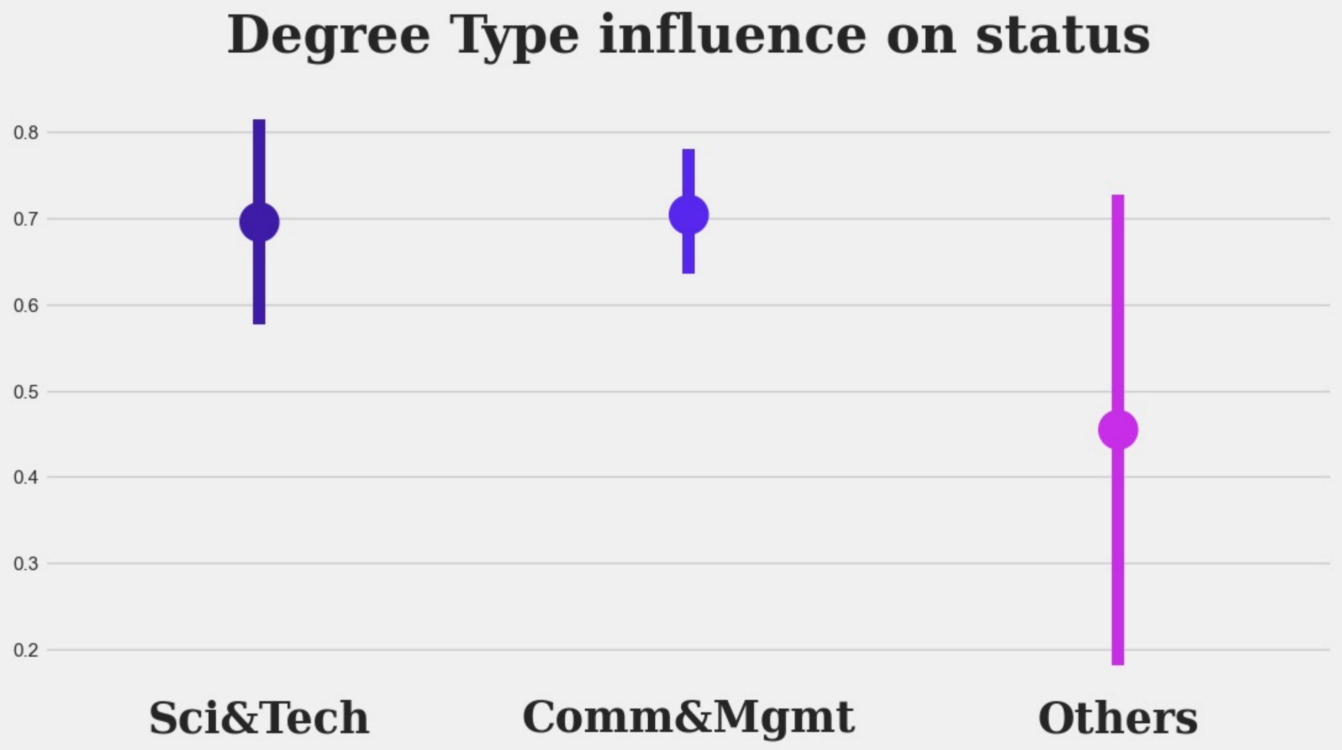
```
Results of T-test                 :    8.807682138862608e-14
Results of U-test (Mann-whitneyu):    4.3024923797997455e-13
```

In [53]:
```
plt.figure(figsize=(12, 6))
degree_t_plot = sns.countplot(x=data.degree_t, palette=two_colors[::-1])
degree_t_plot.set_title('Countplot of degree_t',
                        fontsize=30, y=1.05, **hfont)
degree_t_plot.set(xlabel=None, ylabel=None)
plt.grid(False)
degree_t_plot.set_xticklabels(data.degree_t.unique(), size=25, **hfont)
plt.show()
```



In [54]:
```
fig = plt.figure(figsize=(12, 6))

degree_type_plot = sns.pointplot(x=data.degree_t, y='status', data=data, palette=five_colors)

degree_type_plot.set_title('Degree Type influence on status', fontsize=30, y=1.05, **hfont)
```

```
degree_type_plot.set(xlabel=None,
                     ylabel=None)
degree_type_plot.set_xticklabels(data.degree_t.unique(), size=25, **hfont)
plt.show()
```



In [55]:
```
data.degree_t.unique()
```

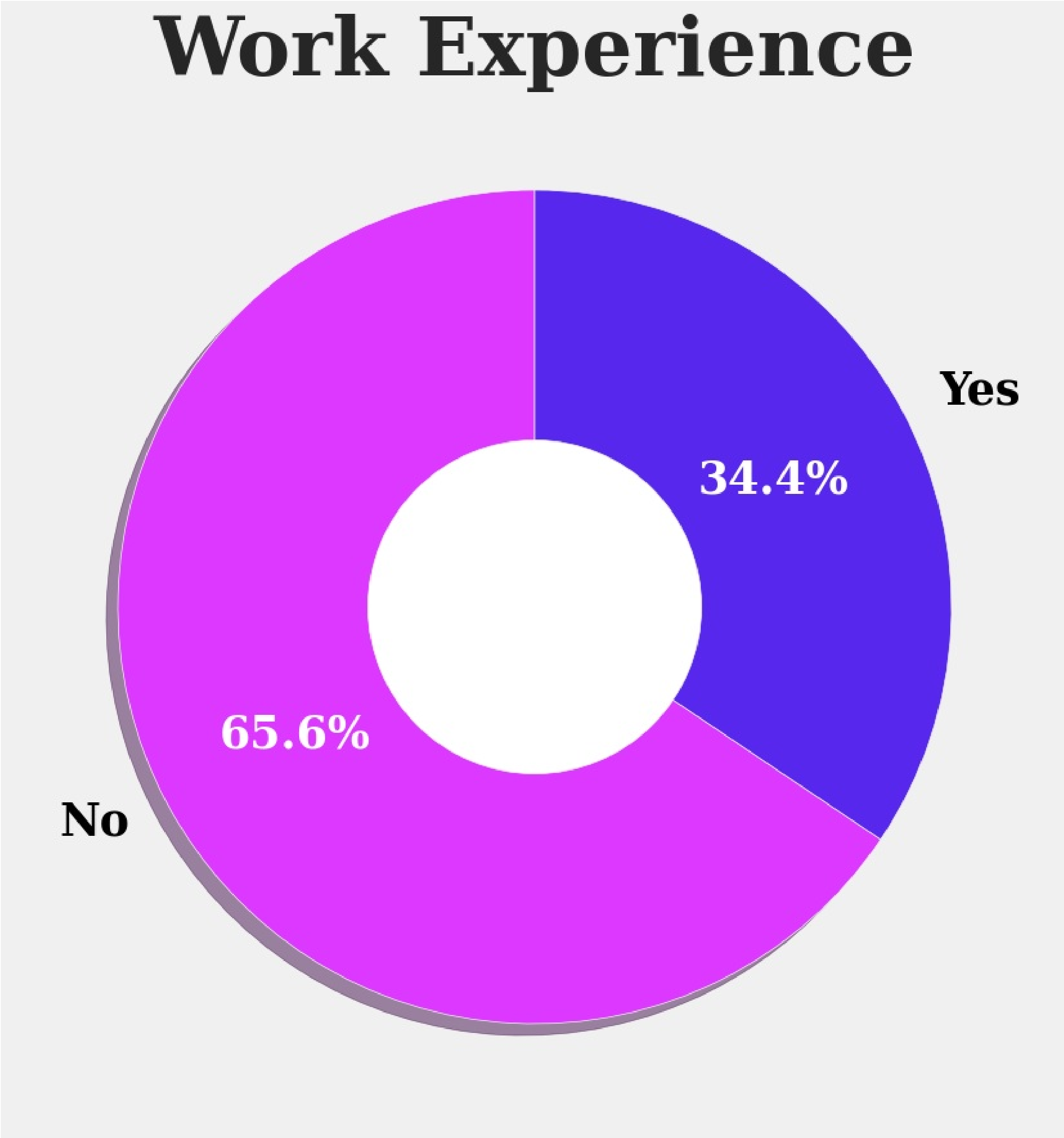
Out[55]:
```
array(['Sci&Tech', 'Comm&Mgmt', 'Others'], dtype=object)
```

