Lec 2 Objective Analysis in Atmsci

Statistical Tests.

for small sample sizes, the t-Statistic is Used, based on the student's t-disturbution.

Z Statistic

$$Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$$

T Statistic

$$t = \frac{\bar{X} - \mu}{S / \sqrt{n-1}}$$

where:-

"S" → Sample of Sandared deviation.

$\sqrt{n-1}$ replaces $\sqrt{n}$ because S^2 is underestimating the true σ^2. referred to as the degrees of freedom.

* The t-Statistic is dependent on the Sample size, So as N, the uncertainty decreases.

The t-distribution probability density function, unlike the bell curve, depends on the Sample size.

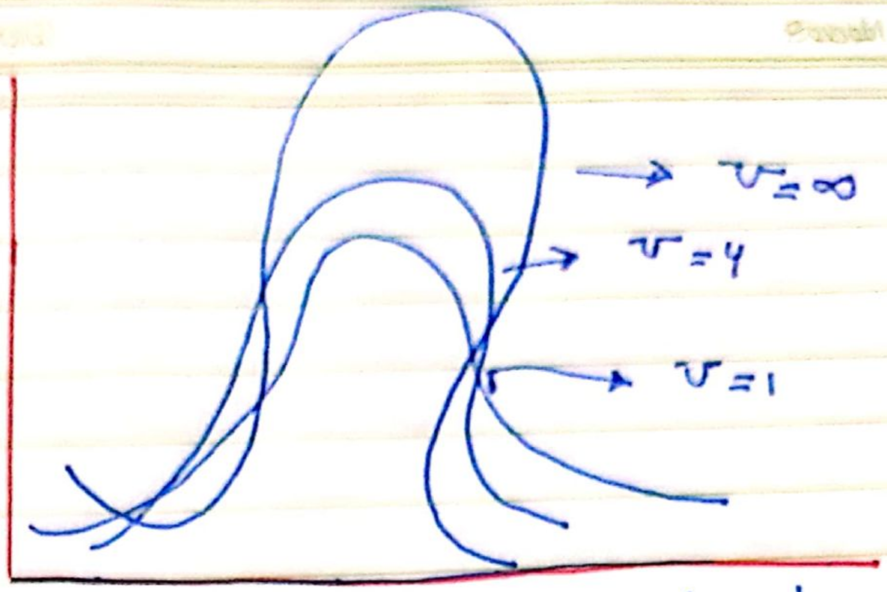
$$f(t) = \frac{f_0(\nu)}{\left(1+\frac{t^2}{\nu}\right)^{\left(\frac{\nu+1}{2}\right)}}$$

where:-

$\nu = N-1 \rightarrow$ degree of freedom.

$t \rightarrow$ t Statistic

$f_0(\nu)$ = constant that depend on (ν) and makes the area under the curve equal to unity.



* As ν decreases the distirbution gets border, reflecting the fact it is border to get the t value near the tail of distribution for a small sample size

- Student t-table given

"Confidence intervels"

Normal dist.

$$\mu = \bar{X} \mp Z_c \frac{\sigma}{\sqrt{N}}$$

T-dist.

$$\mu = \bar{X} \mp t_c \frac{\sigma}{\sqrt{N-1}}$$

where :-

Z_c → Critical Z-Stat.

t_c → Critical t-Stat.

t_c → in this case related to the degree of freedom $(\upsilon - 1)$

* Sample example: Mean Temp.

five Years of January mean temp

Sample mean = $-0.6\,^{\circ}C = \mu$

Std. deviation = $8\,^{\circ}C = \sigma$ or s

What is the 95% confidence interval?

Solution:

Z_Stat	t_Stat
$\mu = \bar{X} \mp Z_c \frac{\sigma}{\sqrt{N}}$	$\mu = \bar{X} \mp t_c \frac{\sigma}{\sqrt{N-1}}$

Z-Stat	t-Stat
$= -60^\circ C \mp 1.96 \frac{8}{\sqrt{5}}$	$= 60^\circ C \mp t_c \frac{\delta}{\sqrt{N-1}}$
$= -60^\circ C \mp 7C^\circ$	$= -60^\circ C \mp 2.78 \frac{8}{\sqrt{5-1}}$
	$= -60^\circ C \mp 11.12 C^\circ$