nir

December 6, 2024

1 -

1.1

[1691]:
```
import numpy as np
import pandas as pd

from matplotlib import pyplot as plt
import seaborn as sns

import json
from sklearn.feature_extraction.text import CountVectorizer

from scipy import stats

import plotly.express as px
```

1.2

[1651]:
```
#          JSON
with open('vacancies_data_with_salary.json', 'r', encoding='utf-8') as file:
    data = json.load(file)

#
vacancies = pd.json_normalize(data)
df = vacancies.copy()
```

2 EDA

[1652]:
```
df
```

[1652]:
```
             id                                                name    area
                                                                    \
0     112620411
1     112595285                                   React-
2     112214994                                Frontend-
3     112543205                             Backend        (Java)
4     112524085                               /frontend
```

```
…         …                                                    …     …
7923  110849150  Engineering & Manufacturing Intern /      …
7924  109079028  Engineering & Manufacturing Intern /      …
7925  112419562
7926  111423693                                  Senior ML Engineer
7927  108659245  Engineering & Manufacturing Intern /      …

                 published_at          schedule
0     2024-12-05T16:19:49+0300              \
1     2024-12-05T13:04:08+0300
2     2024-11-30T09:52:47+0300
3     2024-12-04T17:40:31+0300
4     2024-12-04T14:47:08+0300
…                         …               …
7923  2024-12-03T10:56:39+0300
7924  2024-11-27T16:20:29+0300
7925  2024-12-03T13:07:49+0300
7926  2024-12-05T14:04:15+0300
7927  2024-12-05T15:58:21+0300

                            professional_roles          experience
0                                      [    ]         3   6    \
1                   [      ,       ]    1      3
2                   [      ,       ]    1      3
3                   [      ,       ]    1      3
4                   [      ,       ]
…                                         …                …
7923                                   [   ]
7924                                   [   ]
7925  [                 ,     ]
7926                          [  -    ]         3   6
7927                                   [   ]

           employment                                          key_skills
0               [              ,            ]  \
1               [React, React Native, CSS, HTML, HTML5, Node.j…
2               [JavaScript, HTML, CSS, VueJS, TypeScript, RES…
3               [Java, Spring Framework, SQL, NoSQL, Git, CI/C…
4                                                                   []
…              …                                                      …
7923                                                                []
7924                                              [        ]
7925                                                                []
7926            [Python, SQL, Numpy, pandas, PyTorch, PySpark,…
7927                                                                  []

      salary.from  salary.to salary.currency salary.gross
```

```
0        350000.0   500000.0             RUR        False
1           600.0      950.0             USD        False
2        150000.0   200000.0             KZT         True
3       1000000.0        NaN             KZT         True
4             NaN      200.0             USD        False
…             …          …               …          …
7923     100000.0        NaN             RUR         True
7924     100000.0        NaN             RUR         True
7925      45000.0        NaN             RUR         True
7926          NaN   330000.0             RUR        False
7927     100000.0        NaN             RUR         True

[7928 rows x 13 columns]
```

2.1

[1653]:
```
df.isnull().sum()
```

[1653]:
```
id                     0
name                   0
area                   0
published_at           0
schedule               0
professional_roles     0
experience             0
employment             0
key_skills             0
salary.from          890
salary.to           3425
salary.currency        0
salary.gross           1
dtype: int64
```

[1654]:
```
df = df.drop([ 'salary.gross'], axis=1)
```

2.2

[1655]:
```
df = df.rename(columns={'salary.from':'salary_from',
                        'salary.to':'salary_to',
                        'salary.currency':'salary_currency',
                        'salary.gross': 'salary_gross'})
```

2.3

[ ]:
```

```

[1656]:
```
df[['salary_from', 'salary_to']] = df[['salary_from', 'salary_to']].fillna(0)

#                'salary'
def calculate_salary(row):
    if row['salary_from'] != 0 and row['salary_to'] != 0:
        return (row['salary_from'] + row['salary_to']) / 2
    else:
        return row['salary_from'] + row['salary_to']

df['salary'] = df.apply(calculate_salary, axis=1)
```

2.4

[1657]:
```
df['published_date'] = pd.to_datetime(df['published_at']).dt.strftime('%Y/%m/
↪%d')
```

2.5

[1658]:
```
df['job'] = df['professional_roles'].apply(lambda x: ', '.join(x))
```

[1659]:
```
it_positions = ['      ', '    ', '    ', 'Data', 'Developer', '             ',␣
↪'      ', 'UI/UX     ', 'DevOps', 'Machine Learning Engineer', '      ',␣
↪'  ', '   ']
df = df[df['job'].str.contains('|'.join(it_positions), regex=True)]
```

[1660]:
```
df = df.drop(['published_at', 'professional_roles', 'salary_from',␣
↪'salary_to'], axis=1)
```

2.6

[1661]:
```
#
currency_rates = {
    'USD': 94.5,    #
    'KZT': 0.2,     #
    'BYR': 0.037,   #
    'UZS': 0.0078,  #
    'EUR': 103.2,   #
    'KGS': 1.08,    #
    'AZN': 55.0     #
}

#
df['salary_rub'] = df.apply(
    lambda row: row['salary'] * currency_rates.get(row['salary_currency'], 1)␣
↪if row['salary_currency'] in currency_rates else row['salary'],
    axis=1
)
```

2.7

[1662]:
```
df["key_skills"] = df["key_skills"].apply(lambda x: ",".join(x) if x else '
↪    ')
```

[1663]:
```
df = df.drop('salary', axis=1)
```

[1664]:
```
df = df.drop(['salary_currency', 'id'], axis=1)
```

2.8

[1665]:
```
df['salary_rub'] = df['salary_rub'].astype(int)

df['published_date'] = pd.to_datetime(df['published_date'])
```

