

Math For Cook Inlet Anthropology
Anth 325
Kenai Peninsula College
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1. Archimedes Principal and the Weight of a Marine Kachemak Harpoon float

1.1. Archimedes Principal: In a liquid object's "weight" is equal to the weight of the liquid it displaces.

1.2. Information you need:

1.2.1. $1000 \text{ cm}^3 = 1 \text{ liter}$

1.2.2. 1 liter of water weighs 1 kilogram

1.2.3. 1 kilogram = 2.2 pounds

1.3. Procedure

1.3.1. calculate the volume of the float in cubic centimeters using the formula for the volume of a sphere. Let's say the intestine float is 80 cm in diameter.

$$volume = \frac{4}{3} \pi r^3 \quad \pi \text{ (read "pie")} = 3.14 \quad r \text{ is the radius}$$

$$volume = \frac{4}{3} (3.14) (40^3) \quad volume = \frac{4}{3} (3.14) (64,000)$$

Or 267947 cubic centimeters

Or 268 liters (divide by 1000) (see 1.2.1 above)

Or 268 kilograms (liters to kilograms 1:1, see 1.2.2 above)

Or 589 pounds (times 2.2, see 1.2.3 above)

So, a harpooned seal would drag an 80cm (31 inch) diameter harpoon float through the water as though it were pulling a 589 pound weight.

1.4. Using Archimedes principal, calculate the weight in kilograms and pounds of the following harpoon float diameters:

Diameter	radius	kilograms	pounds
40cm			
60cm			
100cm			

Glottochronology

- 1.5. Based on the finding that written languages change at the rate of 19% of their cognates per 1000 years. That means there should be an 81% correspondence in lexicon between two languages of similar origin after 1000 years.
- 1.6. A cognate is the same word with the same meaning in two languages; and a lexicon is a list of words, how they are said and used, and their meaning from a speakers point-of-view.
- 1.7. The principal of glottochronology is controversial for a number of reasons. First, because written languages change at the rate of 19% per thousand years, does not mean all languages do so. Second, which sample of words you compare makes a big difference ecologically based names such as those for birds may not change rapidly, whereas those involving rapidly changing technology, may change quite rapidly. Third, the principle is based entirely on lexicon (a set 200 word list) and not on grammatical change or other linguistic factors.
- 1.8. The formula is logarithmic because the change is cumulative,
 - 1.8.1. 19% per 1000 years,
 - 1.8.2. 19% of the remaining 81% the next thousand years,
 - 1.8.3. 19% of the remaining 62%, the next thousand years, and so on.

1.9. The Formula

$$t = \frac{\log C}{2 \log r}$$

t = time in thousands of years (1 = 1000 years);

C = the decimal fraction of corresponding cognates between two languages

r = the decimal fraction rate of standardized change of cognates per 1000 years
(.81)

1.10. for example: if C=0.5 then

$$t = \frac{\log 0.50}{2 \log 0.81} \quad t = \frac{-.3}{-.18} \quad t = 1.667 \text{ or } 1667 \text{ years since separation}$$

1.11. Below is a table of percentage of Athabascan shared cognates from Hoijer.

Table 2.1 Percentages of shared cognates among Athapaskan languages

	Koy	Tana	At	Ing	Kut	Han	Nab	Hare	DR	Slave	Chip	Beav	Car	Sar	Hupa	Mat	Kato	Gal	Nav
Tanaina	56	58	63	59	57	60	61	55	52	56	59	46	61	56	48	45	47	54	55
Koyukon	x	79	69	75	76	75	69	63	65	65	72	71	70	66	59	63	61	62	64
Tanana		x	72	70	74	73	68	64	66	66	71	68	71	64	57	60	57	59	59
Atna			x	71	70	72	69	65	66	67	69	68	68	62	57	58	57	62	67
Ingalik				x	69	73	68	64	67	68	71	67	69	64	58	57	55	61	64
Kutchin					x	84	81	74	74	73	79	75	77	69	64	69	68	69	71
Han						x	82	74	74	74	79	76	77	61	61	64	64	67	70
Nabesna							x	74	71	70	73	71	73	66	59	63	63	66	67
Hare								x	86	85	83	78	76	72	65	63	68	73	71
Dogrib									x	88	85	77	75	72	59	59	62	68	68
Slave										x	81	83	77	70	61	58	63	68	69
Chipewyan											x	78	83	79	64	65	68	73	76
Beaver												x	78	75	64	61	66	70	70
Carrier													x	73	63	62	66	71	73
Sarsi														x	60	61	63	66	68
Hupa															x	76	75	75	65
Mattole																x	76	71	65
Kato																	x	78	69
Galice																		x	73

Source: Hoijer, personal communication.

1.12. Calculate the time of separation of Dena'ina (Tanaina) and Ahtna (Atna)

1.12.1. Dena'ina and Ahtna share %63 of cognates

$$t = \frac{\log 0.63}{2 \log 0.81} \quad t = \frac{-0.2}{-0.18} \quad t = 1.1 \text{ or } 1,100 \text{ years or around A.D. 900}$$

1.13. Calculate the separation of Dena'ina and the following Athabascan languages:

Language	Decimal Fraction of Shared Cognates	Number of years separated	Year of separation (subtract from A.D. 2000)
Koyukon			
Ingalik (Deg Hit'an)			
Hupa (California)			
Navaho			