Main job：

1. Reproduce the results of the stochastic collocation method
2. Investigating sparse grid methods

Conclusion：

1. After research, there are two main types of stochastic collocation methods. The first one is to construct an orthogonal polynomial, for which the solution of a certain equation with random coefficients is approximated by a polynomial. According to the orthogonality of the polynomial, the statistical properties of the solution can be obtained simply by calculating the coefficients of the polynomial expansion.The second one is to select the basis function (such as Lagrangian basis function) to construct the interpolation function for the solution of the equation, and the statistical properties of the solution can be found according to the relevant formula.

According to the comparison of the numerical results, the first type cannot express the polynomial for reaction surfaces with large slopes or discontinuities because the polynomial is relatively smooth. Therefore, the statistical properties of the reaction surface are calculated with slow or no convergence to the exact value. The second one has a lower convergence speed when calculating larger slopes or discontinuous reaction surfaces, but its accuracy will be better than the first one.

1. For reaction surfaces with large slopes or discontinuities, the adaptive stochastic collocation method can be used to handle this function. The adaptive approach is to rewrite the interpolation formula in a hierarchical form, adopt a nested sparse grid approach, specify an error limit before the calculation, and encrypt the grid where the error limit is not reached according to the adaptive algorithm associated with the hierarchical surplus. This method effectively improves the convergence speed compared to the traditional stochastic collocation method.

1. The sparse grid method is a method used for interpolation or integration. It selects a subset of the full tensor product collocation points to construct the interpolation. It is an approximation of the full tensor product method, which is a linear combination of tensor product formulas. It sacrifices the accuracy of logarithmic loss and obtains a large computational reduction, which effectively alleviates the curse of dimensionality in the case of high dimensions.