

## Data Collection and Preprocessing Phase

| Section             | Description   |              |              |               |              |               |               |                |                 |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
|---------------------|---|--------------|--------------|---------------|--------------|---------------|---------------|----------------|-----------------|-----------------|-----------|-------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------|------------|-----------|----------|--------------|----------|---------|----------|---------------|----------|-----|-----------|-----------|----------|--------------|----------|---------|----------|--------------|----------|-----|------------|-----------|----------|----------|----------|----------|----------|-----------|----------|-----|------------|-----------|----------|----------|----------|----------|----------|--------------|----------|-----|------------|-----------|----------|--------------|----------|----------|----------|---------------|----------|-----|------------|-----------|----------|---------------|----------|----------|----------|---------------|----------|-----|------------|-----------|-----------|---------------|----------|----------|----------|---------------|----------|--|-------------|-----------|--------|-----|--------|---------|---------------|-----------|----------------|-----------------|--------|-------------|----------|----------|-----------|-----------|----------|----------|----------|-----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------|----------|--------|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|-----------|-----|-----------|----------|-----------|----------|-----------|----------|-----------|-----------|----------|-----------|----------|--------|----------|----------|----------|-----------|----------|-----------|----------|----------|-----------|----------|-----------|---------|----------|----------|----------|----------|-----------|----------|-----------|-----------|-----------|----------|----------|---------------|----------|----------|-----------|-----------|----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|-----------|----------|-----------|----------|----------|-----------|-----------|-----------|----------------|----------|----------|----------|----------|-----------|-----------|----------|-----------|----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------|----------|----------|----------|-----------|-----------|----------|----------|--------|-----------|----------|-----------|----------|-----------|----------|-----------|-----------|-----------|----------|----------|
| Data Overview       | <div>Basic statistics, dimensions, and structure of the data.</div> <div><pre>[22]: data.describe()</pre><table><thead><tr><th></th><th>CreditScore</th><th>Age</th><th>Tenure</th><th>Balance</th><th>NumOfProducts</th><th>HasCrCard</th><th>IsActiveMember</th><th>EstimatedSalary</th><th>Exited</th></tr></thead><tbody><tr><td>count</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td><td>10000.000000</td></tr><tr><td>mean</td><td>650.528800</td><td>38.921800</td><td>5.012800</td><td>76485.889288</td><td>1.530200</td><td>0.70550</td><td>0.515100</td><td>100090.239881</td><td>0.203700</td></tr><tr><td>std</td><td>96.653299</td><td>10.487806</td><td>2.892174</td><td>62397.405202</td><td>0.581654</td><td>0.45584</td><td>0.499797</td><td>57510.492818</td><td>0.402769</td></tr><tr><td>min</td><td>350.000000</td><td>18.000000</td><td>0.000000</td><td>0.000000</td><td>1.000000</td><td>0.000000</td><td>0.000000</td><td>11.580000</td><td>0.000000</td></tr><tr><td>25%</td><td>584.000000</td><td>32.000000</td><td>3.000000</td><td>0.000000</td><td>1.000000</td><td>0.000000</td><td>0.000000</td><td>51002.110000</td><td>0.000000</td></tr><tr><td>50%</td><td>652.000000</td><td>37.000000</td><td>5.000000</td><td>97198.540000</td><td>1.000000</td><td>1.000000</td><td>1.000000</td><td>100193.915000</td><td>0.000000</td></tr><tr><td>75%</td><td>718.000000</td><td>44.000000</td><td>7.000000</td><td>127644.240000</td><td>2.000000</td><td>1.000000</td><td>1.000000</td><td>149388.247500</td><td>0.000000</td></tr><tr><td>max</td><td>850.000000</td><td>92.000000</td><td>10.000000</td><td>250898.090000</td><td>4.000000</td><td>1.000000</td><td>1.000000</td><td>199992.480000</td><td>1.000000</td></tr></tbody></table></div> <div><pre>[30]: data.corr()</pre><table><thead><tr><th></th><th>CreditScore</th><th>Geography</th><th>Gender</th><th>Age</th><th>Tenure</th><th>Balance</th><th>NumOfProducts</th><th>HasCrCard</th><th>IsActiveMember</th><th>EstimatedSalary</th><th>Exited</th></tr></thead><tbody><tr><td>CreditScore</td><td>1.000000</td><td>0.007888</td><td>-0.002857</td><td>-0.003965</td><td>0.000842</td><td>0.006268</td><td>0.012238</td><td>-0.005458</td><td>0.025651</td><td>-0.001384</td><td>-0.027094</td></tr><tr><td>Geography</td><td>0.007888</td><td>1.000000</td><td>0.004719</td><td>0.022812</td><td>0.003739</td><td>0.069408</td><td>0.003972</td><td>-0.008523</td><td>0.006724</td><td>-0.001369</td><td>0.035943</td></tr><tr><td>Gender</td><td>-0.002857</td><td>0.004719</td><td>1.000000</td><td>-0.027544</td><td>0.014733</td><td>0.012087</td><td>-0.021859</td><td>0.005766</td><td>0.022544</td><td>-0.008112</td><td>-0.106512</td></tr><tr><td>Age</td><td>-0.003965</td><td>0.022812</td><td>-0.027544</td><td>1.000000</td><td>-0.009997</td><td>0.028308</td><td>-0.030680</td><td>-0.011721</td><td>0.085472</td><td>-0.007201</td><td>0.285323</td></tr><tr><td>Tenure</td><td>0.000842</td><td>0.003739</td><td>0.014733</td><td>-0.009997</td><td>1.000000</td><td>-0.012254</td><td>0.013444</td><td>0.022583</td><td>-0.028362</td><td>0.007784</td><td>-0.014001</td></tr><tr><td>Balance</td><td>0.006268</td><td>0.069408</td><td>0.012087</td><td>0.028308</td><td>-0.012254</td><td>1.000000</td><td>-0.304180</td><td>-0.014858</td><td>-0.010084</td><td>0.012797</td><td>0.118533</td></tr><tr><td>NumOfProducts</td><td>0.012238</td><td>0.003972</td><td>-0.021859</td><td>-0.030680</td><td>0.013444</td><td>-0.304180</td><td>1.000000</td><td>0.003183</td><td>0.009612</td><td>0.014204</td><td>-0.047820</td></tr><tr><td>HasCrCard</td><td>-0.005458</td><td>-0.008523</td><td>0.005766</td><td>-0.011721</td><td>0.022583</td><td>-0.014858</td><td>0.003183</td><td>1.000000</td><td>-0.011866</td><td>-0.009933</td><td>-0.007138</td></tr><tr><td>IsActiveMember</td><td>0.025651</td><td>0.006724</td><td>0.022544</td><td>0.085472</td><td>-0.028362</td><td>-0.010084</td><td>0.009612</td><td>-0.011866</td><td>1.000000</td><td>-0.011421</td><td>-0.156128</td></tr><tr><td>EstimatedSalary</td><td>-0.001384</td><td>-0.001369</td><td>-0.008112</td><td>-0.007201</td><td>0.007784</td><td>0.012797</td><td>0.014204</td><td>-0.009933</td><td>-0.011421</td><td>1.000000</td><td>0.012097</td></tr><tr><td>Exited</td><td>-0.027094</td><td>0.035943</td><td>-0.106512</td><td>0.285323</td><td>-0.014001</td><td>0.118533</td><td>-0.047820</td><td>-0.007138</td><td>-0.156128</td><td>0.012097</td><td>1.000000</td></tr></tbody></table></div> |              | CreditScore  | Age           | Tenure       | Balance       | NumOfProducts | HasCrCard      | IsActiveMember  | EstimatedSalary | Exited    | count | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | 10000.000000 | mean | 650.528800 | 38.921800 | 5.012800 | 76485.889288 | 1.530200 | 0.70550 | 0.515100 | 100090.239881 | 0.203700 | std | 96.653299 | 10.487806 | 2.892174 | 62397.405202 | 0.581654 | 0.45584 | 0.499797 | 57510.492818 | 0.402769 | min | 350.000000 | 18.000000 | 0.000000 | 0.000000 | 1.000000 | 0.000000 | 0.000000 | 11.580000 | 0.000000 | 25% | 584.000000 | 32.000000 | 3.000000 | 0.000000 | 1.000000 | 0.000000 | 0.000000 | 51002.110000 | 0.000000 | 50% | 652.000000 | 37.000000 | 5.000000 | 97198.540000 | 1.000000 | 1.000000 | 1.000000 | 100193.915000 | 0.000000 | 75% | 718.000000 | 44.000000 | 7.000000 | 127644.240000 | 2.000000 | 1.000000 | 1.000000 | 149388.247500 | 0.000000 | max | 850.000000 | 92.000000 | 10.000000 | 250898.090000 | 4.000000 | 1.000000 | 1.000000 | 199992.480000 | 1.000000 |  | CreditScore | Geography | Gender | Age | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited | CreditScore | 1.000000 | 0.007888 | -0.002857 | -0.003965 | 0.000842 | 0.006268 | 0.012238 | -0.005458 | 0.025651 | -0.001384 | -0.027094 | Geography | 0.007888 | 1.000000 | 0.004719 | 0.022812 | 0.003739 | 0.069408 | 0.003972 | -0.008523 | 0.006724 | -0.001369 | 0.035943 | Gender | -0.002857 | 0.004719 | 1.000000 | -0.027544 | 0.014733 | 0.012087 | -0.021859 | 0.005766 | 0.022544 | -0.008112 | -0.106512 | Age | -0.003965 | 0.022812 | -0.027544 | 1.000000 | -0.009997 | 0.028308 | -0.030680 | -0.011721 | 0.085472 | -0.007201 | 0.285323 | Tenure | 0.000842 | 0.003739 | 0.014733 | -0.009997 | 1.000000 | -0.012254 | 0.013444 | 0.022583 | -0.028362 | 0.007784 | -0.014001 | Balance | 0.006268 | 0.069408 | 0.012087 | 0.028308 | -0.012254 | 1.000000 | -0.304180 | -0.014858 | -0.010084 | 0.012797 | 0.118533 | NumOfProducts | 0.012238 | 0.003972 | -0.021859 | -0.030680 | 0.013444 | -0.304180 | 1.000000 | 0.003183 | 0.009612 | 0.014204 | -0.047820 | HasCrCard | -0.005458 | -0.008523 | 0.005766 | -0.011721 | 0.022583 | -0.014858 | 0.003183 | 1.000000 | -0.011866 | -0.009933 | -0.007138 | IsActiveMember | 0.025651 | 0.006724 | 0.022544 | 0.085472 | -0.028362 | -0.010084 | 0.009612 | -0.011866 | 1.000000 | -0.011421 | -0.156128 | EstimatedSalary | -0.001384 | -0.001369 | -0.008112 | -0.007201 | 0.007784 | 0.012797 | 0.014204 | -0.009933 | -0.011421 | 1.000000 | 0.012097 | Exited | -0.027094 | 0.035943 | -0.106512 | 0.285323 | -0.014001 | 0.118533 | -0.047820 | -0.007138 | -0.156128 | 0.012097 | 1.000000 |
|                     |   | CreditScore  | Age          | Tenure        | Balance      | NumOfProducts | HasCrCard     | IsActiveMember | EstimatedSalary | Exited          |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| count               | 10000.000000  | 10000.000000 | 10000.000000 | 10000.000000  | 10000.000000 | 10000.000000  | 10000.000000  | 10000.000000   | 10000.000000    |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| mean                | 650.528800  | 38.921800    | 5.012800     | 76485.889288  | 1.530200     | 0.70550       | 0.515100      | 100090.239881  | 0.203700        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| std                 | 96.653299   | 10.487806    | 2.892174     | 62397.405202  | 0.581654     | 0.45584       | 0.499797      | 57510.492818   | 0.402769        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| min                 | 350.000000  | 18.000000    | 0.000000     | 0.000000      | 1.000000     | 0.000000      | 0.000000      | 11.580000      | 0.000000        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| 25%                 | 584.000000  | 32.000000    | 3.000000     | 0.000000      | 1.000000     | 0.000000      | 0.000000      | 51002.110000   | 0.000000        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| 50%                 | 652.000000  | 37.000000    | 5.000000     | 97198.540000  | 1.000000     | 1.000000      | 1.000000      | 100193.915000  | 0.000000        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| 75%                 | 718.000000  | 44.000000    | 7.000000     | 127644.240000 | 2.000000     | 1.000000      | 1.000000      | 149388.247500  | 0.000000        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| max                 | 850.000000  | 92.000000    | 10.000000    | 250898.090000 | 4.000000     | 1.000000      | 1.000000      | 199992.480000  | 1.000000        |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