2.9

[1666]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 4944 entries, 1 to 7927
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   name            4944 non-null   object
 1   area            4944 non-null   object
 2   schedule        4944 non-null   object
 3   experience      4944 non-null   object
 4   employment      4944 non-null   object
 5   key_skills      4944 non-null   object
 6   published_date  4944 non-null   datetime64[ns]
 7   job             4944 non-null   object
 8   salary_rub      4944 non-null   int64
dtypes: datetime64[ns](1), int64(1), object(7)
memory usage: 386.2+ KB
```

[1667]:
```
df.isnull().sum()
```

[1667]:
```
name              0
area              0
schedule          0
experience        0
employment        0
key_skills        0
published_date    0
job               0
salary_rub        0
dtype: int64
```

3 analysis_df

[1668]:
```
analysis_df = df.copy()
```

3.1

[1669]:
```
def plot_percent(df, column_name, title, xlabel, flip_axes=False):
    #        -10
    top_10 = df[column_name].value_counts(normalize=True).multiply(100).
↪round(2).head(10).reset_index(name='percent')

    #
    plt.figure(figsize=(12, 6), dpi=200)

    if flip_axes:
        plt.figure(figsize=(16, 8), dpi=200)
        #       flip_axes True,             X   Y
        sns.barplot(data=top_10, x='percent', y=column_name)
        plt.xlabel('    , %')
        plt.ylabel(xlabel)
    else:
        plt.figure(figsize=(12, 6), dpi=200)
        #    ,
        sns.barplot(data=top_10, x=column_name, y='percent')
        plt.xlabel(xlabel)
        plt.ylabel('    , %')
        plt.xticks(rotation=45)

    plt.title(title)

    #
    for index, value in enumerate(top_10['percent']):
        if flip_axes:
            plt.text(value + 0.5, index, f'{value}%', va='center', ha='left',␣
↪fontsize=10)
        else:
            plt.text(index, value + 0.5, f'{value}%', ha='center', va='bottom',␣
↪fontsize=10)

    plt.show()
```

3.2 area

3.2.1

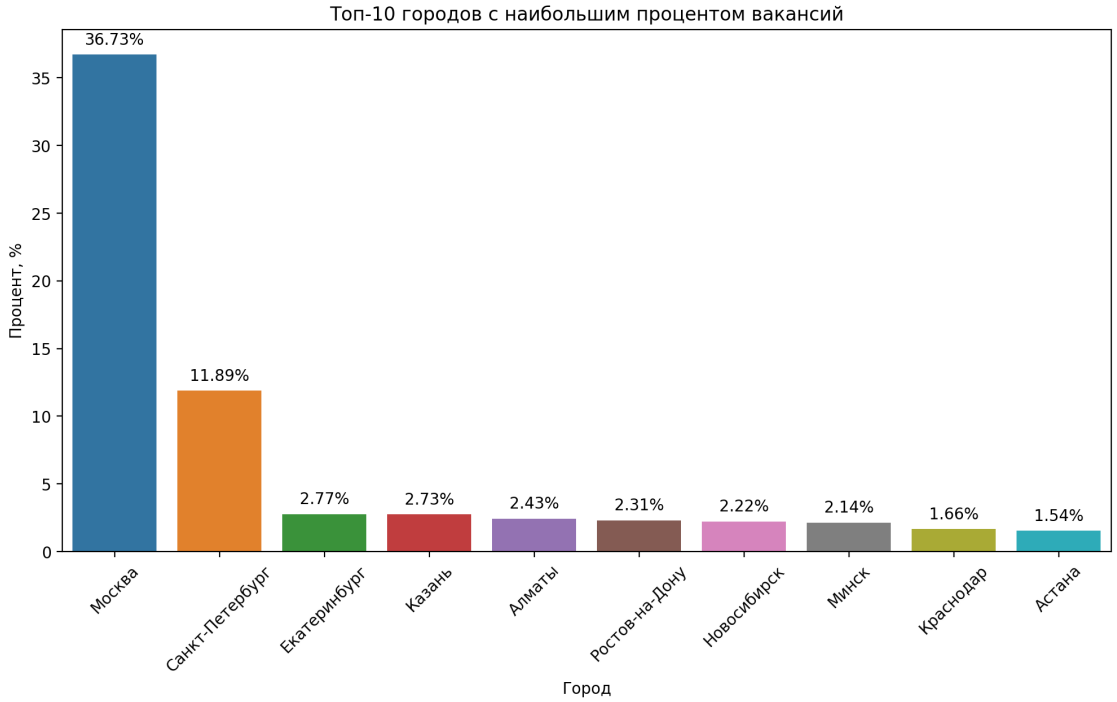
[1670]:
```
print(f'                  - {analysis_df["area"].nunique()}')
```

