## misc

- $P(A|B) = \frac{P(A \cap B)}{P(B)}$
- Bayes: $P(B|A) = \frac{P(A|B)P(B)}{P(A)}$
- $(S^*)^2 = \dfrac{n}{n-1} S^2 = \dfrac{1}{n-1} \sum_{i=1}^{n} (X_i - \bar{X})^2;$
- $S^* = \sqrt{(S^*)^2}, S = \sqrt{S^2}$
- $\mathrm{Var}(X) = \mathbb{E}(X^2) - (\mathbb{E}(X))^2;$
- $\mathrm{cov}(X, Y) = \mathbb{E}\left((X - \bar{X})(Y - \bar{Y})\right) = \mathbb{E}(XY) - \mathbb{E}(X)\mathbb{E}(Y);$

## ordinary least squares

$$b = \frac{\sum (X - \bar{X})(Y - \bar{Y})}{\sum (X - \bar{X})^2} = \frac{\sum xy}{x^2},$$

$x = X - \bar{X}, y = Y - \bar{Y}$
$a$ from $Y = a + bX$
(the line goes to through $(\bar{X}, \bar{Y})$)

### standard error:

the correct regresion line is $Y_i = \alpha_i + \beta_i X_i + \varepsilon_i$
Standard error:

$$\mathrm{SE} = \frac{\sigma}{\sqrt{\sum x^2}} = \frac{\sigma}{\sqrt{n} S_x}$$

Smol SE is good.

### standard squared error

(we lost 2 degs of freedom)

$$\mathrm{SSE} = \frac{1}{n-2} \sum (Y - \hat{Y})^2$$

### P values and stuff

$$t = \frac{b}{\mathrm{SE}}$$

$H_0$: b = 0 (ie there's no relation)
if $t > T_\alpha^{(n-2)}$ then we reject $H_0$
else we don't
(with $\alpha$ liek .005)

### F-statistic

(dont worry about it)
similar to T (from above, but with)

$$F = \frac{\mathrm{RegSS}}{\mathrm{SSE}/(n-2)}$$

and reject if $> F_\alpha^{(1,n-2)}$

**$\mathbf{R^2}$**

$$R^2 = \frac{\text{RegSS}}{\text{TSS}} = 1 - \frac{SSE}{TSS} = 1 - \frac{\sum(Y-\bar{Y})^2}{\sum(Y-\hat{Y})^2}$$

$\hat{Y}$ is the esitmated value of Y (ie $\hat{Y} = a + bX$)
RegSS $= \sum(\hat{Y} - \bar{Y})^2$

# Confidence intervals - tl;dr (this is a lot more information than we need)

## for the average

| type | useful | $X$ type | $n$ size | $\sigma$ known | the interval |
|---|---|---|---|---|---|
| bilateral | x | $\mathcal{N}(\mu, \sigma^2)$ | whatever | yes | $\mu \in \left(\bar{X} - \frac{\sigma}{\sqrt{n}} z_{1-\alpha/2}, \bar{X} + \frac{\sigma}{\sqrt{n}} z_{1-\alpha/2}\right)$ |
| bilateral | x | whatever | big | yes | $\mu \in \left(\bar{X} - \frac{\sigma}{\sqrt{n}} z_{1-\alpha/2}, \bar{X} + \frac{\sigma}{\sqrt{n}} z_{1-\alpha/2}\right)$ |
| no sup | | $\sim \mathcal{N}(\mu, \sigma^2)$ | big | yes | $\mu \in \left(\bar{X} - \frac{\sigma}{\sqrt{n}} z_{1-\alpha}, \infty\right)$ |
| no inf | | $\sim \mathcal{N}(\mu, \sigma^2)$ | big | yes | $\mu \in \left(-\infty, \bar{X} + \frac{\sigma}{\sqrt{n}} z_{1-\alpha}\right)$ |
| bilateral | x | whatever | big | no | $\mu \in \left(\bar{X} - \frac{S^*}{\sqrt{n}} z_{1-\alpha/2}, \bar{X} + \frac{S^*}{\sqrt{n}} z_{1-\alpha/2}\right)$ |
| unilateral | | whatever | big | no | like rows 2 and 3 but with $S^*$ |
| bilateral | x | $\sim \mathcal{N}(\mu, \sigma^2)$ | smol | no | $\mu \in \left(\bar{X} - \frac{S^*}{\sqrt{n}} t_{1-\alpha/2,n-1}, \bar{X} + \frac{S^*}{\sqrt{n}} t_{1-\alpha/2,n-1}\right)$ |
| unilateral | | $\sim \mathcal{N}(\mu, \sigma^2)$ | smol | no | like rows 2 and 3 but with $S^*$ and $t_{1-\alpha,n-1}$ |

## for the variance (dispersion)

just ignore this

| type | where to find | $X$ type | $n$ size | $\mu$ known | the interval |
|---|---|---|---|---|---|
| bilateral | C5 - pg 6 | $\sim \mathcal{N}(\mu, \sigma^2)$ | smol | yes | $\sigma^2 \in \left(\frac{\sum_{i=1}^n (X_i - \mu)^2}{\chi^2_{\alpha/2,n}}, \frac{\sum_{i=1}^n (X_i - \mu)^2}{\chi^2_{1-\alpha/2,n}}\right)$ |
| bilateral | C5 - pg 6 | $\sim \mathcal{N}(\mu, \sigma^2)$ | smol | no | $\sigma^2 \in \left(\frac{(n-1)(S^*)^2}{\chi^2_{\alpha/2,n-1}}, \frac{(n-1)(S^*)^2}{\chi^2_{1-\alpha/2,n-1}},\right)$ |

for $n$ large, look at C5 pg 7 - obs 1.3 tl;dr we make it a normal distribution

# Testarea ipotezelor statistice - tl;dr

don't worry about it

## For the average

$(H_0) : \mu = \mu_0$

| name | where to find | $X$ type | $n$ size | $\sigma$ known | thing$_0$ | bilateral tl;dr |
|---|---|---|---|---|---|---|
| $Z$ test | C6 - pg 6-9 | $\sim \mathcal{N}(\mu, \sigma^2)$ | big | yes | $z_0 = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$ | $z_0 \in \left(-z_{1-\alpha/2}, z_{1-\alpha/2}\right)$ |
| $T$ test | C6 - pg 10-13 | $\sim \mathcal{N}(\mu, \sigma^2)$ | smol | no | $z_0 = \dfrac{\bar{x} - \mu_0}{s^*/\sqrt{n}}$ | $t_0 \in \left(-t_{1-\alpha/2,n-1}, t_{1-\alpha/2,n-1}\right)$ |

## For the variance (dispersion)

$(H_0) : \sigma = \sigma_0$

$\chi^2$-test

$\chi_0^2 = \dfrac{(n-1)(s^*)^2}{\sigma_0^2}$

$H_0$ is acepted (or pedantically "not rejected") if:
$\chi_0^2 \in (\chi^2_{1-\alpha/2,n-1}, \chi^2_{1-\alpha/2,n-1})$

Sun Tzu said: “All exams are based on deception”.
(the quote in statistics was better)