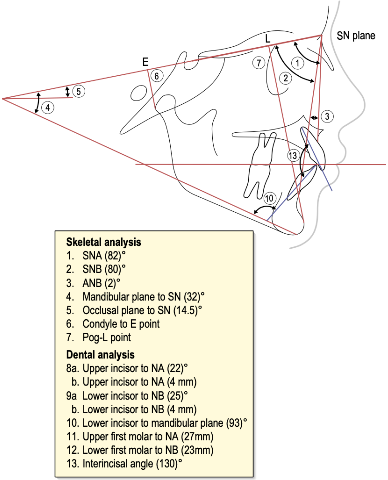
l'Anova

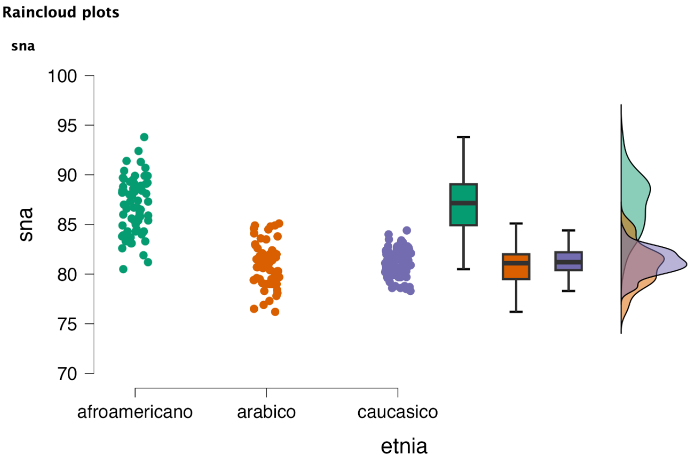
Massimo Borelli

Maggio 2024

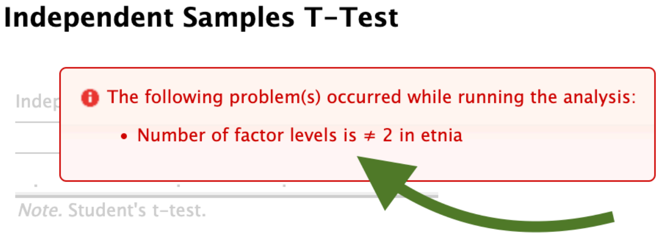
differenti etnie



differenti etnie



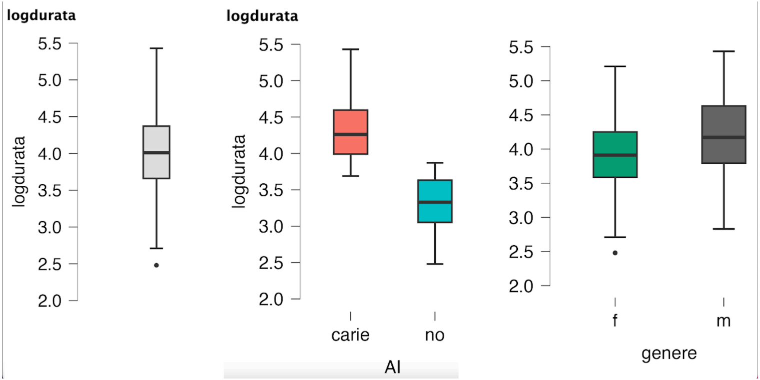
oh no!



$$t = \frac{m_1 - m_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

quale è l'idea chiave?

Se c'è differenza in media, si riduce anche la dispersione



$\sigma = 43$ $\qquad \sigma = 42, \sigma = 10$ $\qquad \sigma = 30, \sigma = 51$

1 la one-way `Anova`

- consideriamo come un **Fixed Factor** la `etnia`
  - in ordine: afroamericano $<$ arabico $<$ caucasico
- come **Dependent Variable** la `sna`

iniziamo con l'approccio frequentista

Tabella: ANOVA - sna

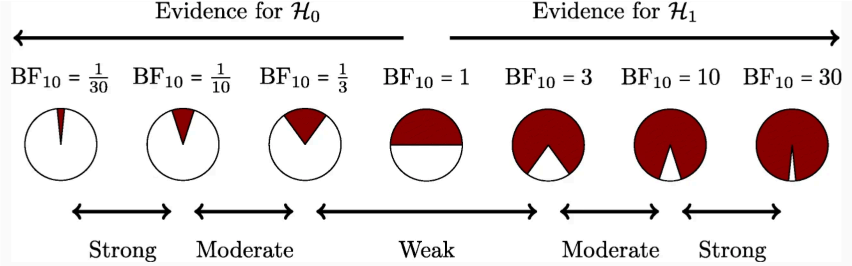
Cases	Sum of Squares	df	Mean Square	F	p
etnia	1620.094	2	810.047	196.673	$< .001$
Residuals	967.905	235	4.119		

Tabella: Descriptives - sna

etnia	N	Mean	SD	SE	Coef. of variation
afroamericano	66	86.927	2.793	0.344	0.032
arabico	67	80.957	2.104	0.257	0.026
caucasico	105	81.197	1.274	0.124	0.016

ora con l'approccio bayesiano

Models	P(M)	P(M|data)	BF_M	..	..
Null model	0.500	5×10^{-48}	5×10^{-48}	..	..
etnia	0.500	1.000	$2 \times 10^{+47}$	..	..



