Biology 4605/7220 Name ________Key________
Exam #1b 1 October 2003

1. H.B.D. Kettlewell, (1956 *Heredity* 10: 287-301) reported the results of a mark recapture experiment in which 201 typical moths and 601 melanic moths were released, exposing them to predation.

	N release	N recapt	% survive	survival odds	odds ratio
Typical	201	34	_17%_	_0.2036_:1	
Melanic	601	205	_34%_	_0.5177_:1	_2.54__

Compute the percent survival as the ratio of recaptured to released moths.
If survival is some percentage p, then the odds in favour of survival are defined as Odds = p/q where q = 1 − p.
Read the expression (Odds = p/q : 1) as "odds are ____ to 1."

The odds ratio, for one group relative to another, is defined as the odds for the one group (typical), divided by the odds for the other group (melanic).

Compute and fill in the survival percentages, the odds, and the odds ratio, in the table above. [5]

2. A convenient statistic for the odds ratio is OR.
Write the value of OR when the odds are the same for typical and melanic moths. OR = ___1__________ [1]

In words, then in symbolic notation, state the H_A/H_o pair for testing whether odds of survival depend on melanism or not. [3]

H_o: OR = 1 The odds of survival are independent of melanism.

H_A: OR ≠ 1 The odds of survival depend on melanism.

3. Assuming you did not know the distribution of the OR statistic, state how you would carry out a randomization test of your H_A/H_o pair. [2]

Make null hypothesis true by randomly drawing n = 205 + 34 = 239 moths from
N = 201 + 601 = 801 moths
Tally number of melanic and typical moths drawn, score these as surviving (recaptured) moths
Compute Odds ratio.
Repeat 1000 times to obtain distribution of OR when H_o: OR = 1 is true.
Compute number of times that randomly drawn OR exceeds OR = 2.54
Compute percentage of times the randomly drawn OR exceeds OR = 2.54
If p less than criterion (5%) then declare OR not equal to 1 (survival odds differ)

4. Hypothesis testing is carried out with frequency distributions, either observed (empirical) or theoretical.

What is the principal advantage of using a theoretical distribution ? [1]

p-value quickly calculated

What is the principal advantage of using an empirical distribution ? [1]

no assumptions in order for p-value to be accurate

What is the principal disadvantage (or cost) or using an empirical distribution ? [1]

takes time to construct the distribution

5. Complete the following computations. [3]

$(20\ \text{km}^{1.5})^2$ = ______400 km^3__________

$(40\ \text{km})^{1.3}$ = _______120.97 $\text{km}^{1.3}$________

R = (20 km)/km $\log_{10}(R)$ = _______1.3___________________

6. List the 5 parts of a well-defined biological quantity, then construct an example. [5]

procedural statement symbol name values units

See lecture notes for example

7. Walters and Green (1997, *Journal of Wildlife Management* 61: 987-1006) devised a value function for calculating the optimum stocking rate for pheasants in a hunting area.

$$u^* = (b - c) / (2\theta)$$

u^* = optimum stocking rate $(\text{year})^{-1}$
b = maximum value per bird stocked (dollars pheasant^{-1}) with dimensions of $[\$]\,[\#]^{-1}$
c = unit cost of stocking pheasant

What units does c have ? ___same as b = (dollars pheasant^{-1})_____ [1]

What units does θ have ? __same as b/u* = (dollars pheasant^{-1})/ $(\text{year})^{-1}$_
_= (dollars $(\text{year})^{1}$ pheasant^{-1})__ [1]

Add the correct exponents to the dimensional matrix

	[$]	[#]	[T]	
u^*	0	0	−1	
c	1	−1	0	[3]
θ	1	−1	1	[3]

8. According to Hattori (1973 *Microbial Life in the Soil* p.384) oxygen uptake in the soil [M = ml/(ml-second)] depends on
oxygen concentration at the soil surface (C_o = ml O_2 per ml liquid)
the diffusion coefficient of oxygen (D = cm^2/second)
the thickness of the oxidative surface layer (z = cm)

$$M = C_o z^2 / 2D$$

Compute oxygen uptake when C_o = 0.02 ml/ml, diffusivity is D = 0.40 cm^2/sec, and depth is 10 cm.

M = __2.5ml/(ml-second)____ [1]

For this predicted value, compute the observed value when the residual value is 0.1 ml/(ml-second).

Data	=	Model	+	Residual	
_2.6__	=	____2.5___	+	___0.1___	[3]

9a. Convert 31.56 megaseconds to years ____________________ [1]

$$31.56 megaseconds \cdot \frac{10^6 seconds}{1 megaseconds} \cdot \frac{1 minute}{60 seconds} \cdot \frac{1 hr}{60 minute} \cdot \frac{1 day}{24 hr} \cdot \frac{1 yr}{365 day} = 1 yr$$

9b. Convert 100 fractal inches $(100\ in)^{1.5}$ to fractal metres __________ [1]
There are 2.54 cm per inch.

$$(100 in)^{1.5} \left(\frac{2.54 cm}{in}\right)^{1.5} \left(\frac{1 m}{100 cm}\right) = 4.048 cm^{1.5}$$