```
                - 251
```

3.2.2

[1671]:
```
plot_percent(analysis_df, 'area', '  -10                              ', '   ')
```

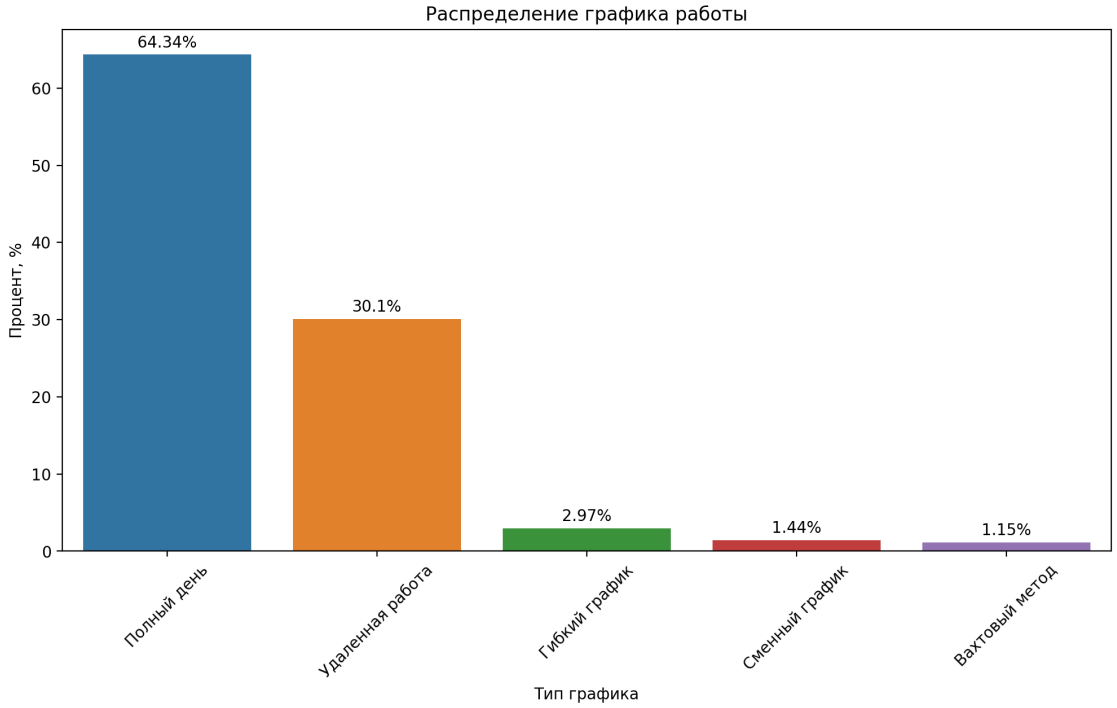
```
<Figure size 2400x1200 with 0 Axes>
```



3.3 schedule

[1672]:
```
plot_percent(analysis_df, 'schedule', '                ', xlabel='      ')
```

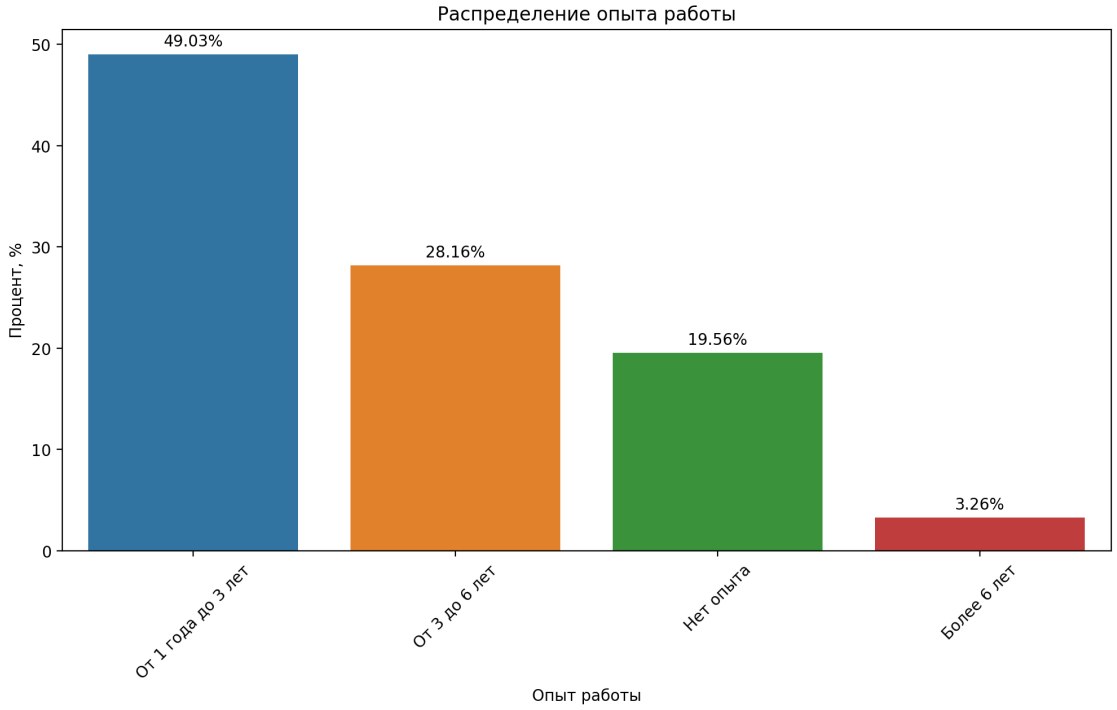
```
<Figure size 2400x1200 with 0 Axes>
```



3.4 experience

[1673]:
```
plot_percent(analysis_df, 'experience', title='                    ', xlabel='  ␣
↪    ')
```

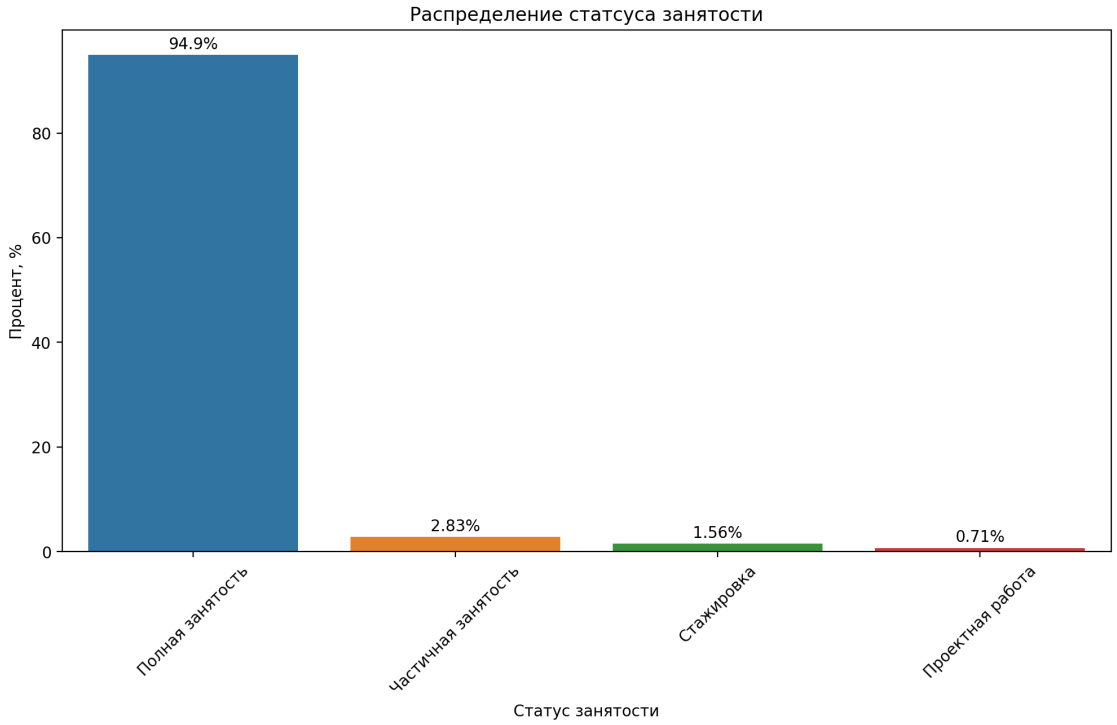
```
<Figure size 2400x1200 with 0 Axes>
```



3.5 employment

[1674]:
```
plot_percent(analysis_df, 'employment', '                    ', 'C          ')
```

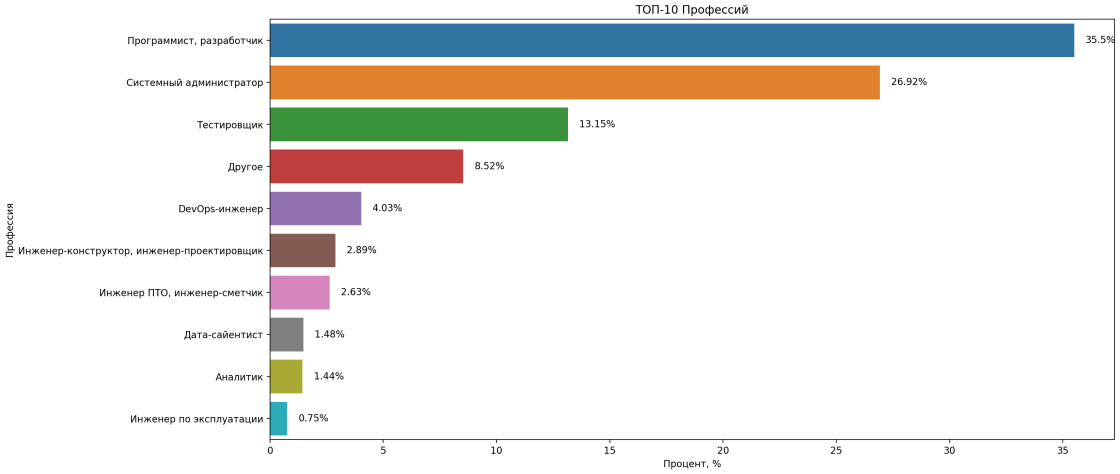
```
<Figure size 2400x1200 with 0 Axes>
```



3.6 job

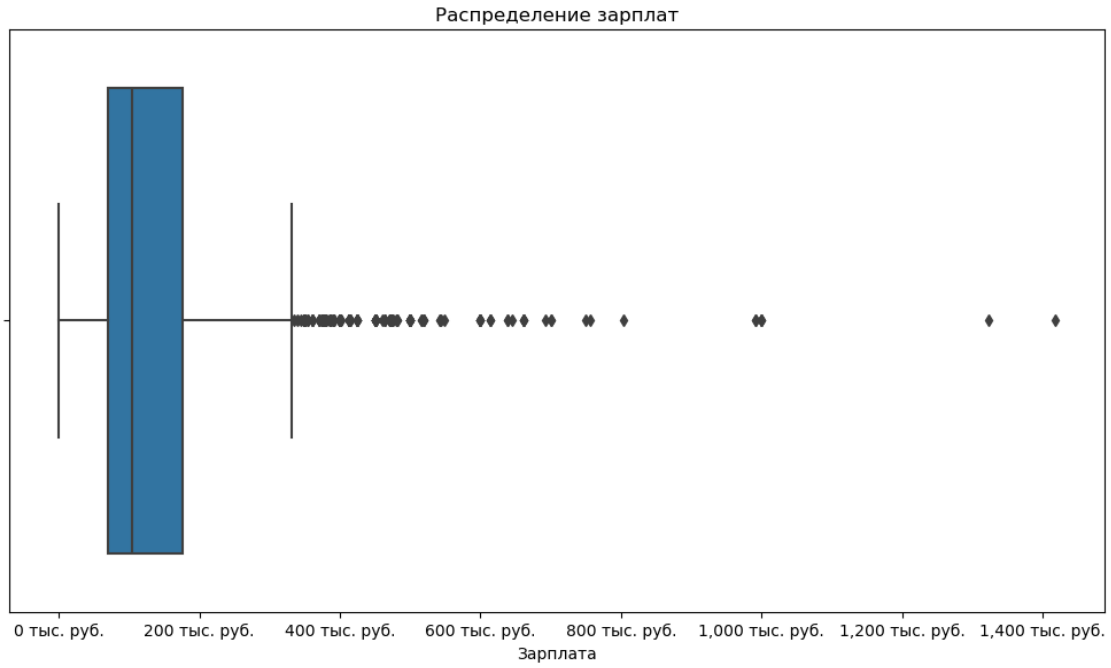
[1675]:
```
plot_percent(analysis_df, 'job', '  -10      ', '     ', True)
```

