

**Admin Notes / Agenda**

- Lesson Review - CDT Stokes
- Return Project corrections.
- Individual tech reports due tomorrow - we will complete an exercise to grade by peers
- MA204 Discussion

**Key Terms:**

1. **Functions** are parameterized mathematical models, we will use to predict outcomes
2. **explanatory variable**
3. **response variable**
4. **Families of Functions** linear, Exponential, and polynomial
5. **parameters** what we can change to affect our model selection
6. **Slope-intercept form of a line**  $y = mx + b$  where  $m$  is the slope or rate of change and  $b$  is the y-intercept
7. **Point slope form of a line**  $y - y_0 = m(x - x_0)$  where  $m$  is the slope or rate of change and  $(x_0, y_0)$  is a point on the line
8. **General form of a line**  $Ax + By + C = 0$  where  $A$ ,  $B$ , and  $C$  are constants.
9. In a **First Principle** approach a function is developed based on a physical or contextual relationship you understand about the problem
10. In an **Empirical** approach a solution type a function is developed based on data first. This may be validated employing contextual information about the problem context or further data.
11. The **Sum of Square Error** (SSE) is a measure of error for your model to the data  

$$SSE = \sum_{i=1}^n (y_i - \hat{y}_i)^2$$
12. The **Sum of Square Total** (SST) is a measure of un-normalized deviation of the data  

$$SST = \sum_{i=1}^n (y_i - \bar{y})^2$$
13. The **slope** ( $m$ ) of a line is a measure of rate of change between two points  $m = \frac{y_2 - y_1}{x_2 - x_1}$
14. The **y-intercept** ( $b$ ) of a line is a measure of rate of change between two points  

$$b = y_1 - mx_1$$
15. The **The Coefficient of Determination** ( $R^2$ ) is the percentage of the total observed variation in the response variable that is accounted for by changes in the explanatory variable  

$$R^2 = 1 - \frac{SSE}{SST}$$

16. **Interpolation:** Using a linear model to predict values *within the range* of the observed data.
17. **Extrapolation:** Using a linear model to predict values *outside the range* of the observed data, which is less reliable because the model may not hold beyond the data.

## 1 Model Family Discussion

### 1.1 Linear

Takes the slope-intercept form of  $y = mx + b$ .

Takes the point-slope form of  $y - y_0 = m(x - x_0)$ .

Takes the General form of a line of  $Ax + By + C = 0$ .

### 1.2 Exponential

Takes the form:  $y = ab^x + d$

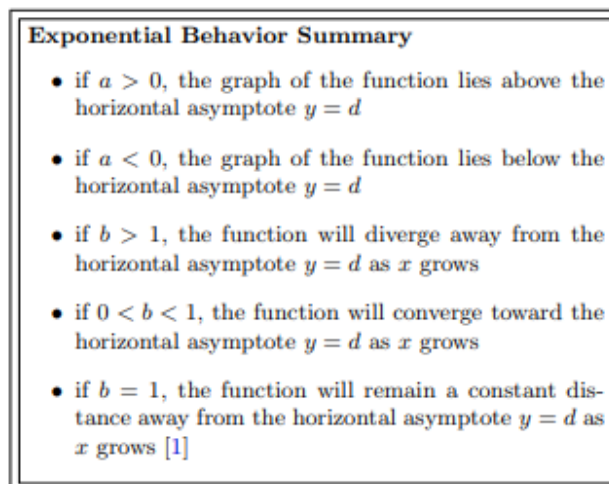


Figure 1: Exponential Behavior Explained

### 1.3 Polynomial

Takes the form:

$$y = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$$

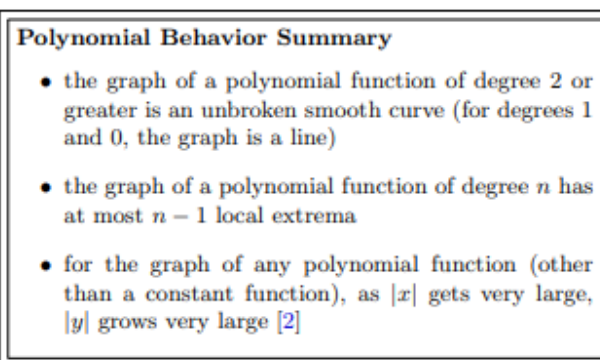


Figure 2: Polynomial Behavior Explained