In [56]:
```
data.degree_t.value_counts()
```

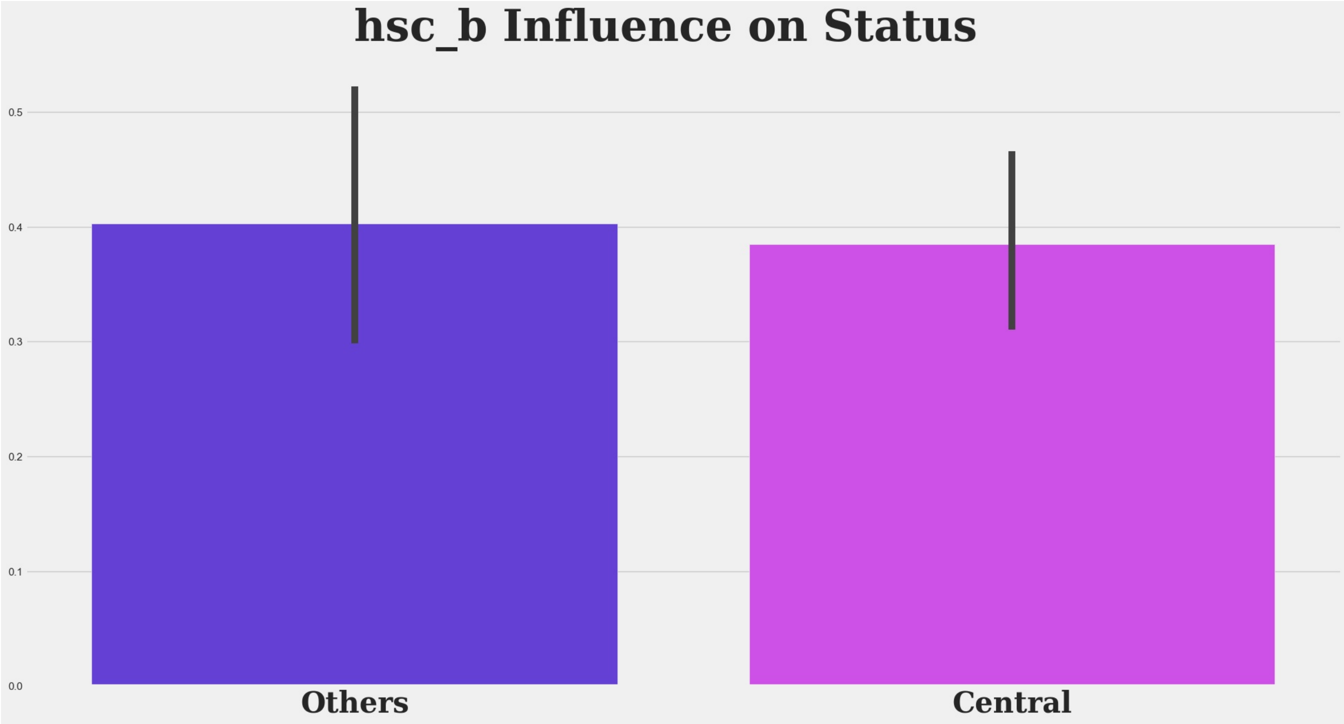
Out[56]:
```
Comm&Mgmt    145
Sci&Tech      59
Others        11
Name: degree_t, dtype: int64
```

In [57]:
```
data.degree_t = data.degree_t.map({'Sci&Tech': 1, 'Comm&Mgmt': 2, 'Others': 3})
```

In [58]:
```
workex_data = data.workex.value_counts()

explode = (0.1, 0.1)
plt.figure(figsize=(14, 10))
patches, texts, pcts = plt.pie(workex_data,
                               labels=workex_data.index,
                               colors=pie_colors,
                               pctdistance=0.65,
                               shadow=True,
                               startangle=90,
                               autopct='%1.1f%%',
                               textprops={ 'fontsize': 25,
                                           'color': 'black',
                                           'weight': 'bold',
                                           'family': 'serif' })
plt.setp(pcts, color='white')

hfont = {'fontname':'serif', 'weight': 'bold'}
plt.title('Work Experience', size=45, **hfont)

centre_circle = plt.Circle((0,0),0.40,fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)
plt.show()
```

