Example 4: Exponents, Logarithms, PDFs and CDFs – Surgical Strike

I use this 'surgical strike' as an introduction to my lecture (and accompanying lab) on sedimentary textures. Students are often intimidated by the entire concept of logarithms, until they come to realize that they are simply the inverse of exponents. I review exponent and log rules because they apply both to common grain size scales (ϕ scale) as well as to chemical equilibrium constants later in the semester.

While most students are familiar with the concept of a histogram, many are unfamiliar with PDFs and CDFs. Therefore, I spend a little more time introducing these topics, and subsequently reinforce them by allowing students to sieve sediment samples and construct their own PDFs and CDFs during the subsequent labs. The chart wizard in EXCEL is a very useful tool for quickly creating such charts.

GEL 3400 – Chapt. 3 Sedimentary Textures

Focus: Siliciclastic Rocks

silicate minerals ↙ ↘ detrital (clasts)

Some useful mathematical concepts:

1. Exponents $\quad b^n \quad$ b = base n = exponent

$b^0 = 1$

$b^1 = b$

$b^{-n} = \frac{1}{b^n} = \left(\frac{1}{b}\right)^n$

$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

$(ab)^n = a^n b^n$

$(b^n)^m = b^{n \cdot m}$

$\sqrt[n]{b} = b^{1/n}$

$\left(\sqrt[n]{b}\right)^n = (b^{1/n})^n = b$

$b^n \cdot b^m = b^{n+m} \qquad 10^2 \cdot 10^3 =$

2. Logarithms (exponents in disguise)!

$b^n = a$ $\log_b a = n$ are equivalent statements

base ⟶ (b)   log = power of b to get a

$\log = \log_{10} =$

$\ln = \log_e =$ natural logarithm

Log rules

$\log_b(b) = 1$ $b^1 = b$

$\log_b(1) = 0$ $b^0 = 1$

$\log(x^a) = a\log(x)$

$\log_b(b^n) = n \log_b(b) = n \cdot 1 = n$

$\log(xy) = \log(x) + \log(y)$

$\log\left(\frac{x}{y}\right) = \log(x) - \log(y)$

$\log_a(x) = \log_b(x)\log_a(b)$

(base conversion)

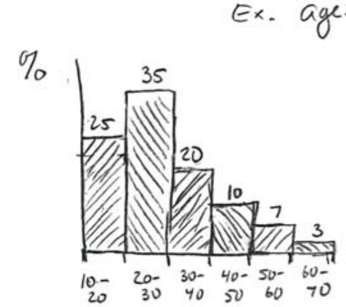
3. PDF's and CDF's

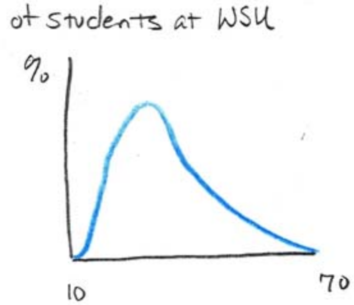
PDF = Probability Density Function or
Probability Distribution Function

CDF = Cumulative Distribution Function

Data = { SET OF MEASUREMENTS }

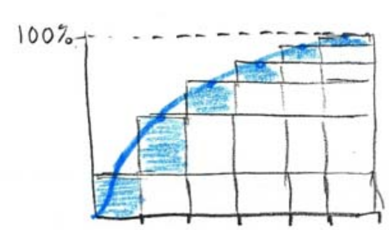
Ex. ages of students at WSU

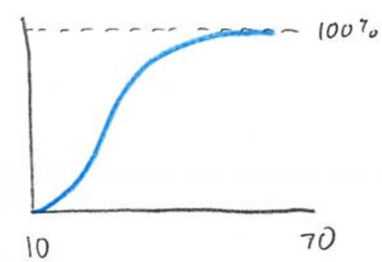




Histogram = plot of % of measurements falling into "bins" of a specified range

PDF = frequency curve recognizes that the variable is continuous





CDF = plot of cumulative %

Note that the PDF can be derived from the CDF (and vice versa).   PDF = CDF′   CDF = ∫PDF

derivative