

# A3SR Math Review

## Properties of Logarithms

### Relevant Courses:

- Quantitative Methods
- Generalized Linear Models

### Notes

#### Definition

Logarithms are defined such that  $\log_b(A) = X$  is equivalent to  $b^X = A$

#### Properties

Using properties of exponents and the definition above, we can derive the following:

- The Product Rule:  $\log_b(MN) = \log_b(M) + \log_b(N)$
- The Quotient Rule:  $\log_b(\frac{M}{N}) = \log_b(M) - \log_b(N)$
- The Power Rule:  $\log_b(M^p) = p\log_b(M)$
- $\log_b(b^X) = X$
- $b^{\log_b(X)} = X$
- $\log_b b = 1$
- $\log_b 1 = 0$

#### Example 1: Expanding logarithms

$$\begin{aligned}\log_e\left(\frac{2x^3}{y}\right) &= \log_e(2x^3) - \log_e(y) \\ &= \log_e(2) + \log_e(x^3) - \log_e(y) \\ &= \log_e(2) + 3\log_e(x) - \log_e(y)\end{aligned}$$

#### Example 2: Condensing logarithms

$$\begin{aligned}2\log_3(x) + \log_3(5) - \log_3(2) &= \log_3(x^2) + \log_3(5) - \log_3(2) \\ &= \log_3(5x^2) - \log_3(2) \\ &= \log_3\left(\frac{5x^2}{2}\right)\end{aligned}$$

## Practice Problems

1. Solve the following:
  - a.  $\log_e(e^x)$
  - b.  $\log_{10}(100)$
  - c.  $\log_{10}(\frac{1}{10})$
  - d.  $\log_{10}(0)$
2. Expand the following:
  - a.  $\log_{10}(\frac{5y^3}{x^2})$
  - b.  $\log_2(\frac{4y^2}{3x})$
  - c.  $\log_e(2x^2y^3)$
3. Condense the following:
  - a.  $4\log_3(x) - 2\log_3(y)$
  - b.  $\log_2(x) + 5\log_2(y) - \log_2(5)$
  - c.  $\log_{10}(5) + \log_{10}(2)$

## Answers

1. Solve:
  - a.  $x$
  - b.  $2$
  - c.  $-1$
  - d. There is no solution because there is no power of 10 that would equal 0
2. Expand:
  - a.  $\log_{10}(5) + 3\log_{10}(y) - \log_{10}(x)$
  - b.  $2 + 2\log_2(y) - \log_2(3) - \log_2(x)$
  - c.  $\log_e(2) + 2\log_e(x) + 3\log_e(y)$
3. Condense
  - a.  $\log_3(\frac{x^4}{y^2})$
  - b.  $\log_2(\frac{xy^5}{5})$
  - c.  $1$

# Matrix Algebra

## Relevant Courses:

-Quantitative Methods

# Derivatives

## Relevant Courses:

- Probability
- Quantitative Methods

# Integrals

## Relevant Courses:

- Probability
- Quantitative Methods

# Summary Statistics

## Relevant Courses:

- Probability
- Quantitative Methods
- Statistical Computing

## **P-Values and T-Tests**

### **Relevant Courses:**

- Quantitative Methods
- Statistical Computing
- Causal Inference

# Correlation and Covariance

## Relevant Courses:

- Quantitative Methods
- Probability



# Ordinary Least Squares Regression

## Relevant Courses:

-Quantitative Methods

## Probability Density/Mass Functions

### Relevant Courses:

- Quantitative Methods
- Probability
- Causal Inference

## **Expectation**

### **Relevant Courses:**

-Probability