```
<Figure size 2400x1200 with 0 Axes>
```



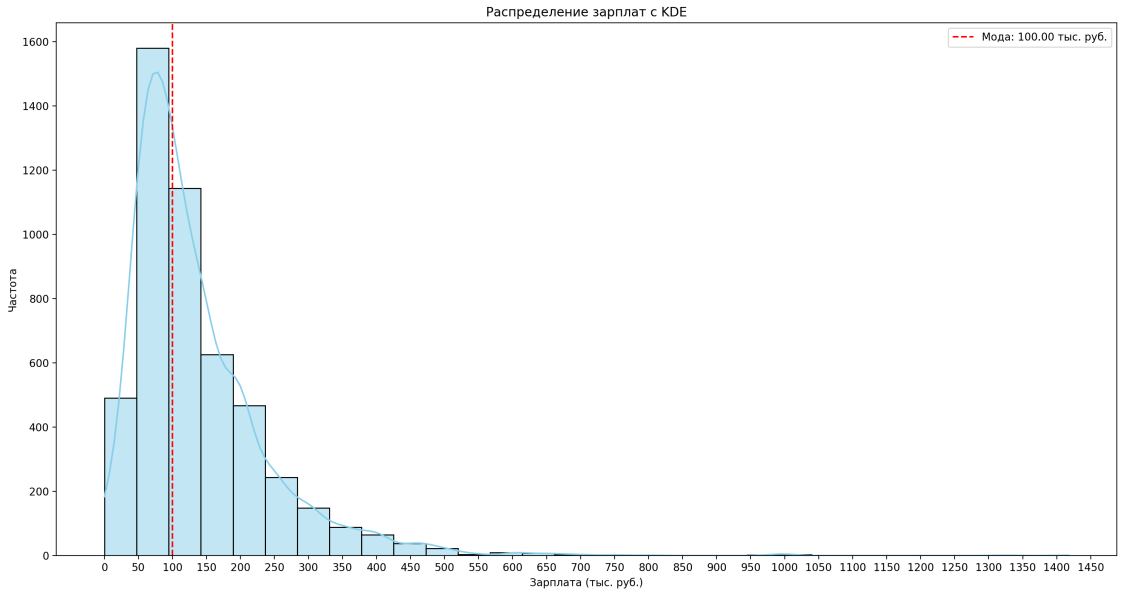
3.7 salary

[1676]:
```
from matplotlib.ticker import FuncFormatter

