This sucks.

The median first marriage age is 26. The pool of singles is shrinking. I'm running out of time. Not quite.

Yes, older singles are rarer. But as you get older, the dateable age range gets wider. An 18-year-old's range is 16-22, whereas a 30-year-old's might be more like 22-46.

I did some analysis of this with census bureau numbers just last weekend. Your dating pool actually grows until middle age. So don't fret so much!

Standard creepiness rule: don't date under (age + 7).


Did your analysis say anything about the dating prospects of people who spend weekends at home making graphs?

Come on, somewhere at the edge of the bell curve is the girl for me.

(from xkcd)
1. Suppose a population grows according to a logistic model with initial population 10 and carrying capacity 100. If the population grows to 25 after one year, what will the population be after another year?

We know that the population will satisfy the equation

\[ P(t) = \frac{M}{1 + Ae^{-kt}} \]

where \( M = 100 \) and

\[ A = \frac{M - P_0}{P_0} = \frac{100 - 10}{10} = 9. \]

We need to use that \( P(1) = 25 \) to find \( k \), and then we will be able to find \( P(2) \).

\[
25 = P(1) = \frac{100}{1 + 9e^{-k}} \implies \frac{100}{1 + 9e^{-k}} = 4 \implies 9e^{-k} = 3 \implies e^{-k} = \frac{1}{3} \implies 3 = e^k \implies \ln 3 = k
\]

So using that \( e^{\ln 3} = 3 \), we have that

\[ P(t) = \frac{100}{1 + 9e^{-(\ln 3)t}} = \frac{100}{1 + 9 \times 3^{-t}} \]

This gives us that

\[ P(2) = \frac{100}{1 + 9 \times 3^{-2}} = \frac{100}{1 + 1} = 50 \]

2. Solve the differential equation \( y' - y = e^x \)

This is a linear differential equation, with \( P(x) = -1 \) and \( Q(x) = e^x \). First, we find

\[ I(x) = \int P(x) = \int -1 \, dx = -x. \]

We multiply both sides by \( I(x) \), which gives us

\[ \frac{d}{dx}(e^{-x}y) = e^{-x}y' - e^{-x}y = 1 \]

Integrating both sides, we get

\[ e^{-x}y = x + C \implies y = \frac{x + C}{e^{-x}} = e^x(x + C) \]
3. Sketch the curve with the polar equation \( r = \sin \theta - 1 \).
If we sketch the graph of \( r \) as a function of \( \theta \) in Cartesian coordinates, we get the sine function shifted down 1. When \( \theta = 0 \), we have \( r = -1 \), which is the marked point. Then we proceed counter clockwise. For more details, see the website listed under the 10.3 homework.

\[ A = \int_{0}^{2\pi} \frac{1}{2} \theta \, d\theta = \frac{1}{4}(2\pi)^2 - \frac{1}{4}(0)^2 = \frac{\pi^2}{4} \]