|                     | CreditScore   | Geography    | Gender       | Age           | Tenure       | Balance       | NumOfProducts | HasCrCard      | IsActiveMember  | EstimatedSalary | Exited    |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| CreditScore         | 1.000000  | 0.007888     | -0.002857    | -0.003965     | 0.000842     | 0.006268      | 0.012238      | -0.005458      | 0.025651        | -0.001384       | -0.027094 |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Geography           | 0.007888  | 1.000000     | 0.004719     | 0.022812      | 0.003739     | 0.069408      | 0.003972      | -0.008523      | 0.006724        | -0.001369       | 0.035943  |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Gender              | -0.002857   | 0.004719     | 1.000000     | -0.027544     | 0.014733     | 0.012087      | -0.021859     | 0.005766       | 0.022544        | -0.008112       | -0.106512 |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Age                 | -0.003965   | 0.022812     | -0.027544    | 1.000000      | -0.009997    | 0.028308      | -0.030680     | -0.011721      | 0.085472        | -0.007201       | 0.285323  |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Tenure              | 0.000842  | 0.003739     | 0.014733     | -0.009997     | 1.000000     | -0.012254     | 0.013444      | 0.022583       | -0.028362       | 0.007784        | -0.014001 |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Balance             | 0.006268  | 0.069408     | 0.012087     | 0.028308      | -0.012254    | 1.000000      | -0.304180     | -0.014858      | -0.010084       | 0.012797        | 0.118533  |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| NumOfProducts       | 0.012238  | 0.003972     | -0.021859    | -0.030680     | 0.013444     | -0.304180     | 1.000000      | 0.003183       | 0.009612        | 0.014204        | -0.047820 |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| HasCrCard           | -0.005458   | -0.008523    | 0.005766     | -0.011721     | 0.022583     | -0.014858     | 0.003183      | 1.000000       | -0.011866       | -0.009933       | -0.007138 |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| IsActiveMember      | 0.025651  | 0.006724     | 0.022544     | 0.085472      | -0.028362    | -0.010084     | 0.009612      | -0.011866      | 1.000000        | -0.011421       | -0.156128 |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| EstimatedSalary     | -0.001384   | -0.001369    | -0.008112    | -0.007201     | 0.007784     | 0.012797      | 0.014204      | -0.009933      | -0.011421       | 1.000000        | 0.012097  |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Exited              | -0.027094   | 0.035943     | -0.106512    | 0.285323      | -0.014001    | 0.118533      | -0.047820     | -0.007138      | -0.156128       | 0.012097        | 1.000000  |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |
| Univariate Analysis | Exploration of individual variables (mean, median, mode, etc.. )  |              |              |               |              |               |               |                |                 |                 |           |       |              |              |              |              |              |              |              |              |              |      |            |           |          |              |          |         |          |               |          |     |           |           |          |              |          |         |          |              |          |     |            |           |          |          |          |          |          |           |          |     |            |           |          |          |          |          |          |              |          |     |            |           |          |              |          |          |          |               |          |     |            |           |          |               |          |          |          |               |          |     |            |           |           |               |          |          |          |               |          |  |             |           |        |     |        |         |               |           |                |                 |        |             |          |          |           |           |          |          |          |           |          |           |           |           |          |          |          |          |          |          |          |           |          |           |          |        |           |          |          |           |          |          |           |          |          |           |           |     |           |          |           |          |           |          |           |           |          |           |          |        |          |          |          |           |          |           |          |          |           |          |           |         |          |          |          |          |           |          |           |           |           |          |          |               |          |          |           |           |          |           |          |          |          |          |           |           |           |           |          |           |          |           |          |          |           |           |           |                |          |          |          |          |           |           |          |           |          |           |           |                 |           |           |           |           |          |          |          |           |           |          |          |        |           |          |           |          |           |          |           |           |           |          |          |

|                    |   |
|--------------------|---|
| Bivariate Analysis | Relationships between two variables (correlation, scatter plots). |
|--------------------|---|

|               |                                   |
|---------------|-----------------------------------|
| Date          | 15 July 2024                      |
| Team ID       | 739886                            |
| Project Title | Telecom Customer Churn Prediction |
| Maximum Marks | 6 Marks                           |

### Data Exploration and Preprocessing Template

Identifies data sources, assesses quality issues like missing values and duplicates, and implements resolution plans to ensure accurate and reliable analysis.

|  |   |
|--|---|
|  | <pre>1]: sns.heatmap(data.corr(),annot=False)</pre> <pre>1]: &lt;Axes: &gt;</pre>   |
| Multivariate Analysis                      | -   |
| Outliers and Anomalies                     | -   |
| <b>Data Preprocessing Code Screenshots</b> |   |
| Loading Data                               | <p>Code to load the dataset into the preferred environment (e.g., Python, R).</p> <pre>[2]: #Reading the dataset       dt=pd.read_csv(r"Churn_Modelling.csv")</pre> |
| Handling Missing Data                      | <pre>[5]: dt.isnull().any()</pre> <p>Code for identifying and handling missing values.</p>  |

|                     |  |
|---------------------|--|
| Data Transformation | <pre>[42]: #training and testing the data from sklearn.model_selection import train_test_split x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)  [43]: #Feature Scaling from sklearn.preprocessing import StandardScaler sc=StandardScaler() x_train=sc.fit_transform(x_train) x_test = sc.transform(x_test)</pre> <p>Code for transforming variables (scaling, normalization).</p>  |
| Feature Engineering | <pre>7]: #Removing columns data=dt.drop(['RowNumber', 'CustomerId', 'Surname'],axis=True)</pre> <p>Code for creating new features or modifying existing ones.</p>  |
| Save Processed Data | <p>Code to save the cleaned and processed data for future use.</p> <pre>[23]: #LabelEncoding  [24]: from sklearn.preprocessing import LabelEncoder le=LabelEncoder()  [25]: #data["CreditScore"]=le.fit_transform(data["CreditScore"]) data["Geography"]=le.fit_transform(data["Geography"]) data["Gender"]=le.fit_transform(data["Gender"]) #data["Age"]=le.fit_transform(data["Age"]) #data["Tenure"]=le.fit_transform(data["Tenure"]) #data["Balance"]=le.fit_transform(data["Balance"]) #data["NumOfProducts"]=le.fit_transform(data["NumOfProducts"]) #data["HasCrCard"]=le.fit_transform(data["HasCrCard"]) #data["IsActiveMember"]=le.fit_transform(data["IsActiveMember"]) #data["EstimatedSalary"]=le.fit_transform(data["EstimatedSalary"]) #data["Exited"]=le.fit_transform(data["Exited"])</pre> |