#
plt.figure(figsize=(10, 6))
sns.boxplot(x=analysis_df['salary_rub'])

#            X
formatter = FuncFormatter(lambda x, pos: f'{int(x / 1000):,}   .   .')
plt.gca().xaxis.set_major_formatter(formatter)

plt.xlabel('     ')
plt.title('             ')
plt.tight_layout()
plt.show()
```



[1677]:
```
plt.figure(figsize=(15,8), dpi=200)



#
mode_salary = analysis_df['salary_rub'].mode()[0]

#       histplot   KDE
```

```
sns.histplot(analysis_df['salary_rub'], kde=True, color='skyblue', bins=30)

#         X,
plt.xlabel('      (  .   .)')
plt.ylabel('    ')
plt.title('               KDE')

#
plt.axvline(mode_salary, color='red', linestyle='--', label=f'   : {mode_salary/
 ↪1000:.2f}   .   .')

#
plt.legend()

#         X,    50   .
xticks = np.arange(0, analysis_df['salary_rub'].max() + 50000, step=50000)  #␣
 ↪   50   .
plt.xticks(xticks, labels=[f'{int(x/1000)}' for x in xticks])  #    "  .   ." ␣
 ↪

plt.tight_layout()
plt.show()
```



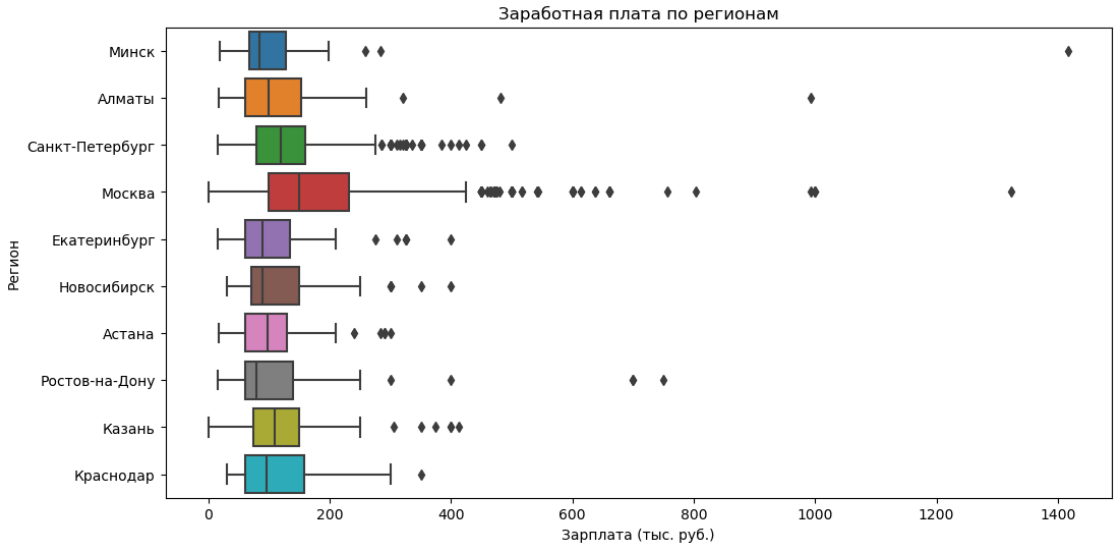
4

4.1 : .

4.1.1 -

[1678]:
```
#                  DataFrame          '   ',              1000
analysis_df.loc[(analysis_df['area'] == '   ') & (analysis_df['salary_rub'] <␣
↪1000), 'salary_rub'] *= 1000
```

[1679]:
```
top_10_area = analysis_df[analysis_df['area'].isin(['    ', '   -     ',␣
↪'       ', '    ', '    ', '   - -  ', '      ', '   ', '     ', '    '])]

