2018-09-18 Tue
Chapter 6.1/6.2

"Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist." –Kenneth Boulding–

Exponential growth

Birth rate ($r = 0.1$), mortality rate ($m = 0.07$). Population after n years

$$P_n = 1.03^n P_0 \tag{1}$$

n	$P_n/P_{\max}$	Left
0	1 (-6)	0.999999
10	1.3439164 (-6)	0.99999866
100	1.9218632 (-5)	0.99998078
200	3.6935582 (-4)	0.99963064
300	7.0985135 (-3)	0.99290149
400	0.13642372	0.86357628
430	0.33113617	0.66886383
450	0.59806876	0.40193124
460	0.80375440	0.1962456
465	0.93177164	0.06822836
467	0.98851653	0.01148347
468	1.0181720	-0.018172

Exponential functions grow very fast!!!!

Exponential functions

$$f(x) = 2^x \tag{2}$$

- Clear what is meant when

  $$x$$

  is integer
- Also clear when x is a rational number
- But what is 2^π, or $3^{\sqrt{2}}$?
- Definition of exponential functions is complicated. Rigorous definition requires integrals!!!!

Rules with exponents

$$a^x a^y = a^{x+y}; \quad (a^x)^y = a^{xy} \tag{3}$$

Logarithmic functions

$$y = \log_b x \Longleftrightarrow b^y = x \tag{4}$$

Defined as the inverse function of the exponential