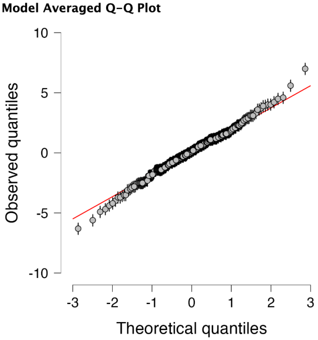
La diagnostica del modello: 'ipotesi di normalità'

Tabella: Equality of Variances (Levene's)

F	df1	df2	p
26.462	2.000	235.000	$<$ .001

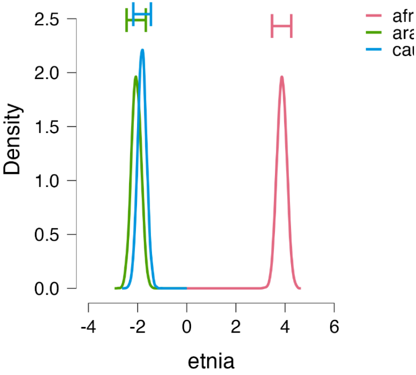
Tabella: Kruskal-Wallis Test

Factor	Statistic	df	p
etnia	123.336	2	$<$ .001



# p < 0.001; ma chi è diverso da chi?

(bayesian | plots |
Model averaged posteriors)



la questione dei 'multiple comparison' /1

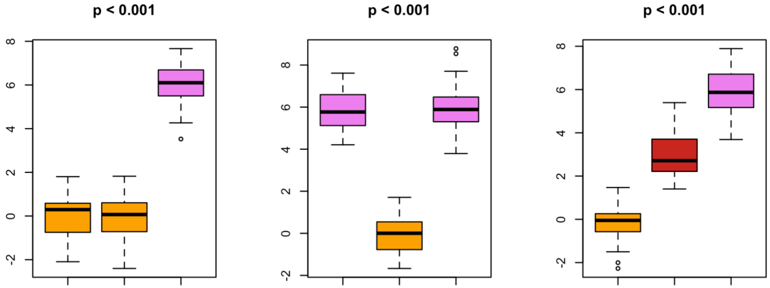
Consideriamo tre simulazioni. Per esempio:

$a = \mathrm{rnorm}(n = 30, \mathrm{mean} = 0, \mathrm{sd} = 1)$

$b = \mathrm{rnorm}(n = 30, \mathrm{mean} = 0, \mathrm{sd} = 1)$

$c = \mathrm{rnorm}(n = 30, \mathrm{mean} = 6, \mathrm{sd} = 1)$

la questione dei 'multiple comparison' /2



la questione dei 'multiple comparison' /3

cattiva idea: fare molti t-tests, ciascuno per ogni coppia di medie.

$\alpha = 0.05$

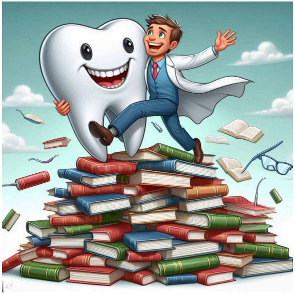
$$1 - (1 - \frac{5}{100}) \cdot (1 - \frac{5}{100}) \cdot (1 - \frac{5}{100}) =$$

$$= 1 - (1 - \frac{5}{100})^3 = 0.143$$

occhio all'errore

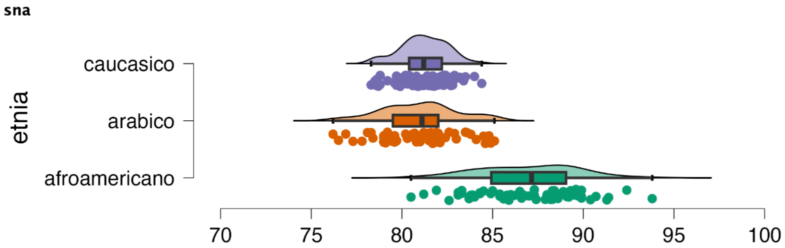
I test multipli gonfiano la probabilità di un errore di primo tipo ('mandare in galera un innocente').

la questione dei 'multiple comparison' /4



Carlo Bonferroni
soluzione 'radicale' (Bernoulli: $1 + nh < (1+h)^n$)
Se $n = 3$ grouppi, allora $n \cdot (n-1)/2 = 3$ confronti, quindi
$h = \alpha/3 = 0.05/3 = 0.017$.

la soluzione dei 'multiple comparison': John Tukey



		Mean Difference	SE	t	p_{tukey}
afroam	arabico	5.971	0.352	16.964	$<$ .001
	caucasico	5.730	0.319	17.974	$<$ .001
arabico	caucasico	-0.240	0.317	-0.758	0.729

un cenno alla two-way Anova

Cases	...	df	Mean Square	F	p
etnia	...	2	816.609	199.215	$< .001$
genere	...	1	8.334	2.033	0.155
etnia * genere	...	2	6.054	1.477	0.230
Residuals	...	232	4.099		