#       .loc
top_10_area.loc[:, 'salary_rub'] = top_10_area['salary_rub'] / 1000  #       ␣
↪

plt.figure(figsize=(12, 6))
sns.boxplot(data=top_10_area, y='area', x='salary_rub')
plt.ylabel('    ')
plt.xlabel('     ( .   .)')
plt.title('                ')
plt.show()
```



4.2 : , .

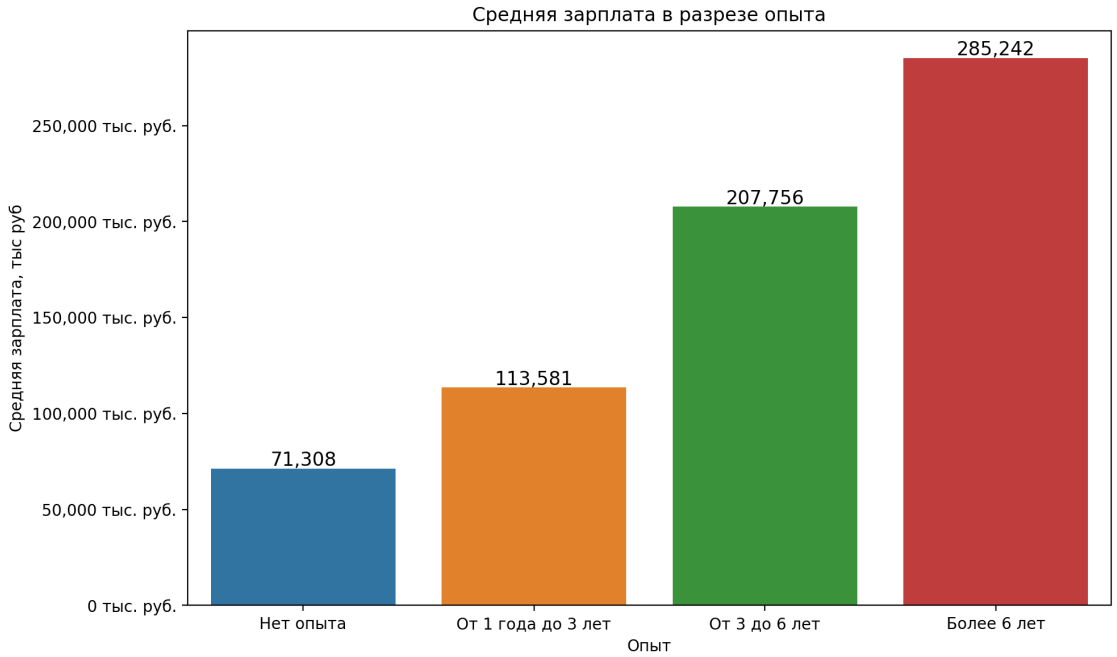
[ ]:
```

```

[1680]:
```
experience_salary = analysis_df.groupby('experience')['salary_rub'].mean().
 ↪round().reset_index(name='mean_salary').sort_values(by='mean_salary')
experience_salary
```

[1680]:

	experience	mean_salary
1		71308.0
2	1 3	113581.0
3	3 6	207756.0
0	6	285242.0

[1681]:
```
#
plt.figure(figsize=(10, 6), dpi=200)
ax = sns.barplot(data=experience_salary, x='experience', y='mean_salary')

#
for p in ax.patches:
    ax.annotate(f'{p.get_height():,.0f}',
                (p.get_x() + p.get_width() / 2., p.get_height()),
                ha='center', va='center',
                fontsize=12, color='black',
                xytext=(0, 5), textcoords='offset points')

#            Y
formatter = FuncFormatter(lambda x, pos: f'{int(x):,}   .   .')
ax.yaxis.set_major_formatter(formatter)

#
plt.xlabel('   ')
plt.ylabel('          ,      ')
plt.title('                    ')

#
plt.tight_layout()
plt.show()
```



4.3 : .

[1682]:
```
analysis_df
```

[1682]:

```
                                                  name              area
1                                      React-                        \
2                                    Frontend-
3                              Backend        (Java)
4                                /frontend
5                              Junior Frontend-           -
…                                                    …                …
7922  Engineering & Manufacturing Intern /      …
7923  Engineering & Manufacturing Intern /      …
7924  Engineering & Manufacturing Intern /      …
7926                                  Senior ML Engineer
7927  Engineering & Manufacturing Intern /      …

                schedule          experience        employment
1                    1      3                \
2                      1      3
3                      1      3
4
5
…                  …                  …                 …
7922
```

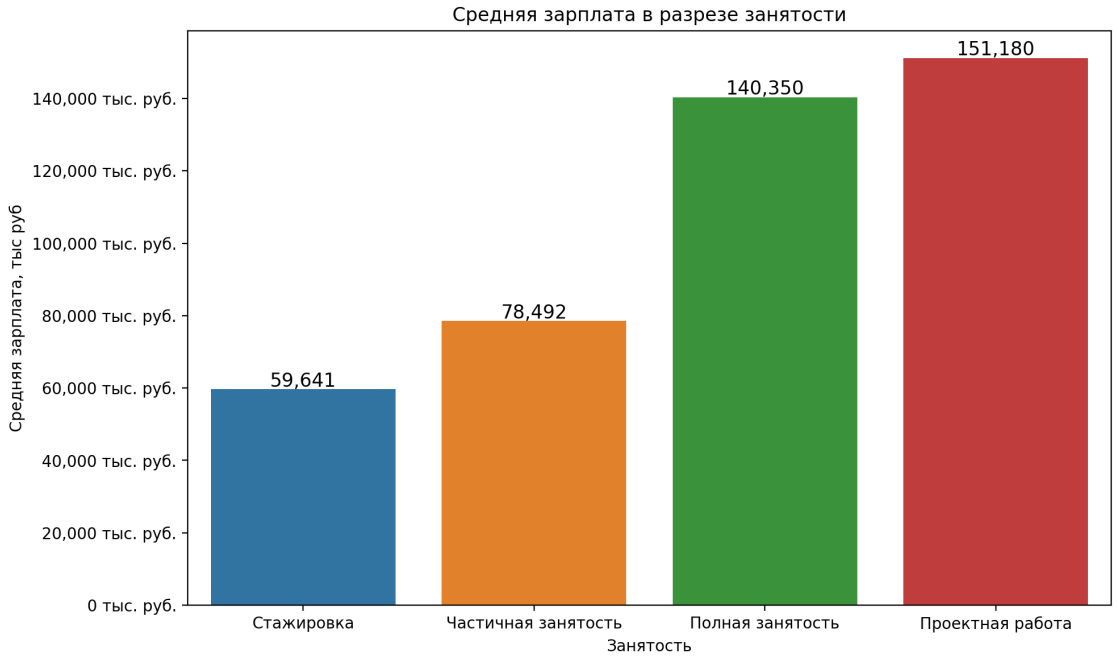
```
7923
7924
7926                    3   6
7927

