Regression Comparison Table

Feature	Simple Linear Regression	Simple Non-linear Regression	Polynomial Regression	Multiple Non-linear Regression	Multiple Linear Regression
Definition	Models the relationship between a dependent variable and a single predictor using a linear equation.	Models the relationship between a dependent variable and a single predictor using a non-linear function.	Models the relationship between a dependent variable and one or more predictors using polynomial terms (e.g., X^2, X^3, etc.).	Models the relationship between a dependent variable and multiple predictors with non-linear relationships.	Models the relationship between a dependent variable and multiple predictors using a linear equation.
Predictors	Single predictor variable X.	Single predictor variable X with a non-linear transformation.	Predictors are polynomial terms of the original variables (e.g., X, X^2, X^3).	Predictors can be any non-linear functions of the original variables (e.g., sin(X), e^X, log(X)).	Multiple predictor variables X1, X2, ..., Xn.
Equation Example	$y = \beta0 + \beta1 X + \varepsilon$	$y = \beta0 + \beta1 e^X + \varepsilon$	$y = \beta0 + \beta1 X + \beta2 X^2 + \beta3 X^3 + \varepsilon$	$y = \beta0 + \beta1 \sin(X1) + \beta2 e^{X2} + \varepsilon$	$y = \beta0 + \beta1 X1 + \beta2 X2 + ... + \beta n Xn + \varepsilon$
Nature of Relationship	Linear relationship with the predictor.	Non-linear relationship with the predictor.	Polynomial relationship with the predictors.	General non-linear relationship with the predictors.	Linear relationship with the predictors.
Linear with Respect to	Linear with respect to the coefficients (parameters).	Non-linear with respect to the predictor but can be linear with respect to coefficients.	Linear with respect to the coefficients (parameters).	Non-linear with respect to both the predictors and the coefficients.	Linear with respect to the coefficients (parameters).
Complexity	Simplest form of regression, easy to implement and solve.	More complex than simple linear regression, often requiring transformation.	Simpler to implement and solve as it reduces to a linear problem.	More complex, often requiring iterative optimization techniques.	More complex than simple linear regression due to multiple predictors, but still linear in nature.

https://github.com/MaryVII/

Estimation Method	Uses ordinary least squares (OLS) for estimation.	Can use non-linear least squares or other non-linear optimization techniques.	Can use ordinary least squares (OLS) for estimation.	Often requires non-linear optimization methods for estimation.	Uses ordinary least squares (OLS) for estimation.
Common Uses	Useful for modeling linear relationships in data.	Useful for modeling specific non-linear relationships in data.	Useful for modeling curved relationships in data.	Useful for modeling complex relationships where polynomial terms may not suffice.	Useful for modeling linear relationships involving multiple predictors.
Interpretability	Easiest to interpret with clear linear relationships.	Interpretation depends on the specific non-linear function used.	Easier to interpret as extensions of linear regression.	Can be more difficult to interpret due to complex functional forms.	Interpretable with clear linear relationships among multiple predictors.
Example Models	Simple linear regression with one predictor.	Exponential growth/decay, logarithmic models.	Quadratic, cubic, quartic polynomial regression.	Exponential, logarithmic, trigonometric regression.	Multiple linear regression models in various fields.
Flexibility	Least flexible, limited to linear relationships.	Flexible within the specific non-linear function used.	Less flexible, limited to polynomial terms.	More flexible, allowing various types of non-linear functions.	More flexible than simple linear regression due to multiple predictors, but limited to linear relationships.