Admin Notes / Agenda

- Turn in Draft Tech Reports to Partner and grade
- Return Project corrections.
- 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 maybe 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 $\text{SST} = \sum_{i=1}^{n}(y_i - \bar{y})^2$
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: $y = ab^x + d$

Exponential Behavior Summary

- if $a > 0$, the graph of the function lies above the horizontal asymptote $y = d$
- if $a < 0$, the graph of the function lies below the horizontal asymptote $y = d$
- if $b > 1$, the function will diverge away from the horizontal asymptote $y = d$ as x grows
- if $0 < b < 1$, the function will converge toward the horizontal asymptote $y = d$ as x grows
- if $b = 1$, the function will remain a constant distance away from the horizontal asymptote $y = d$ as x grows [1]

Figure 1: Exponential Behavior Explained

1.3 Polynomial

Takes the form:

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

Polynomial Behavior Summary

- the graph of a polynomial function of degree 2 or greater is an unbroken smooth curve (for degrees 1 and 0, the graph is a line)
- the graph of a polynomial function of degree n has at most $n - 1$ local extrema
- for the graph of any polynomial function (other than a constant function), as $|x|$ gets very large, $|y|$ grows very large [2]

Figure 2: Polynomial Behavior Explained