                                                 key_skills published_date
1        React,React Native,CSS,HTML,HTML5,Node.js,JSON     2024-12-05  \
2     JavaScript,HTML,CSS,VueJS,TypeScript,REST API,ES6     2024-11-30
3     Java,Spring Framework,SQL,NoSQL,Git,CI/CD,Dock…     2024-12-04
4                                                        2024-12-04
5     JavaScript,REST API,Git,TypeScript,React Nativ…     2024-12-04
…                                                    …            …
7922                                                     2024-12-04
7923                                                     2024-12-03
7924                                                    2024-11-27
7926  Python,SQL,Numpy,pandas,PyTorch,PySpark,Hadoop…     2024-12-05
7927                                                     2024-12-05

                          job  salary_rub
1           ,              73237
2           ,              35000
3           ,             200000
4           ,              18900
5           ,             125000
…                         …          …
7922                             100000
7923                             100000
7924                             100000
7926              -           330000
7927                             100000

[4944 rows x 9 columns]
```

[1683]:
```
employment_salary =analysis_df.groupby('employment')['salary_rub'].mean().
 ↪round().reset_index(name='mean_salary').sort_values(by='mean_salary')
employment_salary
```

[1683]:
```
            employment  mean_salary
2                        59641.0
3                    78492.0
0                     140350.0
1                     151180.0
```

[1684]:
```
#
plt.figure(figsize=(10, 6), dpi=200)
ax = sns.barplot(data=employment_salary, x='employment', y='mean_salary')
```

```
#
for p in ax.patches:
    ax.annotate(f'{p.get_height():,.0f}',
                (p.get_x() + p.get_width() / 2., p.get_height()),
                ha='center', va='center',
                fontsize=12, color='black',
                xytext=(0, 5), textcoords='offset points')

#            Y
formatter = FuncFormatter(lambda x, pos: f'{int(x):,}   .   .')
ax.yaxis.set_major_formatter(formatter)

#
plt.xlabel('     ')
plt.ylabel('          ,      ')
plt.title('                        ')

#
plt.tight_layout()
plt.show()
```



4.4 : “ ” .

[1685]:
```
#      ,          "       "  key_skills
analysis_df['has_training'] = analysis_df['key_skills'].str.contains('       ',␣
↪case=False, na=False)

#              'has_training'
analysis_df['has_training'] = analysis_df['has_training'].apply(lambda x: '    ␣
↪       ' if x else '          ')
```

[1686]:
```
has_training_salary = analysis_df.groupby('has_training')['salary_rub'].mean()
has_training_salary
```

[1686]:
```
has_training
               132159.620213
                139918.316025
Name: salary_rub, dtype: float64
```

[1687]:
```
#                           'has_training'
group_with_training = analysis_df[analysis_df['has_training'] == '      ␣
↪     ']['salary_rub']
group_without_training = analysis_df[analysis_df['has_training'] == '    ␣
↪     ']['salary_rub']

#                                              -
shapiro_with_training = stats.shapiro(group_with_training.dropna())
shapiro_without_training = stats.shapiro(group_without_training.dropna())

#    p-value      0.05,
if shapiro_with_training.pvalue < 0.05 or shapiro_without_training.pvalue < 0.
↪05:
    print('                    ,                        -   .')
    #             -
    u_stat, p_value = stats.mannwhitneyu(group_with_training,␣
↪group_without_training, alternative='two-sided')
else:
    print('                 ,       t-   .')
    #       t-
    t_stat, p_value = stats.ttest_ind(group_with_training,␣
↪group_without_training, nan_policy='omit')

#
if p_value < 0.05:
    print(f'                          (p-value = {p_value})')
else:
    #       p-value   2
    print(f'                            (p-value = {p_value})')
```