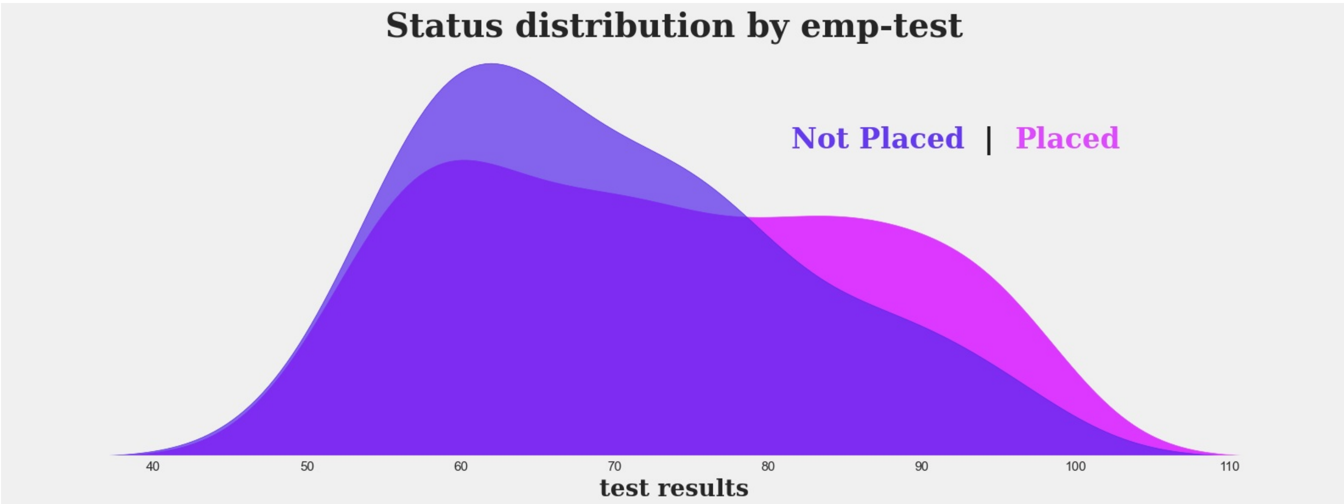


In [59]:
```
workex_plot = sns.catplot(x='status', y='hsc_b', data=data,
                          height=10, aspect=2, kind='bar',
                          palette=two_colors[::-1])
workex_plot.set_xticklabels(['Others', 'Central'], size=30, **hfont)
workex_plot.fig.suptitle('hsc_b Influence on Status', size=45, y=1.05, **hfont)
workex_plot.set(xlabel=None, ylabel=None)
plt.show()
```



In [60]:
```
data.workex = data.workex.map({'No': 0, 'Yes': 1})
```

In [61]:
```
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title(f'Status distribution by emp-test', size=28, **hfont)
ax.grid(False)
ax.axes.get_yaxis().set_visible(False)

height = 0.025

ax.text(96, height, 'Placed', {'fontproperties': 'Serif',
                               'size': '24',
                               'weight': 'bold',
                               'color': two_colors[0]}, alpha=0.9)

ax.text(94, height, '|', {'fontproperties': 'Serif',
                          'size': '24',
                          'weight': 'bold',
                          'color': 'black'}, alpha=0.9)

ax.text(81.5, height, 'Not Placed', {'fontproperties': 'Serif',
                                     'size': '24',
                                     'weight': 'bold',
                                     'color': two_colors[1]}, alpha=0.9)


sns.kdeplot(data.etest_p[data.status == 1], shade=True, ax=ax, color=two_colors[0],
            alpha=1)
sns.kdeplot(data.etest_p[data.status == 0], shade=True, ax=ax, color=two_colors[1],
            alpha=0.7)

plt.xlabel('test results', size=20, **hfont)
plt.show()
```



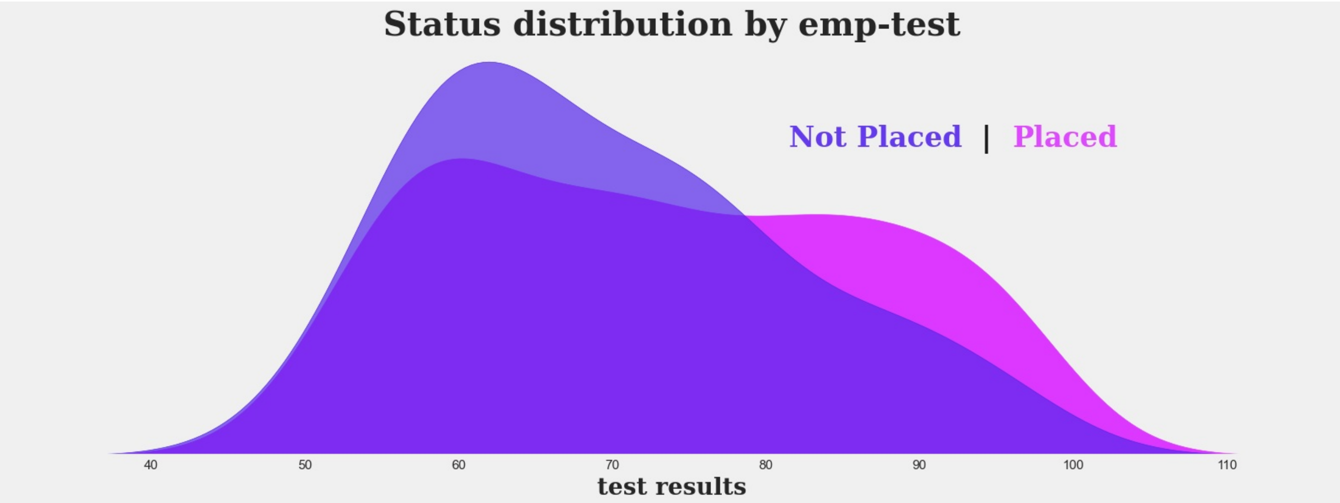
In [62]:
```
data.status.unique()
```

Out[62]: array([1, 0], dtype=int64)

