

# T-Test: l'approccio bayesiano

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# inferenza: il concetto generale



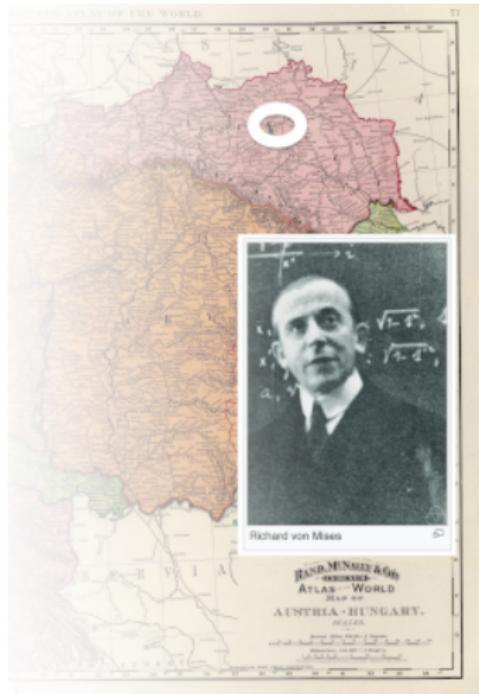
$$H_0 = \{\mu = 0\}$$

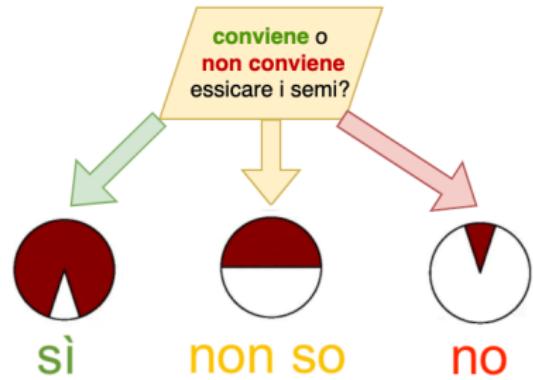
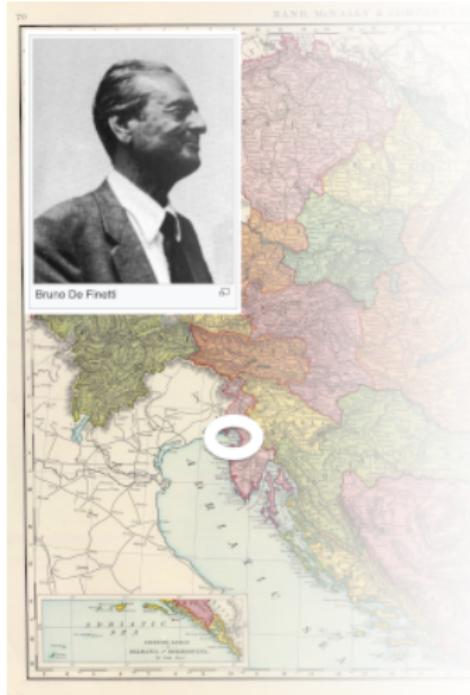



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	t	df	p
difference	1.690	10	<b>0.122</b>

---





ricordate? un cenno al teorema di Bayes

odontoiatra	dolore		Total
	no	si	
carie	19	53	72
no	26	7	33
Total	45	60	105

Qual è la probabilità che l\* mi\* paziente abbia una carie?

Qual è la probabilità che l\* mi\* paziente abbia una carie, sapendo che l\* fa male il dente?

