Statistical analysis

1. Task Description

Calculate the eigenvalues and eigenvectors of a large sparse matrix using numpy's sparse matrix handling.

To compute the eigenvalues and eigenvectors of a large sparse matrix, you can use libraries like `scipy.sparse` and its associated methods, which are optimized for sparse matrix operations. Here's a step-by-step description of how to perform this task using Python:

Steps to Compute Eigenvalues and Eigenvectors of a Sparse Matrix

1. **Create or Load a Sparse Matrix**:
   Use `scipy.sparse` to either create a sparse matrix or load it if it exists in a file.
2. **Use an Efficient Eigenvalue Solver**:
   For sparse matrices, `scipy.sparse.linalg` provides efficient solvers like `eigsh` (for symmetric matrices) and `eigs` (for non-symmetric matrices). These methods are designed for sparse matrix eigenvalue computation and allow you to calculate a subset of eigenvalues/eigenvectors.
3. **Choose the Number of Eigenvalues**:
   Since computing all eigenvalues for large matrices is computationally expensive, you can specify the number of eigenvalues and whether to compute the largest or smallest.
4. **Interpret the Results**:
   The solver returns the eigenvalues and their corresponding eigenvectors.

2.Task Output

```
import numpy as np
from scipy.sparse import random
from scipy.sparse.linalg import eigs, eigsh


n = 1000
density = 0.01
sparse_matrix = random(n, n, density=density, format='csr', dtype=np.float64)


sparse_matrix = (sparse_matrix + sparse_matrix.T) / 2


k = 7


eigenvalues, eigenvectors = eigsh(sparse_matrix, k=k)



print("Eigenvalues:", eigenvalues)
```

```
Eigenvalues: [-2.61071746 -2.58453914 -2.55490583  2.5642907   2.60966519  2.61459032
  5.29550696]
```

- **CODE:**

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