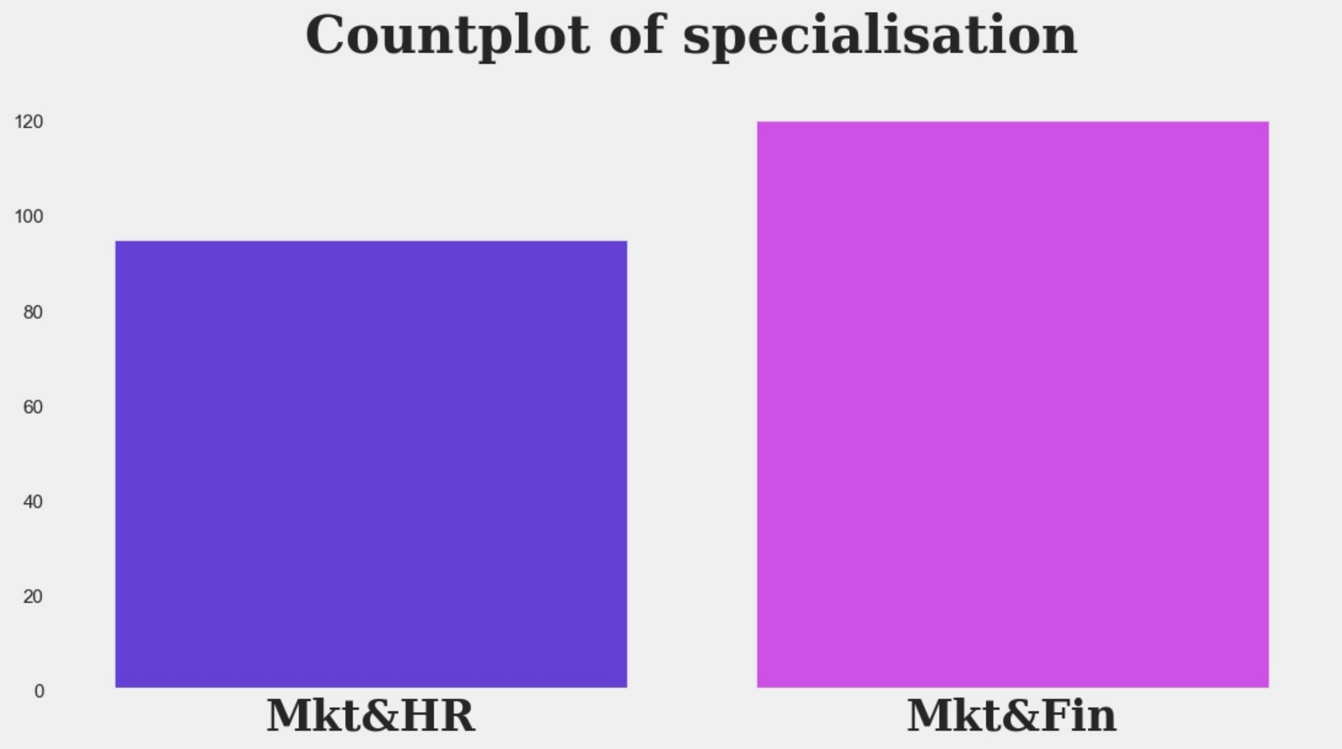
In [63]:
```
data.status.value_counts()
```

Out[63]:
```
1    148
0     67
Name: status, dtype: int64
```

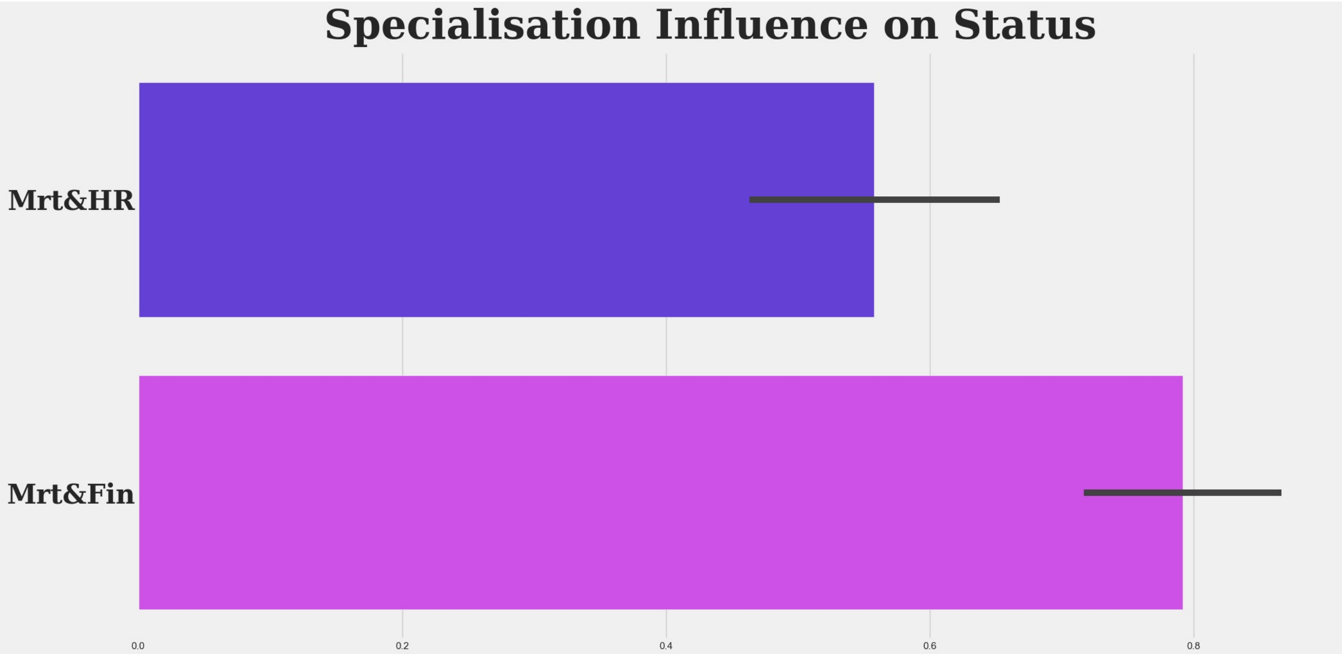
In [64]:
```
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title(f'Status distribution by emp-test', size=28, **hfont)
ax.grid(False)
ax.axes.get_yaxis().set_visible(False)

height = 0.025

ax.text(96, height, 'Placed', {'fontproperties': 'Serif',
                               'size': '24',
                               'weight': 'bold',
                               'color': two_colors[0]}, alpha=0.9)

ax.text(94, height, '|', {'fontproperties': 'Serif',
                          'size': '24',
                          'weight': 'bold',
                          'color': 'black'}, alpha=0.9)

ax.text(81.5, height, 'Not Placed', {'fontproperties': 'Serif',
                                     'size': '24',
                                     'weight': 'bold',
                                     'color': two_colors[1]}, alpha=0.9)


sns.kdeplot(data.etest_p[data.status == 1], shade=True, ax=ax, color=two_colors[0],
            alpha=1)
sns.kdeplot(data.etest_p[data.status == 0], shade=True, ax=ax, color=two_colors[1],
            alpha=0.7)

plt.xlabel('test results', size=20, **hfont)
plt.show()
```



In [65]:
```
plt.figure(figsize=(12, 6))
specialisation_plot = sns.countplot(x=data.specialisation, palette=two_colors[::-1])
specialisation_plot.set_title('Countplot of specialisation',
                              fontsize=30, y=1.05, **hfont)
specialisation_plot.set(xlabel=None, ylabel=None)
plt.grid(False)
specialisation_plot.set_xticklabels(data.specialisation.unique(), size=25, **hfont)
plt.show()
```



