

Allometry problem set

Analyze the numerical problems below in Minitab. You should hand in a summary of each answer consisting of a small figure, a statement about the statistical results and answers to the question. **Do not hand in raw Minitab output. Be concise.**

- 1) Below are the standard body lengths (snout to tail fork) and wet weights of some fish. Plot 1) mass vs. standard length and 2) $\log(\text{mass})$ vs. $\log(\text{length})$.
 - a. Which plot is a better representation of the allometric relationship?
 - b. What is the allometric slope?
 - c. Does the slope you obtained fit with theoretical expectations?

Standard length (mm)	Mass (g)
38	0.7
45	1.0
53	1.8
54	2.3
61	3.8
65	3.6
72	5.1
75	5.7
75	6.3
84	7.5
89	8.9
90	10.7
119	23.7
144	43.1
156	55.2
171	55.7
180	78.3

- 2) Many comparative studies are made on museum specimens where measurements of body mass were never originally recorded and must be estimated from what is left. This raises an interesting allometric question about whether other measures can be reasonably substituted for body size. Below are measurements of the mandibular lengths from racoon (*Procyon lotor*) skulls along with their body masses. Make both the linear and logarithmic allometric plots.
 - a. Does the allometric slope fit with theoretical explanations?
 - b. What might cause any deviation from the expected slope?
 - c. Is mandibular length a reasonable substitute for body mass in racoons?

Mandibular length (mm)	Body mass (g)
69.35	252
70.70	376
75.20	346
75.30	444

75.30	468
75.80	504
76.30	534
76.90	566
77.90	365
78.45	470
78.70	548
78.80	524
78.80	680
79.20	624
79.30	500
79.70	416
80.40	716
80.65	714
81.15	696
82.20	706
83.20	588
84.60	742

- 3) Below are some measurements from bird skins along with mean body masses for each species.
- a. What is the allometric slope?
 - b. Why might this slope deviate from the theoretical value?
 - i. Is there any functional reason for the deviation?
 - ii. Is there any experimental reason for the deviation?

Body mass (g)	Wing length (mm)
6.0	41
7.1	48
8.8	54
9.8	53
11.8	71
12.0	67
13.3	72
14.0	62
24.1	79
25.5	87
39.0	110
46.0	114
68.0	113

- 4) Below are lengths and diameters of femur bones from a range of mammals.
- a. Do these data support the idea that bone diameter must increase hypoallometrically ($b > 1$) with length due to loading constraints?

Femur length (mm)	Femur diameter (mm)
11	1.0
13	1.0
16	1.5
74	6.0
90	8.0
90	6.0
109	8.0
127	7.0
128	10.0
142	10.0
148	19.0
157	11.0
163	15.0
174	11.0
178	11.0
190	22.0
298	22.0
305	32.0
335	25.0
370	40.0
420	26.0
475	62.0
1320	126.0
1370	163.0

5) Suppose you collect the following data set of jump distances (cm) versus time since molt to the second instar (a measure of age, in days) in male *Schistocera americana* (the American locust, a grasshopper).

Time (days)	Jump dist (cm)
4	50
8	49
12	53
17	61
19	59
22	68
27	70
39	81
46	94
55	102
60	115

What can you conclude about the relationship between jump distance and age in *S. americana* males?

6) As egg size increases among a group of egg-laying organisms (say, dinosaurs), would you expect egg *shape* to remain constant? Why or why not? If not, in what ways might you expect egg shape to change with size?