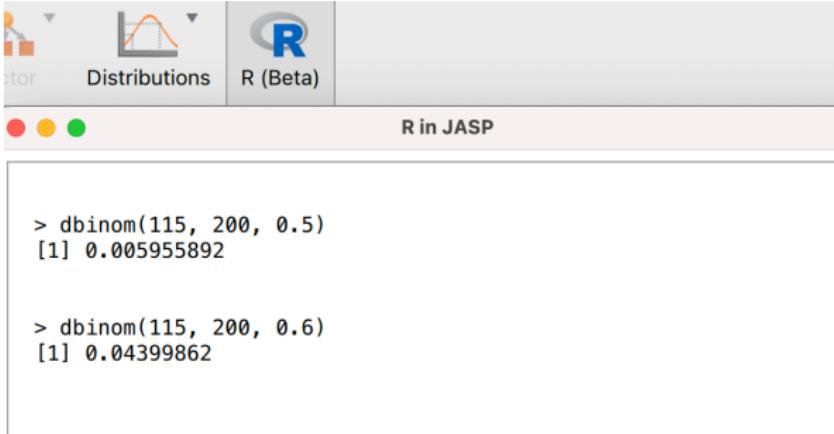
# un nuovo ingrediente: il fattore di Bayes



- urna di Alice equa ( $p = 0.5$ )
- urna di Bob truccata ( $p = 0.6$ ).  
(schema binomiale, estrazioni con  
rimpiazzo)
- osserviamo 115 successi su 200  
estrazioni

? era l'urna di Alice o di Bob ?

# un nuovo ingrediente: il fattore di Bayes



The screenshot shows the JASP software interface. At the top, there is a menu bar with three items: a gear icon labeled "Factor", a histogram icon labeled "Distributions", and an "R (Beta)" icon. Below the menu bar is a window titled "R in JASP". Inside this window, there are two R code snippets:

```
> dbinom(115, 200, 0.5)
[1] 0.005955892

> dbinom(115, 200, 0.6)
[1] 0.04399862
```

$$\frac{P(X = 115 \mid Bob)}{P(X = 115 \mid Alice)} \approx \frac{.044}{.006} \approx 7.4$$

# un nuovo ingrediente: il **fattore di Bayes**



il **fattore di Bayes**:

$$\frac{P(D|M_1)}{P(D|M_2)} = \frac{P(M_1|D)}{P(M_2|D)} \cdot \frac{P(M_2)}{P(M_1)}$$

it is much more likely that the balls have been drawn by Bob's urn: about seven times higher

<b>Not Kiln-Dried</b>	<b>Kiln-Dried</b>	<b>Difference</b>
1903	2009	+106
1935	1915	-20
1910	2011	+101
2496	2463	-33
2108	2180	+72
1961	1925	-36
2060	2122	+62
1444	1482	+38
1612	1542	-70
1316	1443	+127
1511	1535	+24

.. dunque, ecco il **risultato** del test T di Student bayesiano



### JASP: **Bayesian One Sample T-Test**

	$BF_{10}$	error %
difference	0.885	0.021

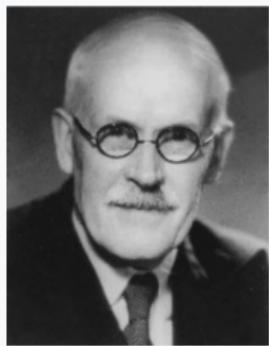
*Note.* For all tests, the alternative hypothesis specifies that the population mean differs from 0.

ci rimane da capire: **come si interpreta questo risultato?** Conviene o non conviene essiccare i semi?

## What does JASP stand for?

In recognition of Bayesian pioneer Sir Harold Jeffreys, JASP stands for Jeffreys's Amazing Statistics Program.

