POPULATION CALCULATION WORKSHEET

You will need to be familiar with these equations.

POPULATION DENSITY

$$\left(\frac{\text{population}}{\text{area}}\right) = \textbf{Population Density}$$

for example: $\left(\frac{270{,}000{,}000 \text{ people}}{9{,}166{,}605 \text{ sq. km.}}\right)$ = 29 people per square kilometer

BIRTH OR DEATH RATES:

$$\left(\frac{\text{\# of births or deaths per year}}{\text{Total population}}\right) = \textbf{Birth or Death Rate}$$

NOTE: to find Crude Birth/Death Rates, multiply the rate by 1,000

for example: $\left(\frac{23{,}452 \text{ births}}{942{,}721 \text{ people}}\right)$ = 0.025 = 2.5% birth rate

25 = Crude Birth Rate

FINDING POPULATION GROWTH RATE (r):

(This does not include immigration or emigration)

$$\left(\frac{\text{crude births} - \text{crude deaths}}{10}\right) = \textbf{r \%}$$

for example: $\left(\frac{40 - 30}{10}\right)$ = 1.0%

FINDING THE DOUBLING TIME OF A POPULATION: THE RULE OF 70!!!

(This only applies if the population is growing exponentially)

Why 70? It is 100 x ln(2). What does that mean? Who cares…the math works!

$$\left(\frac{70\%}{\text{r (in percent form)}}\right) \text{ or } \left(\frac{0.7}{\text{r (in decimal form)}}\right) = \textbf{Doubling Time (dt) in years}$$

for example: $\left(\frac{70\%}{7\%}\right)$ or $\left(\frac{0.7}{0.07}\right)$ = 10 years

FINDING FUTURE POPULATION FROM GROWTH RATE:

$$(\text{initial population}) \times (\text{growth rate})^{\text{years}} = \textbf{Final Population}$$

NOTE: a growth rate of 3% is expressed as 1.03; a growth rate of 0.25% is 1.0025

for example: $(468{,}843 \text{ people}) \times (1.03)^{10 \text{ years}}$ = 630,085 people

Population Problems – SHOW ALL WORK!!

Given the following information, answer questions 1-4.

Schuhlsville is an island of 5000 square miles off the coast of Jabooty. There are currently 250,000 inhabitants of the island. Last year, there were 12,000 new children born and 10,000 people were recorded as deceased.

1. What is the current population density?

$\frac{\text{Population}}{\text{area}} = \frac{250{,}000}{5000\ mi^2} = 50\ \text{inhabitants}/mi^2$

2. What are the birth and death rates?

$\text{Birth} = \frac{12{,}000}{250{,}000} = 0.048 = 4.8\%$ $\times 1000$ = 48 CBR

$\text{Death} = \frac{10{,}000}{250{,}000} = 0.04 = 4\%$ $\times 1000$ = 40 CDR

3. What is the population growth rate (r)?

$\frac{(48-40)}{10} = 0.8\%$

4. In how many years will the population of Schuhlsville double?

$\frac{70}{0.8} = 87.5$ years

Given the following information, answer questions 5-8.

The country of Transylvania contains 2.3 million people (vampires not included) and covers 800,000 square miles. In the year after the last census, there were 109,000 new children born and 111,000 people died.

5. What is the current population density?

$\frac{\text{Population}}{\text{area}} = \frac{2.3 \times 10^6\ ppl}{800{,}000\ mi^2} = 2.9\ \text{inhabitants}/mi^2$

6. What are the birth and death rates?

$B = \frac{109{,}000}{2.3 \times 10^6} = 0.047 = 4.7\%$ $\times 1000$ = 47 = CBR

$D = \frac{111{,}000}{2.3 \times 10^6} = 0.048 = 4.8\%$ $\times 1000$ = 48 = CDR

7. What is the population growth rate (r)?

$\frac{47-48}{10} = -0.1\%$

★ 8. In how many years will the population of Transylvania double?

$\frac{70}{-0.1} = 700$ years population reduced by half

9. Given a 2010 world population growth rate of about 1.3% per year, how long would it take the world's population to double?

$\frac{70}{1.3} = 54$ years

How old will you be when this doubling occurs?

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10. If a country doubles its population in 56 years, what has its population growth rate during that time?

$\frac{70}{x} = 56$ $\quad \frac{56x}{56} = \frac{70}{56}$ $\quad x = 1.25$

11. Calculate the growth rates and doubling times for the countries listed below.

Country	Birth Rate (2011)	Death Rate (2011)	Growth Rate (r)	Doubling Time
United States	13	8	0.5	140
Mexico	19	5	1.4	50
Japan	8	9	-0.1	700 halving time
United Kingdom	13	9	0.4	175
China	12	7	0.5	140
India	23	7	1.6	43.8
Nigeria	41	16	2.5	28
South Africa	21	14	0.7	100
Canada	11	7	0.4	175
Italy	9	10	-0.1	700 halving time

12. According to the 2010 census, Cedar Rapids contained 126,326 people. In 2011, there were an estimated 127,904 people. That translates to a growth rate of 1.2%. Based on this growth rate, what will the population of Cedar Rapids be 5 years from now?

$(127,904) \times (1.012^{\wedge}5) = 135,764$ people

…10 years from now?

$(127,904) \times (1.012^{\wedge}10) = 144,108$ people

…50 years from now?

$(127,904) \times (1.012^{\wedge}50) = 232,225$ people

…100 years from now?

$(127,904) \times (1.012^{\wedge}100) = 421,634$ people

13. In April of 2010 the U.S. population was 308,745,538 and it is growing by about .97%. Assuming a constant growth rate, what will the population be in 2020?

$(308,745,538) \times (1.0097^{10}) = 340,035,494$

…in 2050?

$(308,745,538) \times (1.0097^{40}) = 454,250,005$

…in 2100?

$(308,745,538) \times (1.0097^{90}) = 736,059,213$

14. What would happen to the population growth rate of a country that maintains a high crude birth rate of 32 but was able to reduce their crude death rate from 28 to 12?

$\frac{32-28}{10} = 0.4\%$ $\frac{32-12}{10} = 2\%$

What would happen to the doubling time of this country?

$\frac{70}{0.4} = 175$ years $\frac{70}{2} = 35$ years

15. We are currently adding 84 million people to the world's population each year. That is about 229,000 each day. Below is a listing of some of the world's worst disaster, along with an approximate death toll. At today's growth rate, determine how many minutes, hours, days, weeks, or months it would take to replace those lost.

Past disasters	Approximate # of deaths	Present world population growth replaces this # in what time span?
Hurricane Katrina	1836	1836/229000 = 0.008017 days x 24 hr = 0.1924 hr x 60 min = 11.54 min
September 11, 2001 attacks	2996	2996/229000 = 0.013 days x 24 hrs = 0.32 hr x 60 min = 18.8 min
U.S. accidental deaths in 2007	123,700	12.96 hrs
Sumatra tsunami on 12/26/04	225,000	0.98 days = 23.6 hrs
American deaths in all wars as of 2010	655,000	2.86 days
Total U.S. auto deaths through 2007	3,000,000	13.1 days
Influenza epidemic, 1918	21,000,000	91.7 days
Total AID's deaths through 2005	25,000,000	109.2 days
The Black Plague, 1347-51	75,000,000	75,000,000/229000 = 327.5 days