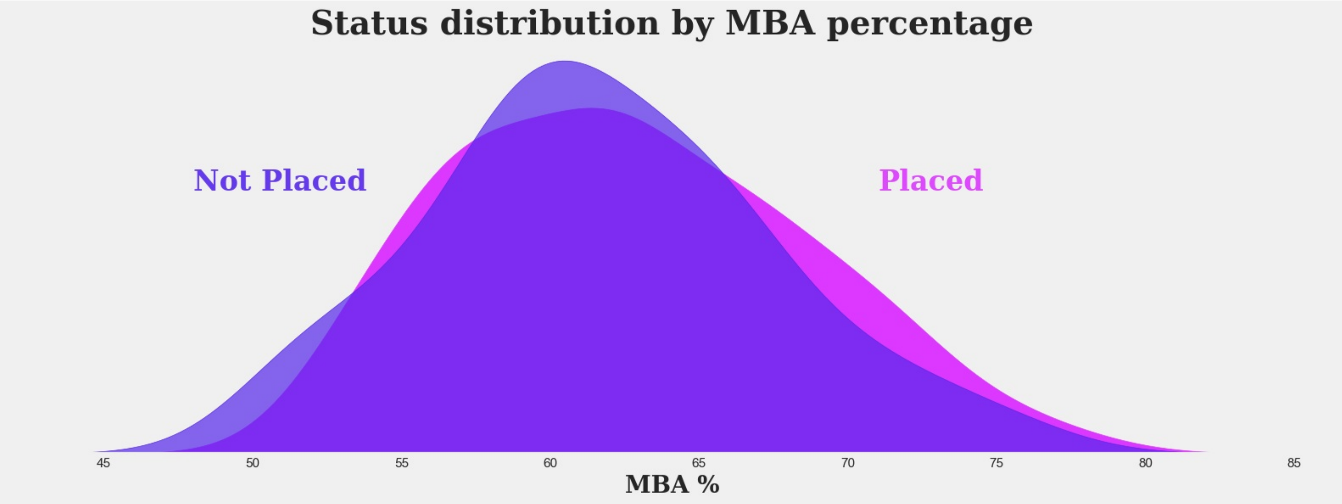
In [66]:
```
spec_catplot = sns.catplot(x='status', y='specialisation', data=data,
                           height=10, aspect=2, kind='bar',
                           palette=two_colors[::-1])
spec_catplot.set_yticklabels(['Mrt&HR', 'Mrt&Fin'], size=30, **hfont)
spec_catplot.fig.suptitle('Specialisation Influence on Status', size=45, y=1.05, **hfont)
spec_catplot.set(xlabel=None, ylabel=None)
plt.show()
```



In [67]:
```
data.specialisation = data.specialisation.map({'Mkt&Fin': 1, 'Mkt&HR': 0})
```

In [68]:
```
fig = plt.figure(figsize=(18, 6))
ax = fig.add_subplot(111)
plt.title(f'Status distribution by MBA percentage', size=28, **hfont)
ax.grid(False)
ax.axes.get_yaxis().set_visible(False)

height = 0.045

ax.text(71, height, 'Placed', {'fontproperties': 'Serif',
                               'size': '24',
                               'weight': 'bold',
                               'color': two_colors[0]}, alpha=0.9)

ax.text(48, height, 'Not Placed', {'fontproperties': 'Serif',
                                   'size': '24',
                                   'weight': 'bold',
                                   'color': two_colors[1]}, alpha=0.9)
```

```python
sns.kdeplot(data.mba_p[data.status == 1], shade=True, ax=ax, color=two_colors[0],
            alpha=1)
sns.kdeplot(data.mba_p[data.status == 0], shade=True, ax=ax, color=two_colors[1],
            alpha=0.7)

plt.xlabel('MBA %', size=20, **hfont)
plt.show()
```



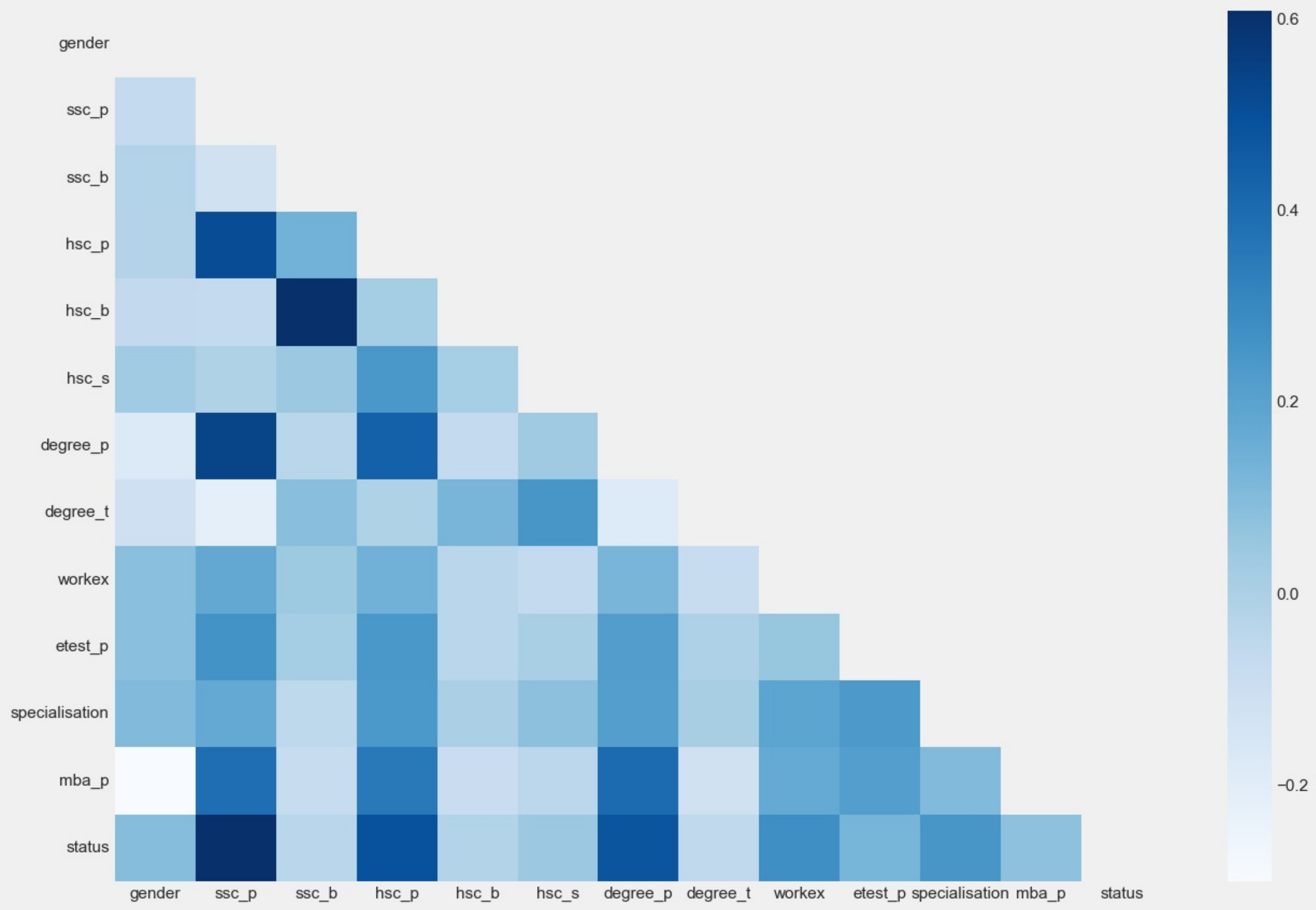
In [69]:

```python
placed_group = data[data.status == 1]['mba_p']
not_placed_group = data[data.status == 0]['mba_p']

placed_group_for_wil = np.random.choice(placed_group, len(not_placed_group))

t_test = stats.ttest_ind(placed_group, not_placed_group)
u_test = stats.mannwhitneyu(placed_group, not_placed_group)

print(f'P-value (alpha = 0.05)')
print('-'*7)
print(f'T-test  : {t_test.pvalue:.5f}')
print(f'U-test  : {u_test.pvalue:.5f}')
```

```
P-value (alpha = 0.05)
-------
T-test  : 0.26145
U-test  : 0.35471
```