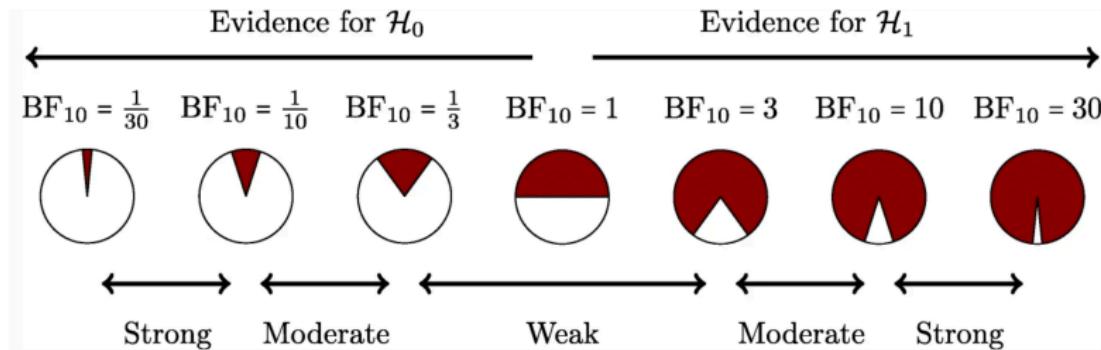
Sir Harold Jeffreys



$K$	dHart	bits	Strength of evidence
$< 10^0$			Negative (supports $M_2$ )
$10^0 \text{ to } 10^{1/2}$			Barely worth mentioning
$10^{1/2} \text{ to } 10^1$		3	Substantial
$10^1 \text{ to } 10^{3/2}$		6	Strong
$10^{3/2} \text{ to } 10^2$		9	Very strong
$> 10^2$			Decisive



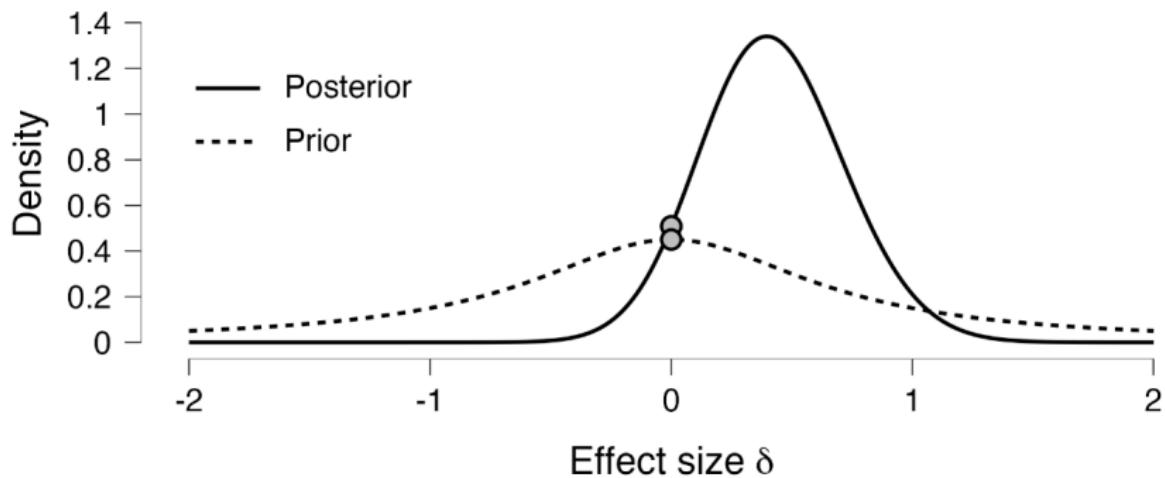
	$BF_{10}$	error %
difference	0.885	0.021



van Doorn et al, PMID: 33037582



	$BF_{10}$	error %
difference	0.885	0.021



## In conclusione

A 2-sided one-sample t-test comparing the sample population difference ( $m = 33.7$ ) to the null mean ( $\mu = 0$ ) returns a p-value = .122, not significant according an  $\alpha$  level of 0.10. The  $BF_{01}$  of 0.885 suggests anecdotal evidence in favour of the alternative hypothesis: therefore the observed data are 1.13 times more likely to have occurred under the null than under the alternative hypothesis.

ci poniamo alcune domande ..

il dataset `roma.ods`

- c'è un effetto legato a `AgePatient` rispetto alla diagnosi dell'`Histology`?
- il biomarker `logCA125` predice `Histology`?
- il biomarker `logCA19-9` predice `Histology`?
- il biomarker `logCEA` predice `Histology`?