## Polynomial Regression Coefficients

In polynomial regression with a specified degree, the number of coefficients (including the intercept) is determined by the number of polynomial terms generated from the input features.

### Single Feature Polynomial Terms

For a single feature x and polynomial degree d = 3, the polynomial terms will be:

- x^0 (intercept)
- x^1
- x^2
- x^3

This results in 4 terms, and thus 4 coefficients (including the intercept).

### Multiple Features Polynomial Terms

For multiple features, the number of terms increases due to interaction terms up to the specified polynomial degree.

#### Example: Two Features and Degree 3

For two original features x1 and x2, and polynomial degree d = 3, the polynomial terms include all combinations of these features up to the cubic term:

- x1^0 x2^0 (the intercept)
- x1^1 x2^0, x1^0 x2^1
- x1^2 x2^0, x1^1 x2^1, x1^0 x2^2
- x1^3 x2^0, x1^2 x2^1, x1^1 x2^2, x1^0 x2^3

To count these terms, use the combinatorial formula for the number of polynomial terms generated from n features and degree d:

Number of terms = (n + d)! / (d! * (n + d - d)!)

For n = 2 and d = 3:

Number of terms = (2 + 3)! / (3! * (2 + 3 - 3)!) = 5! / (3! * 2!) = (5 * 4) / (2 * 1) = 10

Thus, with two features and a polynomial degree of 3, there will be 10 terms, resulting in 10 coefficients in the regression model, including the intercept term.