In [70]:

```python
plt.figure(figsize=(14, 10))

corr_mask = np.triu(data.corr())
h_map = sns.heatmap(data.corr(), mask=corr_mask, cmap='Blues')
h_map
plt.show()
```



In [71]:
```
X = data.drop(['status'], axis=1)
y = data.status

print(X.shape, y.shape)
```

```
(215, 12) (215,)
```

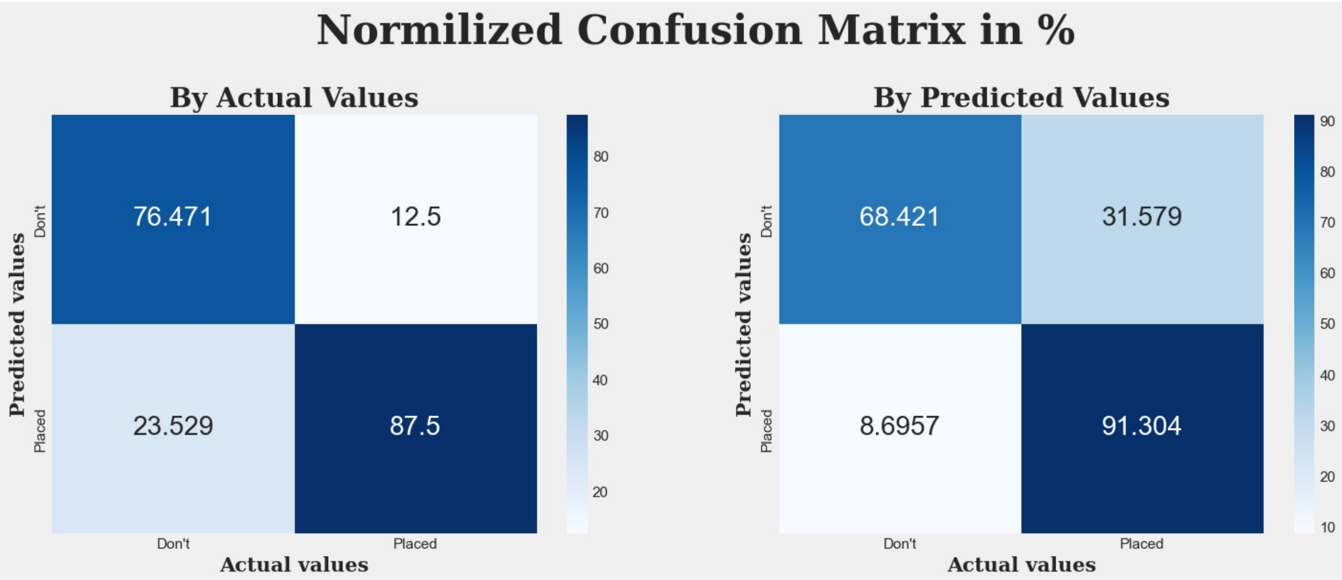
In [72]:
```
X = X.drop(columns=['etest_p'])
```

In [73]:
```
from sklearn.metrics import precision_score, f1_score, recall_score, roc_auc_score

models_results = [0]*5

def show_training_results(X, y, model_name, model, split_share=0.3, **kwargs):

    print(f'The model {model_name} with parameters : {kwargs}')
    m = model(**kwargs)

    X_train, X_test, y_train, y_test = \
        train_test_split(X, y, test_size=split_share, random_state=rnd_state)

    m.fit(X_train, y_train)

    score = m.score(X_test, y_test)

    prediction = m.predict(X_test)
    pred_proba = m.predict_proba(X_test)

    precision = precision_score(y_test, prediction)
    recall = recall_score(y_test, prediction)
    F1 = f1_score(y_test, prediction)
    roc = roc_auc_score(y_test, pred_proba[:,1])

    all_metrics = np.array([score, precision, recall, F1, roc])

    print('-'*32)
    print(f'Score          ========>>> {score:.{3}f}')
    print()
    print(f'Precision      ========>>> {precision:.{3}f}')
    print()
    print(f'Recall         ========>>> {recall:.{3}f}')
    print()
    print(f'F1             ========>>> {F1:.{3}f}')
    print()
    print(f'ROC-AUC        ========>>> {roc:.{3}f}')

    plot_conf_mat(m, X_test, y_test)

    return all_metrics
```

```python
def plot_conf_mat(model, X_test, y_test):

    y_pred = model.predict(X_test)

    pred_matrix = confusion_matrix(y_test, y_pred, normalize='true') * 100
    actual_matrix = confusion_matrix(y_test, y_pred, normalize='pred') * 100

    df_cm_true = pd.DataFrame(actual_matrix, index = ["Don't", 'Placed'],
                              columns = ["Don't", 'Placed'])

    df_cm_pred = pd.DataFrame(pred_matrix, index = ["Don't", 'Placed'],
                              columns = ["Don't", 'Placed'])

    fig, axis = plt.subplots(figsize=(16, 6), ncols=2)

    # Actual Values plot

    sns.heatmap(df_cm_true,
                annot=True,
                cmap='Blues',
                fmt='.5g',
                ax=axis[0],
                annot_kws={"size": 20}).set_title('By Actual Values', fontsize = 20, **hfont)
    axis[0].set_xlabel('Actual values', fontsize = 15, **hfont)
    axis[0].set_ylabel('Predicted values', fontsize = 15, **hfont)

    # Prediction's Values plot

    pred_plot = sns.heatmap(df_cm_pred,
                annot=True,
                cmap='Blues',
                fmt='.5g',
                ax=axis[1],
                annot_kws={"size": 20}).set_title('By Predicted Values', fontsize = 20, **hfont)
    axis[1].set_xlabel('Actual values', fontsize = 15, **hfont)
    axis[1].set_ylabel('Predicted values', fontsize = 15, **hfont)

    fig.subplots_adjust(top=0.8)
    fig.suptitle('Normilized Confusion Matrix in %', size=30, **hfont)

    plt.show()
```