```
analysis_df = analysis_df.drop(['has_training'], axis=1)
```

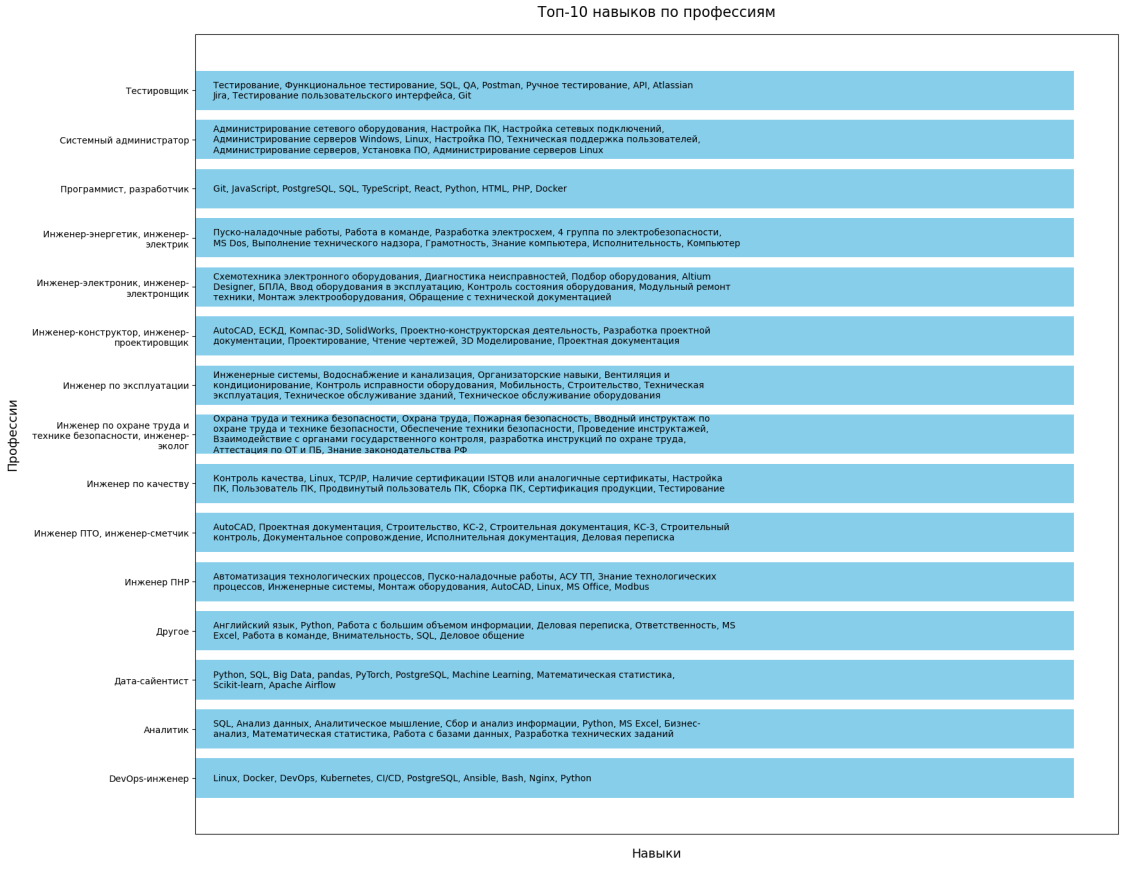
, - .
(p-value = 0.04068661721120872)

4.5 -10 IT

[1688]:
```
#       "       "
skills_by_job = (
    analysis_df
    .assign(key_skills=analysis_df['key_skills'].str.split(','))  #
    .explode('key_skills')  #
    .query("key_skills != '       '")  #                  "       "
    .groupby(['job', 'key_skills'])  #
    .size()  #
    .reset_index(name='count')  #          DataFrame
)

#       -10
top_skills_by_job = (
    skills_by_job
    .sort_values(['job', 'count'], ascending=[True, False])  #
    .groupby('job')  #
    .head(10)  #       -10
    .groupby('job')['key_skills']  #
    .apply(lambda x: ', '.join(x))  #
    .reset_index(name='top_skills')  #          DataFrame
)
```

[1689]:
```
#
top_skills_by_job['job'] = top_skills_by_job['job'].str.wrap(30)  #
top_skills_by_job['top_skills'] = top_skills_by_job['top_skills'].str.wrap(100)
#
top_skills_by_job = top_skills_by_job.sort_values('job', ascending=True)  #

#
plt.figure(figsize=(18, 14))  #

#
bars = plt.barh(top_skills_by_job['job'], [1] * len(top_skills_by_job),
color='skyblue', height=0.8)  #

#             (    )
```

```
for bar, skills in zip(bars, top_skills_by_job['top_skills']):
    plt.text(
        0.02,  #
        bar.get_y() + bar.get_height() / 2,
        skills,
        ha='left',
        va='center',
        fontsize=10,
        color='black',
    )

#
plt.xlabel('    ', fontsize=14, labelpad=15)  #              X
plt.ylabel('     ', fontsize=14, labelpad=15)  #               Y
plt.title('  -10              ', fontsize=16, pad=20)  #
plt.xticks([])  #         X
plt.tight_layout(pad=2.5)  #

#
plt.show()
```



[1690]:
```
analysis_df
```

[1690]:
```
                                                  name             area
1                                      React-                       \
2                                    Frontend-
3                               Backend        (Java)
4                                 /frontend
5                               Junior Frontend-           -
…                                                    …               …
7922  Engineering & Manufacturing Intern /      …
7923  Engineering & Manufacturing Intern /      …
7924  Engineering & Manufacturing Intern /      …
7926                                  Senior ML Engineer
7927  Engineering & Manufacturing Intern /      …

              schedule          experience        employment
1                  1      3                \
2                    1      3
3                    1      3
4
5
…                 …                 …               …
7922
7923
7924
7926                    3   6
7927

                                          key_skills published_date
1        React,React Native,CSS,HTML,HTML5,Node.js,JSON     2024-12-05  \
2     JavaScript,HTML,CSS,VueJS,TypeScript,REST API,ES6     2024-11-30
3     Java,Spring Framework,SQL,NoSQL,Git,CI/CD,Dock…     2024-12-04
4                                                        2024-12-04
5     JavaScript,REST API,Git,TypeScript,React Nativ…     2024-12-04
…                                                    …            …
7922                                                     2024-12-04
7923                                                     2024-12-03
7924                                                    2024-11-27
7926  Python,SQL,Numpy,pandas,PyTorch,PySpark,Hadoop…     2024-12-05
7927                                                     2024-12-05

                          job  salary_rub
1           ,              73237
2           ,              35000
3           ,             200000
4           ,              18900
5           ,             125000
```

```
…                          …          …
7922                                100000
7923                                100000
7924                                100000
7926                -           330000
7927                                100000

[4944 rows x 9 columns]
```

[ ]:

[1693]:
```
#           ,        6      2024
start_date = pd.to_datetime("2024-11-06")
df_filtered = df[df['published_date'] >= start_date]

#
df_grouped = df_filtered.groupby([df_filtered['published_date'].dt.date,␣
 ↪'job']).size().reset_index(name='count')

#
fig = px.line(df_grouped, x='published_date', y='count', color='job',
              title='                ',
              labels={'published_date': '         ', 'count': '           '})
fig.show()
```

4.6 : , (10 17 , 17 24)

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