Common Formulae

Contents

DNA:

1 A260 = 0.05 µg DNA/µL
A260 /A280 = 2.0
Å = 6.02 x 10^{23} molecules/mole
1 haploid human genome = 3.2 x 10^{9} bp
Avg MW of DNA = 654 Dal/bp (1 Dalton = 1 gm/mole)
1 cell = 7 pg genomic DNA

Protein

Mouse Ig heavy chain = 52 kD
Mouse cyclin A2 = 47 kD
Mouse CDK2 = 39 kD
Mouse Ig lambda light chain = 26 kK

λ + HindIII

(kB)	23.130	9.416	6.557	4.361	2.322	2.027	0.564	0.125
(fraction of total)	0.477	0.194	0.135	0.090	0.478	0.418	0.0116	0.0028

Bacteria:

10^{9} bacteria/mL = 1 A_{600}

Relative centrifugal force (g):

RCF = 1.12 R$(rpm/1000)^{2}$

$$rpm = 948\sqrt{RCF/R}$$

(where R = radius in mm)

Radiation:

Measurement	International (SI) Unit	U.S. Unit	Conversions
Radioactivity	Becquerel (Bq)	Curie (Ci)	3.7E+10 Bq = 1 Ci)
Absorbed Dose	Gray (Gy)	RAD	1 Gy = 100 RADs
Equivalent Dose	Sievert (Sv)	REM	1 Sv = 100 REMs

1 Bq = 1 dps (disintegrations per second)
1 Ci = dps/ dps in 1 gm radium
1 Gy = 1 J/kg (Joules absorbed per kg of target liquid or gas)

Radiation dose:

Relationships

1 R (Röntgen) = ionizing energy emitted in air
1R @1 rad (radiation absorbed dose in a liquid or gas)

1 Sv = Q x Gy
1 rem = Q x rad (rem = Röntgen equivalents in man)
(Q = "quality score" ~ 1 for ß particles.)

To convert radioactivity to dose (e.g. 1 Ci 32P in 1 L H2O)
1 Ci = 4.12E-03 W / 1 kg
= 4.12E-03 Gy/sec

Characteristics of common radionuclides in biology labs:

				Major radiation Energies (MeV/dis)			
Nuclide	Atomic Number	Half Life	Principal Mode(s) of Decay	α	$\beta-$	γ and X	(W/Ci)
3H	1	1.233E+01 yr	$\beta-$		0.00568		3.37E-05
14C	6	5.730E+03 yr	$\beta-$		0.0495		2.93E-04
32P	15	14.282 days	$\beta-$		0.6947		4.12E-03
35S	16	87.51 days	$\beta-$		0.0486		2.88E-04
125I	53	60.14 days	EC		0.0179	0.0423	3.57E-04
131I	53	8.040 days	$\beta-$		0.1913	0.3826	3.40E-03

Radiation risk:

Avg U.S. background radiation exposure = 0.36 rem
Maximum annual occupational dose = 5 rem
4 Sv causes a doubling of total cancer risk (baseline = 0.22)
1 Sv causes a doubling of leukemia risk (baseline = 0.0063)

References:

http://www.umich.edu/~radinfo/
http://www.radtexas.org/radunits.html)

Sample variance:

Measures of Variance:

$$V = \sigma^2 = \sum_{i=1}^{n} \frac{|x - \mu|}{n}$$

(where μ= true population mean, σ = population S.D.)

For Gaussian (bell shaped) distributions, μ ± σ are the inflections points of the curve , i.e. where it becomes concave with $d^2P/dx^2 = 0$, and the area under the probabity curve = 68%.

Sample variance:

$$s^2 = \sum_{i=1}^{n} \frac{|x_i - X|}{n-1}$$

Variance for a linear transformation of x:

$$y = mx + b$$

(where m = slope, b = y-intercept)

$$\sigma_y = m\sigma_x$$

Variance of multiple measurements:

For addition

$$V_{(x+y)} = V_x + V_y$$

(the variance is additive)

i.e.

$$s_{(x+y)} = \sqrt{s_x^{\ 2} + s_y^{\ 2}}$$

For multiplication

$$\frac{V_{xy}}{\mu_x \mu_y} = \frac{V_x}{\mu_x^{\ 2}} + \frac{V_y}{\mu_y^{\ 2}}$$

(the relative variance is additive)

i.e.

$$s_{xy} = \sqrt{\left(\frac{s_x^{\ 2}}{\mu_x^{\ 2}} + \frac{s_y^{\ 2}}{\mu_y^{\ 2}}\right)(\mu_x \mu_y)}$$

(O.K., I admit that I'm guessing here)

Poisson distributions

$$P(x) = \frac{e^{-\mu}\mu^{x}}{x!}$$

$P(1) = e^{-\mu}\mu$ (the first element of the Poisson, i.e. the probability of 1 event per observation)

The probabilities of even or odd numbers of events:

$P(x_{odd}) = 1/2(1 - e^{-2\mu})$ (for example the probability of 1,3,5… SCE per chromosome)

$$P(x_{even}) = 1/2(1 + e^{-2\mu})$$

Variance:

$\mu_x = s_x^{\ 2}$ (for Poisson distributions the mean = variance)

Sample size determination

For numerical data, comparing one group to a known standard:

$$n = \left[\frac{(z_\alpha - z_\beta)\sigma}{\mu_x - \mu} \right]^2$$

(where z_α and z_β are the z-values for type 1 or type 2 errors, σ is the std. Deviation of the population and μ is the true population mean.)

For numerical data, comparing 2 groups to each other:

$$n = 2\left[\frac{(z_\alpha - z_\beta)\sigma}{\mu_x - \mu} \right]^2$$

e.g. let α=0.95, ß=0.8, z_α=1.96, z_β= -1.28

$$n = \frac{21\sigma^2}{(\mu_x - \mu)^2}$$

For ordinal (true/false) data comparing the proportions of two groups to each other, the X^2 *gives:*

$$n = \left[\frac{z_\alpha \sqrt{2(\pi_c - \pi_c^{\,2})} - z_\beta \sqrt{(\pi_x - \pi_x^{\,2}) + (\pi_c - \pi_c^{\,2})}}{\pi_x - \pi_c} \right]^2$$

(where π_c is the control frequency, and π_x is the experimental frequency)

e.g. for α=0.05, and 1-ß=0.8:

n	π_c	π_x
50	0.33	0.66
24	0.25	0.66
10	0.20	0.80