In [74]:
```python
rnd_state = 0

models_results[0] =   show_training_results(X, y,
                      'LogReg',
                      LogisticRegression,
                      max_iter=5000,
                      random_state=rnd_state)
```

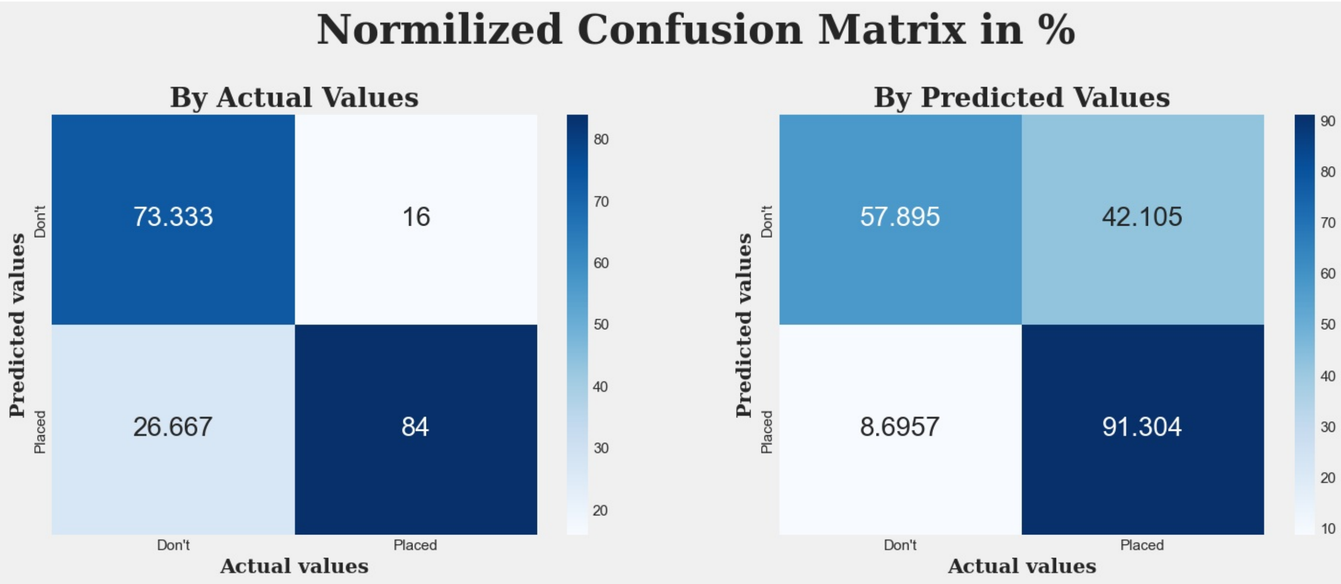
```
The model LogReg with parameters : {'max_iter': 5000, 'random_state': 0}
--------------------------------
Score          ========>>> 0.846

Precision      ========>>> 0.875

Recall         ========>>> 0.913

F1             ========>>> 0.894

ROC-AUC        ========>>> 0.931
```



In [75]:
```python
models_results[1] =   show_training_results(X, y,
```

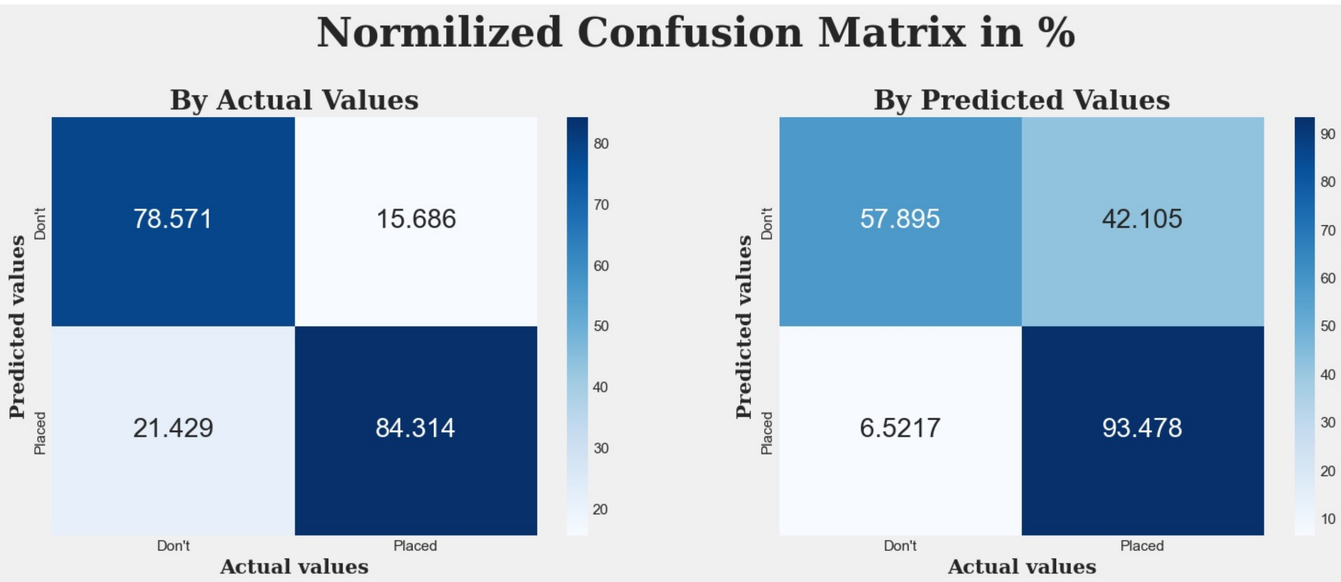
```
                         'RF',
                         RandomForestClassifier)
```

```
The model RF with parameters : {}
--------------------------------
Score          ========>>> 0.815

Precision      ========>>> 0.840

Recall         ========>>> 0.913

F1             ========>>> 0.875

ROC-AUC        ========>>> 0.894
```



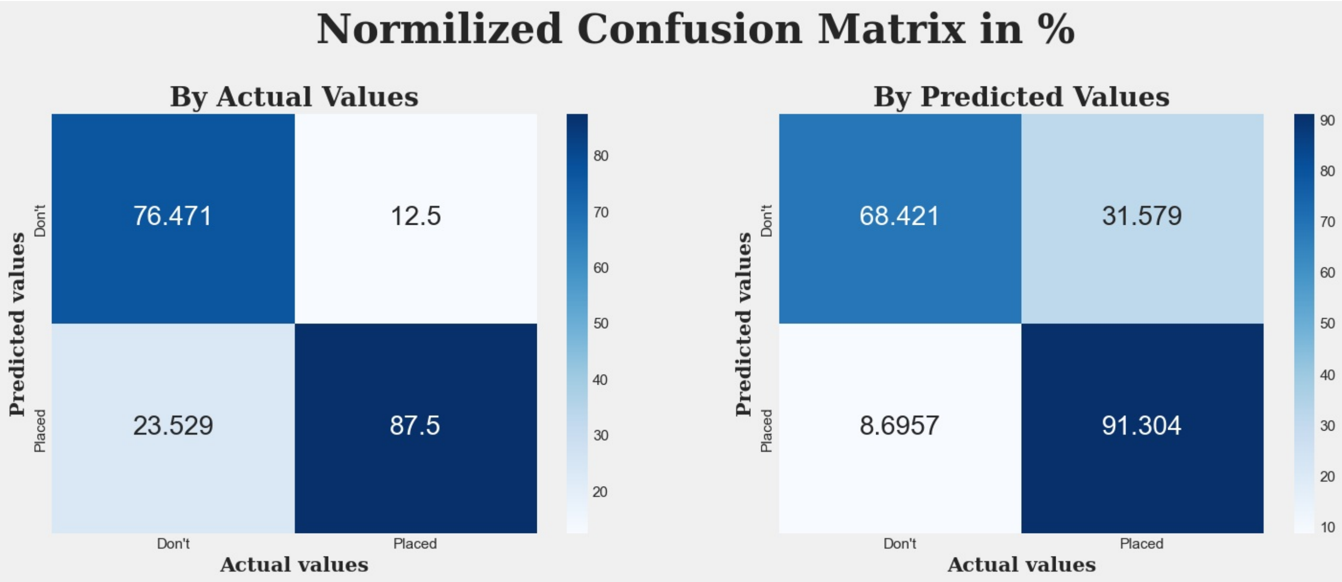
In [76]:
```
models_results[2] =   show_training_results(X, y,
                      'AdaBoostClassifier',
                      AdaBoostClassifier)
```

```
The model AdaBoostClassifier with parameters : {}
--------------------------------
Score          ========>>> 0.831

Precision      ========>>> 0.843

Recall         ========>>> 0.935

F1             ========>>> 0.887

ROC-AUC        ========>>> 0.932
```



In [77]:
```
models_results[3] =   show_training_results(X, y,
                      'GradientBoostingClassifier',
                      GradientBoostingClassifier)
```

```
The model GradientBoostingClassifier with parameters : {}
--------------------------------
Score          ========>>> 0.846

Precision      ========>>> 0.875

Recall         ========>>> 0.913

F1             ========>>> 0.894

ROC-AUC        ========>>> 0.874
```



In [78]:
```
os.environ["KMP_SETTINGS"] = "false" # to avoid a huge warning about sort of settings
```

In [79]:
```
from keras import backend as K

def recall_m(y_true, y_pred):
    true_positives = K.sum(K.round(K.clip(y_true * y_pred, 0, 1)))
    possible_positives = K.sum(K.round(K.clip(y_true, 0, 1)))
    recall = true_positives / (possible_positives + K.epsilon())
    return recall

def precision_m(y_true, y_pred):
    true_positives = K.sum(K.round(K.clip(y_true * y_pred, 0, 1)))
    predicted_positives = K.sum(K.round(K.clip(y_pred, 0, 1)))
    precision = true_positives / (predicted_positives + K.epsilon())
    return precision

def f1_m(y_true, y_pred):
    precision = precision_m(y_true, y_pred)
    recall = recall_m(y_true, y_pred)
    return 2*((precision*recall)/(precision+recall+K.epsilon()))
```

In [80]:
```
def neural_net_results(X, y):

    K.set_session(42)

    y = keras.utils.to_categorical(y, 2)

    X_train, X_val, y_train, y_val = train_test_split(X, y,test_size=0.25,
                                                      random_state=rnd_state)

    scaler = StandardScaler()
    X_train = scaler.fit_transform(X_train)
    X_val = scaler.transform(X_val)

    model = keras.Sequential([
        keras.layers.Flatten(input_dim=X_train.shape[1]),
        keras.layers.Dropout(0.5),
        keras.layers.Dense(36, activation='relu'),
        keras.layers.Dense(36, activation='relu'),
        keras.layers.Dense(2, activation='softmax')
    ])
    model.summary()

    model.compile(optimizer='adam',
                  loss='categorical_crossentropy',
                  metrics=[f1_m, precision_m, recall_m])

    history = model.fit(X_train, y_train,
              batch_size=100, epochs=150,
              validation_data=(X_val, y_val),
              verbose=0)
```

```python
    score = loss, f1_score, precision, recall = model.evaluate(X_val, y_val, verbose=0)
    print(f'Neural Network score results    ========>>> {score}')

    history_plot(history)

    return score


def history_plot(history):

    fig = plt.figure(figsize=(12, 8))
    plt.title('Loss of ANN', size=35, **hfont)
    plt.plot(history.history['loss'], label="Train loss")
    plt.plot(history.history['val_loss'], label="Test loss")
    plt.legend()


def plot_nn_model(model):
    plot_model(model, show_shapes=True)
```

In [ ]:

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